Simulation Models in eGovernment
Using System Dynamics

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To My Parents

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Ahmed Abdeltawab Abdelgawad Aboughonim

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Abstract

System Dynamics (SD) is a method to build simulation models using computers, to study the behaviour of systems, and apply what-if scenarios aiming at achieving optimal policy design. In this thesis, we are introducing an SD approach in modelling the eGovernment. The thesis is based on two topics or essays: *eParticipation* and *eAccessibility* as examples of eGovernment areas that SD models have not been used in before, to show how SD can be used in modelling and supporting decisions in the field of eGovernment, especially in new areas. Although this research is part of the eGovMon project[1] where the use of SD method is indicated, via a literature review we shed light on the mathematical modelling methods commonly used in the eGovernment field, and a comparison between the suitable methods and SD is sketched showing the benefits of and our rationale behind choosing SD.

eParticipation aims at linking ordinary people with politics and politicians by making the policymaking process understandable and easy to follow via Information and Communication Technologies. To apply this concept, we were interested in finding a topic of public interest that needs to be highlighted and promoted. Employment policies for Persons with Disabilities (PWD)[2] including factors that prevent or promote them to move from welfare recipients to join the labour force in Norway, is such a topic. The employment rate for PWD in Norway is unchanged since 2000, and is not as high as the neighbouring countries, despite the repeated governmental promises. Under this topic, we have administered two questionnaires, one of them towards PWD and another towards potential employers.

The PWD questionnaire covered PWD attitudes towards employment in Norway, including information about the factors enabling them to work, encouraging them to take available work opportunities, and preventing them from active job application. Correspondingly, the second questionnaire covered the attitudes of employers towards recruiting PWD in Norway, including factors encouraging employers to, and preventing them from recruiting PWD, as well as information related to employers' awareness of

[1] More information is available at: http://tingtun.no/research-archive and http://wiki.egovmon.no

[2] In this thesis, we use the term "Persons with Disabilities (PWD)" as we believe it is a more correct term than "Disabled People", as used by the *Convention on the Rights of Persons with Disabilities* (http://www.un.org/disabilities/convention/conventionfull.shtml). In our papers, however, we used the term "disabled people" to be consistent with the term that is still being used by several Norwegian governmental data sources like *Statistics Norway* (http://www.ssb.no) and *NAV* (http://www.nav.no).

facts about PWD employment. The results were incorporated in an SD model which focuses on enabling PWD to move from welfare to work. The model is intended to be used by policymakers, disability organisations, and individual citizens, and support more targeted discussions among them.

Additionally, this model was encapsulated in an Interactive Learning Environment (ILE). To explore how the model could change how its users think and take decisions, the ILE was assessed by an expert opinion poll, and tested with users in two different experiments. 67% of the sample of our expert opinion poll thinks that the ILE achieves its intended goals. Furthermore, 71% of the candidates of both experiments have redefined certain knowledge as a result of using the ILE.

eAccessibility of a website refers to the ability of all people to use this website irrespective of their disabilities or the client devices they use to access the Internet. It is an important aspect of websites in general and of public websites in particular. Access to public websites is crucial to assure equal opportunities for all citizens to participate in the society. The government exerts efforts to enhance accessibility, yet there is still room for improvement. Many ways could be proposed to enhance accessibility. However, the impact of selected actions is hard to predict due to diversification and contradiction, in addition to the continuous change of the system over time.

Under this topic, we have analysed questionnaires collected via a couple of surveys on eGovernment measurement methods, in addition to administering another questionnaire and a sample of webpages to classify the Norwegian municipal website accessibility failures according to their original causes. Moreover, we have conducted a set of personal interviews with representatives from municipalities. The findings including factors affecting the accessibility of the municipal websites were compiled into an SD model, which is intended to support policymakers' and website managers' decisions, and to enhance their mental models. This SD model was also encapsulated in an ILE, which was used in an experiment with users. Results show that 80% of the experiment candidates have redefined certain knowledge as a result of using this ILE.

Table of Contents

List of Figures

List of Tables

Abbreviations

ATAG	Authoring Tool Accessibility Guidelines
CLD	Causal Loop Diagram
CMS	Content Management System
DIFI	Norwegian Agency for Public Management and eGovernment
FFO	Norwegian Federation of Organizations of Disabled People
GMB	Group Model Building
GUI	Graphical User Interface
HCP	Telenor's Handicapped-Programme (Currently known as Open Mind)
HTML	Hypertext Markup Language
ICT	Information and Communication Technology
ILE	Interactive Learning Environment
NAV	Norwegian Labour and Welfare Administration
OECD	Organisation for Economic Co-operation and Development
PWD	Persons with Disabilities
SD	System Dynamics
SDBILE	System Dynamics Based Interactive Learning Environment
SSB	Statistics Norway
UiA	University of Agder
UWEM	Unified Web Evaluation Methodology
W3C	World Wide Web Consortium
WCAG	Web Content Accessibility Guidelines

Terminologies

α change	An absolute quantitative attitude change [1]. A real change in the opinion on a fixed measurement scale.
β change	An attitude measurement scale intervals recalibration, i.e. a redefinition in the measurement standards. A change in the measurement continuum, or a change in the measurement standard/scale.
γ change	A conceptual change in the attitude, i.e. a redefinition of the measurement construct [2]. A new conceptual frame of reference, which causes a meaningful answer based on this new understanding.
eAccessibility	eAccessibility or accessibility of a website refers to the ability of all people to use this website, irrespective of their disabilities or the client devices they use to access the Internet [3], [4].
eGovernment	eGovernment, Electronic Government, or Digital Government is broadly defined as interactions taking place between the government and people in a digital form [5]. eGovernment is narrowly defined as the use of Information and Communication Technology (ICT) in a way that improves government services provided to businesses and citizens, including governmental organisations and their employees [6], [7]. Even a narrower definition restricts the eGovernment to services provided merely through the Internet [7], others exclude the intra-government interactions from the definition [8].
eParticipation	eParticipation aims at linking ordinary people with politics and politicians by making the policymaking process understandable and easy to follow via ICT [9], [10].
Interactive Learning Environment	ILE is "software for educational purposes, for supporting the process of learning, where the focus is on learning through the interaction with the computer (human-computer interactivity)" [11]. Different literature refers to an ILE as management flight-simulator, microworld, business simulator, management simulator, etc. based on certain differences [12], [13].
Mental Model	A mental model, in general, could be defined as "a construct of cogni-

tive psychology. Mental models are internal representations of conceptual and causal interrelations among elements that people use to understand phenomena" [14]. The mental model in the SD context is a special case of the mental model, distinguished by the closed-loop concept and being more comprehensive [14].

Open Mind Programme — A very successful two years vocational rehabilitation programme introduced by the Norwegian telecommunication company *Telenor*.[3] This programme was previously known as *Handicapped-Programme* [15], [16]. The programme is operated and mostly executed by Telenor. It consists of three months of classroom training, and 21 months of on-the-job training in Telenor or one of its partner companies [15], [16].

Pre-Test — In the context of finding α, β, and γ change, the Pre-test questionnaire consists of a number of Likert items (strongly disagree … strongly agree), which is conducted prior to the intervention of an experiment. These Likert items constitute multiple-item scale unidimensional construct as described in [17].

Post-Test — In the context of finding α, β, and γ change, the Post-test questionnaire contains the same Likert items used in the Pre-Test, and is being asked to the participants after the intervention.

Retrospective Pre-test or Then-test — In the context of finding α, β, and γ change, after answering how an experiment participant thinks now about each statement of the Post-Test after the gameplay, the participant is asked to think back in time before the gameplay, and report how much she/he agreed or disagreed with the same statement based on her/his new understanding. This is called the Retrospective Pre-test or the Then-test [18].

[3] http://www.telenor.no

Part I. Introduction and Literature Review

1 Introduction

1.1 Background and Motivation

eGovernment, Electronic Government, or Digital Government is broadly defined as interactions taking place between the government and people in a digital form [5], narrowly defined as the use of Information and Communication Technology (ICT) in a way that improves government services provided to businesses and citizens, including governmental organisations and their employees [6], [7]. Even a narrower definition restricts the eGovernment to services provided merely through the Internet [7], others exclude the intra-government interactions from the definition [8].

From the broad definition perspective, eGovernment has been practised for 60 years, since the first time the mainframe was used in the statistics office [19]. Otherwise, we can think of eGovernment as just 20 years old [20]. Either way, the use of eGovernment is spreading all over the world since its beginning and till now [21], [22]. Several eGovernment projects are established daily; nevertheless many of them fail [23]. In 2013 Dawes wrote: "the failure rate of investments in ICTs to meet governmental needs remains high and consumes both resources and credibility" [24]. In 2014 one report claimed that –although little data being available –from 60% to 80% of the eGovernment projects fail to achieve their designated goals [25].

The failure of eGovernment projects is mainly caused by poor implementation [26] and /or poor management practices [26], [27], which in turn are the results of inconsistencies between the targets and needs these projects have been established for, and what happens in reality [26]. Therefore, there is a great need for methods, models, and/or decision support tools that can help in examining the results of starting projects, or in taking decisions in the planning phase to increase the probability of success [24]. In 1998, during one of the US National Science Foundation Digital Government Research Program workshops, a research wish list was prepared. One of these wishes was: "intuitive decision support tools for public officials. Technologies and data standards that encourage information search, selection, analysis, and sharing can strongly influence the nature and effectiveness of decision-making by elected officials, senior executives, and program managers alike. The use of new tools by decision makers may also have implications for public participation and open government" [28], [29]. Even till 2013, this list is still relevant [24].

eGovernment is a dynamically changing and complex system [30]–[32]. Yet, only few mathematical models or modelling frameworks have dealt with that [33], leading to a

pressing need for a decision-support tool based on a robust scientific methodology, that gives the decision maker a way to deal with the complexity of such a system efficiently. This tool should be capable of examining the decision in the planning phase, and demonstrate its results before implementation. For such a tool to find its way to success, it should be possible to engage the decision maker in different modelling and implementation phases, as well as using the final product phase. This tool should be capable of educating the decision makers about the system, by being capable of showing its underlying structure in transparent ways that are easy to comprehend, i.e. an "intuitive decision support tools for public officials" [24], [29].

System Dynamics (SD) is a method to build simulation models using computers, to study the behaviour of systems [11], [34], [35]. SD is used in modelling interactions among dynamically complex and changing over time system components [13], [36]. The SD model enables its users to understand how their policies and decisions interact with the underlying structure of the system and influence its behaviour [34]. Moreover, the SD model enables its users to apply different what-if scenarios to test different sets of policies aiming at achieving optimal policy design [11].

The SD model can be further presented to users in the form of software for supporting the process of decision-making, or for supporting the process of learning about the system. This software is called Interactive Learning Environment (ILE) [11], [13], and occasionally titled System Dynamics Based Interactive Learning Environment (SDBILE) [12].[4] This ILE will be the interface which the decision maker, or the non-technical user in general, will use to gain access to the features of the SD model [13]. Generally, the SDBILE aims at changing its users' mental models, which are the ways they perceive the system. It is more likely that mental models are the basis of the decision taken by decision makers more than the reality of their system [11].

eGovernment system –like any other Information System– is a socio-technical system, composed of various components: software, hardware, telecommunications, data, people, and procedures [36]–[38]. Considering the interactions among these components especially the management process and the people component, many ways could be proposed to enhance its performance [11], [34], [35], [39], [40]. The interactions among these components are dynamically complex and changing over time, making SD

[4] Since all our research is based on SD, in the rest of this thesis, we will use the terms: ILE and SDBILE interchangeably.

one of the most suitable methods to be used in modelling them [36]. Further discussion about the suitability of SD to model eGovernment will come later in this chapter.
To stand on the current breadth and depth of SD use in the eGovernment field, we investigated the accumulated literature on eGovernment models using SD. We have conducted a thorough investigation by searching two popular reference databases, namely the E-Government Reference Library,[5] and the SD bibliography database[6] for SD applications in the eGovernment field. Together both databases contain more than 18,000 references. Out of more than 115 papers resulted from the search process, only 25 were found relevant. Further description can be found in Chapter 2. Although –as mentioned earlier– the SD method is very suitable to be applied in the eGovernment field, the identified publications resulted from our literature survey is limited in number, and not covering many eGovernment application areas. Furthermore, none of the investigated literature has presented an ILE. Consequently, they miss the feature of making the model directly accessible by non-technical users.

1.2 Research Questions

In the last section, we have shed some light on three main points: the need for more decision support in the field of eGovernment, the suitability and capability of the SD models to suffice such a need, and the inadequacy of SD application in the field of eGovernment. Building on that, this thesis aims at answering the following main research question:
How can SD be used in modelling and supporting decisions in the field of eGovernment, focusing on penetrating new eGovernment areas that SD models have not been built for previously?
We have chosen two eGovernment areas that SD models have not used in before, namely *eParticipation* and *eAccessibility*.
eParticipation aims at linking ordinary people with politics and politicians, by making the policymaking process understandable and easy to follow via ICT [9], [10], and for that we have chosen the problem of PWD employment in Norway as an example of a case to be promoted via eParticipation. While, accessibility of a website, in general, refers to the ability of all people to use this website, irrespective of their disabilities or the client devices they use to access the Internet [3], [4]. It is an important aspect of websites in general and of public websites in particular, to be able to serve all citizens

[5] Available at: https://catalyst.uw.edu/webq/survey/jscholl/22768
[6] Available at: http://www.systemdynamics.org/bibliography-download-page

equally, and for that we have chosen to focus on the eAccessibility of the Norwegian municipal websites. More details and background information about eParticipation and eAccessibility can be found in Chapter 3 and Chapter 7 respectively.

To answer the main research question, the following partial research questions were taken into consideration:

RQ 1. Why SD is selected to model and support decisions in the field of eGovernment, and based on the literature, how to justify that SD is an appropriate method to model decisions in the eGovernment and the selected application areas?

RQ 2. How can SD be used in modelling and supporting decisions in a case to be promoted via eParticipation, particularly in the case of PWD employment?

RQ 3. What are the core problems and issues regarding the SD implementation in the eParticipation area, particularly in the case of PWD employment?

RQ 4. How can SDBILE be used in promoting eParticipation, particularly in the case of PWD employment?

RQ 5. What would the impact of using SDBILE in promoting eParticipation be, particularly in the case of PWD employment?

RQ 6. How can SD be used in modelling and supporting decisions in the case of eAccessibility?

RQ 7. What are the core problems and issues regarding the SD implementation in the eAccessibility area?

RQ 8. How can SDBILE be used in changing eGovernment managers' mental models in the case of eAccessibility?

RQ 9. What would the impact of using SDBILE in enhancing the eAccessibility of eGovernment websites be?

1.3 Research Methodology

This Ph.D. research is part of the eGovMon project [41],[7] where the use of SD method is indicated. As part of the eGovMon, developing and implementing online decision-support simulation tool/policy-support simulation model using SD modelling method and carrying out *what-if* analysis were not arbitrary. Yet, in this section, via a literature review, we shed light on the mathematical modelling methods commonly used in the eGovernment field, and a comparison between the suitable methods and SD is sketched showing the benefits of and our rationale behind choosing SD.

Furthermore, in this introduction, we discuss our philosophical views about SD as a modelling method, and as a science. We also present the different SD model represen-

[7] More information is available at: http://tingtun.no/research-archive and http://wiki.egovmon.no

tations, as well as our selected SD modelling software package in comparison to other available packages. Furthermore, we introduce the techniques used in collecting data and information to build our models, including the choice of services and software packages when applicable. Finally, we introduce our approach in building and testing our SDBILEs, including the analysis method, and the rationale behind our choices of services and software packages in comparison to the others.

1.3.1 Mathematical Modelling Methods in the eGovernment Research and Why System Dynamics

A mathematical model is an abstraction of the reality into a system of mathematical equations [42]–[47]. Different ways to classify mathematical modelling methods exist, such as [46]. Another comprehensive example is [47], which classifies mathematical modelling methods based on the subject matter of the model (mathematical physics, theoretical chemistry, mathematical economics or econometrics, etc.), techniques used in solving them (classical algebra, matrices, ordinary or partial difference equations, mathematical programming, etc.), their purpose (description, insight, prediction, optimisation, etc.), or according to their nature (linear vs non-linear, static vs dynamic, deterministic vs stochastic, or discrete vs continuous).

Different mathematical modelling methods are used in eGovernment field research. We have investigated the literature from different sources to find as many as possible of these methods. We have started by searching the "E-Government Reference Library (EGRL) version 12" published in July 6, 2016, hosted by Hans Jochen Scholl, University of Washington. The EGRL includes 8,181 eGovernment related references. We have also examined EBSCO Information Services, hosted by EBSCO Information Services,[8] and Scopus hosted by Elsevier.[9]

Our search keywords in the EGRL database were "mathematical model" and "simulation" in all fields. Whereas for EBSCO and Scopus, we have added to the previous keywords, the eGovernment keyword variants: "electronic government", "digital government", "egovernment", "e-government", "e-gov" and "egov" to be searched for in all fields. We have removed many duplicates, in addition to papers that do not have mathematical modelling application. In general, more weight was given to journal papers during the investigation. This investigation was not meant to be comprehensive, we

[8] https://search.ebscohost.com

[9] https://www.scopus.com

just wanted to find out the continuum of mathematical modelling methods used in the eGovernment field, and collect some examples. The following methods with respective examples were identified:

1. Agent-Based Modelling (ABM), examples [48]–[51]
2. Bayesian Approach, examples [52]–[55]
3. Computable General Equilibrium (CGE), examples [56], [57]
4. Discrete Event Simulation (DES), examples [58], [59]
5. Regression, examples [60]–[67]
6. Fuzzy Cognitive Mapping (FCM), examples [68]–[70]
7. Markov Chains, examples [53], [71], [72]
8. Multi-Agent Simulation (MAS), examples [73]–[77]
9. Neural Networks (NN), examples [78], [79]
10. Petri Nets, examples [80]–[83]
11. Structural Equation Modelling (SEM), examples [84]–[91]
12. System Dynamics (SD), examples [92]–[95], [30]

We have followed the same literature investigation method to find literature using different mathematical modelling methods within the two selected eGovernment application areas PWD employment and eAccessibility using suitable keywords. For the PWD employment, we have used different mathematical modelling methods names, in addition to "employment", and one of these words "PWD", "disability", "disabilities", or "disabled". The following methods with respective examples were identified:

1. Bayesian Approach, examples [96], [97]
2. Discrete Event Simulation (DES), example [98]
3. Regression, examples [99], [100]
4. Markov Chains, example [101]
5. Structural Equation Modelling (SEM), examples [102]–[104]
6. System Dynamics (SD), example [105]

While in the domain of eAccessibility, we have conducted several searches using different mathematical modelling methods names, and one of these keywords "eAccessibility", "web accessibility", or "webpage accessibility" each time. The following methods with respective examples were identified:

1. Bayesian Approach, example [106]
2. Regression, examples [107]–[109]
3. Markov Chains, examples [110]
4. Petri Nets, example [111]

5. Structural Equation Modelling (SEM), examples [112], [113]

A complex system is a set of interacting components/elements [114], [115] which in total acts in a nonlinear way, as it is characterised by emergent behaviour "emergence" which is generated from the interaction of these components at the system level (macro) rather than the component level (micro) [116], [117]. As mentioned earlier, eGovernment is a dynamically changing [32], and complex socio-technical system [36]–[38]. The existence of people component in such a system, who take decisions and interact with other components as well as among themselves, makes the planning and the management of such a complex systems very hard, as over time people can change their decisions and the rest of the system adapts to that [116].

Furthermore, a checklist abbreviated "SIMULATE" was introduced in [116], to help researchers in determining whether dynamic simulation modelling is appropriate to model the system/problem under investigation. This checklist recognises eight problem requirements/characteristics of simulation modelling methods that distinguish them from other modelling methods. Table 1-1 shows the "SIMULATE" checklist characteristics and their descriptions, in addition to how these characteristics apply to the eGovernment system in general, and to the two intended application areas, the PWD employment in the case of eParticipation example, and the case of enhancing eAccessibility. Based on the eGovernment and the two domain properties presented in Table 1-1, in addition to the previously indicated complexity, time-dependency, non-linearity of the eGovernment system in general, literature like [116], [118], and [119] find that complex simulation modelling methods: System Dynamics (SD), Discrete-Event Simulation (DES), and Agent-Based Modelling (ABM) to be suitable modelling methods for such systems.

These three modelling methods use computers to simulate systems from different perspectives. In addition to differentiate the system's variable into either stocks or flows, SD searches for the cause-and-effect relations between these variables, in an ultimate goal of composing several feedback loops. These feedback loops interact with each other and are accounted for the overall system behaviour over time [34]. DES sees the system as set of entities. Each entity has a set of attributes, and consumes system resources. Over time these entities go through queues, and experience events, causing the overall system behaviour [120]. ABM looks at the system as a set of interacting autonomous agents. These agents, governed by their internal logic, interact with their environment as well as each other, to cause the overall system behaviour [116].

Table 1-1: The SIMULATE checklist—adapted from [116]

	Problem requirement	**eGovernment**	**PWD employment**	**Enhancing eAccessibility**
System	Modelling multiple events, relationships, and stakeholders representing the system processes.	eGovernment as an Information System/Socio-technical system has multiple technical components, and multiple stakeholders [36]–[38], consequently multiple events, and relationships.	The system has multiple stakeholders like PWD, employers, and the government, and multiple relationships connecting these stakeholders, like employment, paying salaries, paying disability pensions … etc.	The system has multiple stakeholders like web-editors, main editors, vendors, and multiple relationships connecting them like training, consultancies … etc.
Interactions	Including nonlinear or spatial relationships among stakeholders and their context that influence behaviours and make outcomes in the system difficult to anticipate.	The eGovernment has a non-linear behaviour [121].	The system has non-linear relationships among stakeholders.	The system has non-linear relationships among stakeholders.
Multilevel	Modelling a problem from strategic, tactical, or operational perspectives.	Depending on the scope of the problem under investigation. However, from our intended system planning enhancement, strategic perspective seems more important than others.	Strategic perspective.	Strategic and operational perspectives.
Understanding	Modelling a complex problem to improve the system that cannot be solved analytically.	Complex problem that cannot be solved analytically.	Complex problem that cannot be solved analytically.	Complex problem that cannot be solved analytically.
Loops	Modelling feedback loops that change the behaviour of future	Like any other complex system, feedbacks cannot be ignored.	Feedback loops exist.	Feedback loops exist.

	Problem requirement	eGovernment	PWD employment	Enhancing eAccessibility
	interactions and the consequences for the system.			
Agents	Modelling multiple stakeholders with behavioural properties that interact and change the performance of the system.	eGovernment as an Information System/Socio-technical system has multiple technical components, and multiple stakeholders [36]–[38].	Multiple stakeholders, however in this case we care more about the overall aggregate behaviour of the stakeholders than behaviour of a single entity.	Multiple stakeholders, however in this case we care more about the overall aggregate behaviour of the stakeholders than behaviour of a single entity.
Time	Time-dependent and dynamic transitions in a system.	eGovernment is a dynamically changing system [30]–[32].	Time-dependent system.	Time-dependent system.
Emergence[10]	Considering the intended and unintended consequences of system interventions to address policy resistance and achieve target outcomes.	"[M]any e-Government projects fail to deliver their promises in terms of specific outcomes. Some of such failures are the result of a lack of understanding about the relationships among technologies, information use, organizational factors, institutional arrangements, and socio-economic contexts involved in the selection, implementation, and use of information and	Decisions taken to increase the PWD employment as an intended consequence might have unpleasant unintended consequences as well. For example, one PWD vocational rehabilitation and training programme aimed at increasing the employment probability of PWD has also increased the PWD job-searching periods. Because of the time span the PWD spent in	Decision intending at enhancing eAccessibility might include updating webserver software that complies with more accessibility guidelines. The intended consequence of such an update is enhancement in the level of eAccessibility. However, the unintended consequence is that website staff has to start a new —perhaps long— learning process before they mature using

[10] Emergence or emergent behaviour "refers to the novel and coherent structures, patterns, and properties that arise from the interaction of the parts of a complex system and take place at the system scale rather than at the component's scale" [116].

	Problem requirement	eGovernment	PWD employment	Enhancing eAccessibility
		communication technologies (ICT), producing mismatches and unintended consequences" [30].	training without looking for jobs, the average job-searching time almost did not change either the PWD has taken the programme or not [122].	the new software (learning curve effect [123], [124]).

Table 1-2: Comparison of SD, DES, and ABM—adapted from [125]

Aspect	SD	DES	ABM[11]
Type of problems	Strategic[12]	"Operational, tactical"	"Strategic, operational, tactical"
Perspective	"System-oriented, emphasis on dynamic complexity (top–down)"	"Process-oriented, emphasis on detail complexity (top–down)"	"Individual-oriented, dynamic and detail complexity (bottom–up)"
Resolution	"Homogeneous entities, continuous policy pressures and emergent behavior"	"Individual heterogeneous passive entities, attributes, and events"	"Individual heterogeneous active agents, decision rules"
Origin of dynamics	"Deterministic endogenous fixed structure"	"Stochastic endogenous fixed processes"	"Agent–agent, agent–environment interactions and adaptive behavior of agents"

[11] Following the practice of [116], microsimulation and ABM are combined under ABM. "individual-based simulation modeling—modeling formulated at the level of individual agents or actors—is associated with two major traditions: 1) microsimulation, originating in economics and emphasizing evolution based on empirically grounded, statistical relationships, and 2) ABM, originating in computer science and traditionally depending on algorithmic and rule-based formulations in richer, dynamic, environments. Although their origins, emphases, and preferred patterns of practice differ, these methods overlap in content and underlying concepts, and we consider them here together. In accordance with growing practice, we refer to both below as 'agent-based models'" [116].

[12] In [125], under SD authors have add operational to strategic. Clearly they have chosen to combine SD and Dynamic Systems (DS). SD and DS have the same theoretical basis. Others like [119] which was one of the references of [125] keeps SD and DS separate.

Aspect	SD	DES	ABM[11]
Handling of time	“Continuous”	“Discrete”	“Discrete”
Approach	“Exploratory and explanatory”	“Explanatory”	“Exploratory and explanatory”
Basic building blocks	“Feedback loops, stocks, and flows”	“Entities, events, queues”	“Autonomous agents, decision rules”
Data sources	“Broadly drawn: qualitative and quantitative”	“Numerical with some judgmental elements”	“Broadly drawn: qualitative and quantitative”
Unit of analysis	“Feedback loops and stocks’ dynamics”	“Queues, events”	“Decision rules, emergent behaviour”
Mathematical formulation	“Differential equations”	“Mathematically described with logic operators”	“Mathematically described with logic operators and decision rules”
Outputs	“Understanding of structural source of behavior modes, patterns, trends, relevant structures, aggregate key indicators”	“Point predictions, performance measures”	“Detailed and aggregate key indicators, understanding of emergence due to individual behavior, point predictions”
Model maintenance	“Upkeep may require large structure modifications, global”	“Upkeep may require process modifications, global. Allows for local modifications regarding individual heterogeneity”	“Upkeep may require simple local modifications”
Development time	“Dependent on the problem, purpose, and scope of the model; these models may require less time to be developed”	“These models are more data intensive. This requires more time regarding obtaining data and data analysis to prepare model inputs. Programming and calibration are usually very time consuming”	“These models can be data intensive, which requires data analysis and time to obtain the data. Programming and calibration are usually very time consuming”
Cost	“In general, SD is less costly than are DES and ABM. This involves data requirements, and skill sets needed”	“Because of costs associated with data and skill sets required, these methods tend to be more costly than is SD”	“If the model is data intensive or requires primary data collection, costs may increase. Skill sets required may also increase the costs”

Various academic publications aimed at comparing these three complex simulation modelling methods to each other, and/or to other methods, for example [118], [119], [125], and [126]. Our assessment will be based on these efforts. A summarised comparison among the three methods adapted from the [125] is shown in Table 1-2.
Based on Table 1-2, the aggregate key indicators resulting from the SD model, understanding of structural source of behaviour modes, behaviour patterns and trends, and the structures relevant to that behaviour [125] are considered great tools in explaining the SD model results, in comparison to when trying to explain the behaviour of the other two methods. This makes using SD modelling more suitable in our case, as one of our requirements is educating the users of our models about the underlying system structure, and the reasons behind system behaviour.
The same point is emphasised more, from the model purpose point of view or the reason behind building the model shown in Figure 1-3–adapted from [125], as out of the three dynamic simulation modelling methods, merely SD provides its users with clear connections between model variables. This also includes showing the connection between policies and results. Furthermore, the loops affecting the system, and usually causing the problems [119], [125], [127]. Moreover, SD is the only method supporting stakeholders' engagement, in terms of using the final model as well as during the modelling process. Stakeholders' engagement is one of the eGovMon project requirements.

Table 1-3: Purpose ("What is the purpose of the model?"/"What is the problem being investigated?"/"Why are we building this model?") – adapted from [125]

Purpose	SD	DES	ABM
Deterministic	Yes		
Engaging stakeholders	Yes		
Relevance of patterns and/or aggregate values	Yes		Yes
Strategic level problem	Yes		Yes
Workflow queues and wait times are a big concern		Yes	
Capture heterogeneity		Yes	Yes
Importance of tracking individual behaviour		Yes	Yes
Tactical level problem		Yes	Yes
Operational level problem		Yes	Yes
Relevance of agent-agent and agent-environment interactions			Yes

From the model object point of view, or the scope of the model (model boundaries) shown in Table 1-4 –adapted from [125], barely SD requires more accessible skill set from either the modeller or the user, making it easier to involve stakeholders either dur-

ing building or using the SD model. In the same direction, the process of building SD models is quicker compared to the two other types.

Table 1-4: Object ("What is the scope of the model (boundary)?"/"What are we modelling?"/"Is it feasible?") – adapted from [125]

Object	SD	DES	ABM
Population size scalability	Yes		
More accessible skill set	Yes		
Aggregate level data	Yes		Yes
Quick construction	Yes		Yes
Flexibility		Yes	Yes
Heterogeneity scalability		Yes	Yes
Individual level data		Yes	Yes
Agency/human choice adaptability		Yes	Yes
Dynamics across networks		Yes	Yes

To conclude, SD is the only tool that engages stakeholders by showing them the underlying system structure. It also shows them how their policies and decision affect the final results over time, in terms of patterns, trends, and aggregate values, supporting planning and strategic level decisions. It further has fewer requirements when it comes to their skill sets, enabling them to participate in building in addition to using the models. Accordingly, SD is suitable for and fulfilling our research requirements. This answers our first partial research question RQ 1 of why SD is selected to model and support decisions in the field of eGovernment, and how to justify that SD is an appropriate method to model decisions in the eGovernment and the selected application areas.

1.3.2 System Dynamics Modelling Method

SD is an application of Servomechanism or Information Feedback Systems Theory (Control Theory) [34], [128] to almost all kinds of systems. SD model is no different from other mathematical models, as it is an abstraction of the reality into a system of mathematical equations, precisely a system of simultaneous non-linear first order differential equations, i.e. state equations. These equations should be solved –usually numerically– to reproduce the behaviour of the real life system, situation, or the problem under investigation.

1.3.2.1 The Philosophy of SD

Different philosophical points of view about SD exist, for example, see [129], [130]. In our view, SD is based on four philosophical concepts. The first is the feedback phe-

nomenon, as stated by the SD Society,[13] "one cannot study the link between X and Y and, independently, the link between Y and X and predict how the system will behave. Only the study of the whole system as a feedback system will lead to correct results" [131]. The second philosophical concept is that the system consists of only two main types of variables; the first type is called *Flow*, which accumulates into the other type which is called *Stock* or *Level* over time. In mathematical terms, a *Stock* is the integration of a *flow*, i.e.:

$$Stock = \int_{t_0}^{t} Flow \cdot dt + Stock_0$$

The other variables that might exist in the SD model are auxiliary variables that contain additional algebraic expressions needed to compute the flows from the other variables in the model. The third philosophical concept of SD lies in human mental models. The fourth philosophical concept of SD is the endogeneity origins of the cause, in other words, the behaviour of a system is primarily caused by its internal structure, not by exogenous variables [34], [35], [129].

1.3.2.2 SD Model Representations

The SD model is of a mathematical nature in its core. Nonetheless, it uses two kinds of graphical representations to convey the causalities in the model, and hence in the real world. One type is the *Causal Loop Diagram* (CLD) [11] shown in Figure 1-1, where all the variables either stocks or flows are presented in the same way. The arrows between every two variables differ in sign (either positive or negative) to express direct or inverse cause-effect relations between the two variables they connect respectively. These arrows could compose two different sorts of loops, either loops with exponentially growing/decaying behaviour, called *reinforcing loops* denoted by R, or loops with goal seeking behaviour, called *balancing loops* denoted by B.

The figure shows a simplified version of a population model presented in [11].[14] The *Population* variable grows as the *Birth Rate* increases. Meanwhile, as the *Population* grows, the *Birth Rate* which is the product of the *Fractional Birth Rate* and the *Population* increases. These two relations/arrows shown in the figure constitute a *Reinforcing loop* denoted by R1. R1 causes the *Population* to grow exponentially. We have to no-

[13] This society is the SD governing body, and the organiser of the annual International SD conference. In addition, the society is responsible for the main SD publication channels.

[14] We have simplified the the original model by making the Carrying Capacity constant.

tice that R1 could cause the *Population* to decay exponentially as well. If the *Population* depletes for some reason, the *Birth Rate* will decrease, causing further depletion in the *Population* and so on. On the other side, the *Population* is depleted by an increase in the *Death Rate*. As the *Population* depletes, the *Death Rate* which is also the product of the *Fractional Death Rate* and the *Population* decreases. This way, these two relations/arrows in the figure constitute a *Balancing loop* denoted by B1. Simply, if the *Population* changes, either growing or depleting, the *Death Rate* will change in the opposite direction, to balance the effect of the *Population* change.

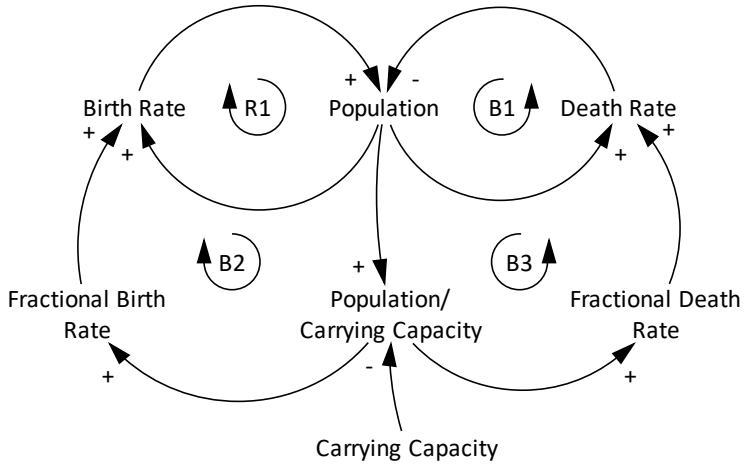

Figure 1-1: Example of Causal Loop Diagram

The *Carrying Capacity* of any environment is "the number of organisms of a particular type it can support and is determined by the resources available in the environment and the resource requirements of the population" [11]. Both *Fractional Birth Rate* and *Fractional Death Rate* are directly proportional to the ratio of *Population*/*Carrying Capacity*. Because this ratio is directly proportional to the *Population*, two new *balancing loops* denoted by B1 and B2, are constituted.

The other type of the SD graphical representations is the *Stock and Flow* diagram. Figure 1-2 shows the same population model described above in *Stock and Flow* notation. In this type, stocks are distinguished from flows with rectangles around them. In addition, there are two kinds of connectors, single lined and double lined arrows to transfer information and material flows respectively. The nature of the *Population* variable as stock appears in the figure; also the nature of both the *Birth Rate* as an in-flow to the *Population*, and the *Death Rate* as an out-flow from the *Population* appear as well. The other variables that are shown in the figure are auxiliary variables. Moreover, whenever the cloud symbols are shown in the *Stock and Flow* diagram, they indicate that we do

not care about the source of the sink of the material flow in this specific case. The same loops described above are shown in the figure.

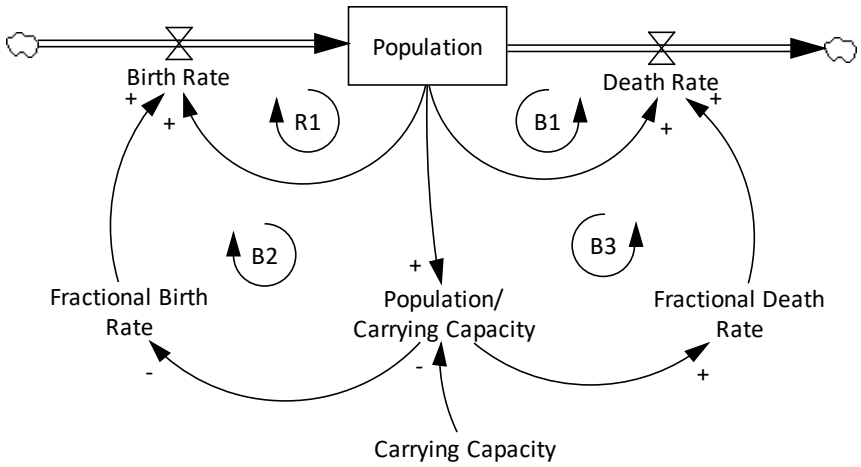

Figure 1-2: Example of Stock and Flow diagram

1.3.2.3 SD as a Science

Every SD model could be considered as a theory on its own [129], [132]. For this theory to be considered scientific, it should be falsifiable. For example, the model has to be refused, if it involves any contradictions in its structure and/or any inconsistencies in its variables' units of measurements, i.e. failing any of the validation tests. Furthermore, the SD model is empirically testable against real historical data, and if it could not survive the attempts of empirical testing, i.e. it could not reproduce the historical behaviour, it is refused. Moreover, the SD model provides predictions like other types of mathematical models, for example the econometric models and the Computable General Equilibrium (CGE) models. In view of these facts, the SD model is considered to be scientific by Popper's criteria [133]–[135].

1.3.2.4 SD Modelling Software Packages

Since the beginning of the SD field, many SD modelling software packages have been introduced. The SD Society mentioned *Dynamo*, *iThink*/*STELLA*, *Powersim Studio*, and *Vensim* under the core tools section on their website [136]. Azar in [137] has compiled a concise historical and informative introductions about many SD packages. We have extracted information about the core tools in Table 1-5.

Table 1-5: SD software packages historical/informative introductions

Package	Information
Dynamo	"It is the first SD simulation language originally developed by Jack Pugh at MIT, the language was made commercially available from Pugh-Roberts in the early 1960s. DYNAMO is originally designed for batch processing on mainframe computers. It was made available on minicomputers in the late 1970s, and became available as 'micro-dynamo' on personal computers in the early 1980s. DYNAMO today runs on PC compatibles under Dos/Windows. It provides an equation-based development environment for SD models" [137]
iThink/STELLA	"Originally developed in by isee systems (http://www.iseesystems.com) in 1985 by Barry Richmond. IThink and Stella software provided a graphically oriented front end for the development of SD models. They offer a practical way to dynamically visualise and communicate how complex systems and ideas really work. Diagrams, charts and animation help visual learners discover relationships between variables in an equation. Verbal learners might surround visual models with words or attach documents to explain the impact of a new environmental policy. IThink and Stella are available for Macintosh and Windows computers" [137]
Powersim Studio	"In the mid 1980s, the Norwegian government sponsored research aimed at improving the quality of high school education using SD models. This project resulted in the development of Mosaic, an object-oriented system aimed primarily at the development of simulation-based games for education. Powersim was later developed as a Windows-based environment for the development of SD models that also facilitates packaging as interactive games or learning environments (http://www.powersim.no)" [137]
Vensim	"Originally developed in the mid 1980s for use in consulting projects. Vensim was made commercially available in 1992 by Ventana Systems, Inc. (Harvard, Massachusetts) (http://www.vensim.com). It is an integrated environment for the development and analysis of SD models. Vensim runs on Windows and Macintosh computers to simulate dynamic behaviour of systems that are impossible to analyse without appropriate simulation software, because they are unpredictable due to many influences, feedback, etc. It helps with causality loops identification and finding leverage points. Vensim also provides some other dynamic functions like arrays, Monte Carlo sensitivity analysis, optimisation, data handling, application interfaces and others" [137]

Although *Dynamo* was the software package that was developed to simulate SD models since the beginning of the field, due to lacking a GUI, it is not commonly used nowadays [136]. Currently the most commonly used packages are *iThink*/*STELLA*,

Powersim, and *Vensim* [136]. *iThink* and *STELLA* are almost the same software package, from the same developer. Each of them will run models developed by the other, and have the same GUI. They differ in their targeted audience. *iThink* is targeting business users, while *STELLA* is targeting academics and researchers [138]. Based on that, we have considered only *STELLA* in addition to other core packages in our comparison, which we have conducted to select a package to use in developing our SD models. We have collected information from the packages respective websites mentioned in Table 1-5. All three packages use the same Stock and Flow diagram notation with superficial differences, in addition to the possibility of drawing CLDs. All packages have the functionality of optimisation/model calibration, sensitivity analysis, adding subscripts/arrays to models, and basic validity testing via unit checking. All three packages supply a free model reader version, which can simulate models however cannot edit. Table 1-6 shows the differences between the three packages.

As one of our goals is to build an ILE based on our SD models, the three packages capability of building an ILE was taken into consideration. Another option is to build a web-based ILE, for that in Table 1-6 we have included the different packages model format support by SD web-based tools. SD web-based tools enable users to use SD models on their computers, phones, and other devices that can browse the internet. We have used the web-based tools list introduced by the SD Society under the web-based tools section on their website [139]. These tools are *Forio Online Simulations*, *iMODELER*, *Insight Maker*, *Sysdea*, *isee Exchange*,[15] and *BROADVIEW*. *Forio Online Simulations* is providing two different solutions: *Forio Simulate* and *Epicenter*, so we have included both. More information about web-based tools is available in Subsection 1.3.4.1.

Table 1-6: SD core software packages comparison

	STELLA	**Powersim Studio**	**Vensim**
Automatically simulate a model on changes	Stella Live	No	SyntheSim
Advanced validity testing	No	No	Reality Checks
Advanced simulation reporting (ex. histograms, Gantt charts)	No	No	Yes

[15] Older isee web-based technologies include Stella Modeler for iPad and Stella Net Sim

	STELLA	Powersim Studio	Vensim
and results statics			
Free personal/educational version	No	Studio Express: can edit and simulate models with no more than size 80 variables	Vensim PLE: can edit and simulate any model, however does not support subscripts
Model format is support by Web Based Tools: Forio Online Simulations—Forio Simulate	Yes	Yes	Yes
Model format is support by Web Based Tools: Forio Online Simulations—Epicenter	No	No	Yes
Model format is support by Web Based Tools: isee Exchange	Yes	No	No
Model format is support by other Web Based Tools: iMODELER, Insight Maker, Sysdea, and BROADVIEW	No	No	No

To build our SD models, we have selected Vensim for two reasons. The first was, as mentioned earlier, that this Ph.D. is part of the eGovMon project. One of the eGovMon requirements was the dissemination of results publically; with the availability of the *PLE (Personal Learning Edition)* [140] version for free for educational and personal use, it is possible for any person to use almost any model developed using Vensim. Compared to the Studio Express of Powersim, Vensim PLE is far more capable in terms of models to run in addition to the modelling process itself.[16] The second reason was that the Vensim model format is supported by more SD web-based tools, including both *Forio Simulate*[17] and *Epicenter*,[18] which we have used later to develop our ILEs.

[16] We have prepared versions of our models that avoided subscripts/arrays, and could run completely on Vensim PLE.

[17] Forio's second generation platform for online creating and running simulations (http://forio.com/simulate).

Advanced validity checks and reporting tools in addition to the SyntheSim mode could be definitely added to the reasons. How to do mathematical modelling and implementing SD models using Vensim PLE is included in Appendix I.

1.3.3 Data Collection Methods

In different occasions, while collecting data and information for our SD models, in addition to testing the effect of using our SDBILEs on the users, we have used two types of surveys: interviews and questionnaires [141].[19] In the following subsections, we describe in details how we used each type.

1.3.3.1 Interviews

Interviews, in general, are very practical and handy as a tool to collect data and information for building SD models. They are useful in collecting qualitative data, in different SD modelling steps, including: problem definition and system conceptualization, model formulation, and analysis of model behaviour and model evaluation [142]. Furthermore, their use covers mental models elicitation as well [143]. Even certain quantitative data items could be collected through interviews [11].

In the case of eAccessibility, interviews helped in extracting knowledge about the system structure from the interviewees, in addition to certain data items. In all the occasions where we used interviews, we started by literature review around the issue under investigation. The result was a preliminary understanding of the structure of the investigated issue, in addition to certain data items. This was used afterwards in conducting a set of semi-structured personal interviews with web-editors and web-masters from four different Norwegian municipalities, namely *Hole*, *Holmestrand*, *Grimstad*, and *Trondheim*, to have deeper understanding about the system structure inside the Norwegian municipal website. Afterwards, we have conducted another personal interview with Grimstad followed by a phone interview with Trondheim. These interviews in addition to more literature review helped us in building our eAccessibility SD model.

1.3.3.2 Questionnaires

We have used online questionnaires to collect data for our SD models, as well as to test the effect of using our ILEs many times during the course of this research. The time, the effort, and the cost needed for using online questionnaires are very limited, com-

[18] Forio's third generation platform for simulation, modelling, and analytics (http://forio.com).

[19] Several sources use the word "survey" to refer to "questionnaire".

pared to the traditional paper and pencil type [144], [145]. In all cases, we have used a convenience sample, as it was more practical taking into consideration the possible financial support and human availability from one side, and avoid any sampling difficulties expected with online questionnaires [144], [145] from the other side. Furthermore, using a convenience sample helped in avoiding the issues of participant connectivity and computer illiteracy that arise from using online questionnaires [144], [145].

To administer our data collection questionnaires, we have used a paid service called SurveyXact, as it was licensed by UiA.[20] Nevertheless, this tool could not support our needs when we came to testing our ILEs. We were interested in a tool that enables implementing a new type of questions, specifically using JavaScript to be able to embed our ILE interface in the middle of a questionnaire.

As mentioned before, public dissemination was an eGovMon requirement, also the usage of open source software was required as much as possible, as part of the possibility of public result dissemination. Moreover, as we will show in a later subsection, this supports the idea of having a full free ILE testing platform based on our generic ILE framework.

To find a suitable open source online survey software, we have searched SourceForge[21] for the terms: "survey" and "questionnaire" independently, and the results were filtered using the following criterion: Category: "WWW/HTTP", Translations: "English", Status: "Mature" and "Production/Stable" (ignoring "beta" and "alpha") Programming Language: "PHP" and "JavaScript", came with two packages. Of two resulted packages, only Limesurvey was an online survey tool, the other was Content Management System (CMS). The rationale behind selecting the PHP as the programming language for this web-service is basically the popularity of PHP. According to the W3Techs (World Wide Web Technology Surveys) "PHP is used by 82.3% of all the websites whose server-side programming language [they] know" [146], therefore it becomes easier for others to use our code in their implementations in terms of the probability of them knowing how to write programmes using PHP, and more importantly the availability of web hosts—including free hosts— that support PHP.

After surveying several questionnaire administering tools, we came up with an open source tool called Limesurvey[22] as it supports such a requirement. Lastly, because of

[20] http://www.surveyxact.no

[21] https://sourceforge.net

[22] https://www.limesurvey.org

using these ready-made online questionnaire tools, we have guaranteed similar questionnaire screen configurations appearing to all participants [144].

1.3.4 System Dynamics Based Interactive Learning Environments (SDBILE)

An ILE is "software for educational purposes, for supporting the process of learning, where the focus is on learning through the interaction with the computer (human-computer interactivity)" [11]. Our ILEs are based on SD models as their core. Different literature refers to an ILE as management flight-simulator, microworld, business simulator, management simulator, etc. based on certain differences [12], [13]. However, in this thesis, we do not differentiate between these terms.

A mental model, in general, could be defined as "a construct of cognitive psychology. Mental models are internal representations of conceptual and causal interrelations among elements that people use to understand phenomena" [14]. The mental model in the SD context is a special case of the mental model, distinguished by the closed-loop concept and being more comprehensive [14].

Davidsen in [147] identified two purposes for developing SDBILE in general. They aim at either changing their users' mental models for educational purposes, or identifying their users' mental models for research and validation purposes. In this thesis, the SD models were built with the intention to serve users both for decision making and mental model enhancement. However, our SDBILEs are dedicated mainly for educational purposes, so that their Graphical User Interfaces (GUIs) were simplified in terms of ignoring many policy options that exist and can be changed in original models. Furthermore, their forecasting time spans were increased, in order to show greater effects of the policies, serving the same educational purpose.[23]

To develop our ILEs, we had two options; either developing desktop/mobile application or cloud/web-based ILE. Cloud/web-based solutions provides many features including cost, agility, and scalability [148], in addition to possibility to be accessed anywhere, without specific prior installation process [148]–[151]. Based on that, we went for the latter solution.

[23] In both models (Vensim files), we have included GUI with more comprehensive policy options (controls) compared to the SDBILEs' GUIs mentioned here. Snapshots of these SDBILEs are included in Appendix II.

1.3.4.1 SD Web-Based Services

Using the correct technologies can save the cost and effort. As mentioned earlier, we have conducted a comparison between the web-based services presented by the SD Society under the web-based tools section on their website [139]. These services are:

- *Forio Online Simulations* which provides two different solutions:
    1. *Forio Simulate* (http://forio.com/simulate/)
    2. *Epicenter* (http://forio.com/products/epicenter/)
- *iMODELER* (http://www.consideo.com/)
- *Insight Maker* (https://insightmaker.com/)
- *Sysdea* (https://sysdea.com/)
- *isee Exchange* (https://exchange.iseesystems.com)
- *BROADVIEW* (http://getbroadview.com)

We have conducted different experiments with these services to recognise their potential, and find out which will suit our requirements.

Table 1-7 summarises the results of these experiments. We have checked the possibility of having a free account, whether models can be licensed under creative commons, whether they support Vensim model format or at least be able to import it, whether models interface built with these service can be imbedded in other services outside their domain so that we can conduct our ILE experiments with users, and whether they rely on web technologies that we can edit and add more functionalities (for example connect to other server-side service to log ILE users actions).

Table 1-7: SD web-based services comparison

	Free account	**Models can be licensed under creative commons**	**Vensim model format support**	**Embeddable interface outside its tool**	**Editable interface outside its tool**
Forio Online Simulations—Forio Simulate	Yes	Yes	Yes	Yes	No
Forio Online Simulations—Epicenter	Yes	Yes	Yes	Yes	Yes
iMODELER	Yes	No	No	No	No
Insight Maker	Yes	Yes	No	No	No
Sysdea	No	No	No	No	No

	Free account	Models can be licensed under creative commons	Vensim model format support	Embeddable interface outside its tool	Editable interface outside its tool
isee Exchange	Yes	No	No	No	No
BROADVIEW	No	No	No	No	No

Only Forio solutions were able to support Vensim model format in addition to the possibility of having a free account and licensing the models user creative commons. Based on that, we have selected their services to develop our ILEs.

1.3.4.2 ILE Framework

To develop our ILEs, we have developed a generic ILE framework, which we used as a base for our ILEs. This generic framework can be used by others to develop their ILEs. As mentioned in the last subsection we have used *Forio Simulations services*, specifically for this ILE framework we have used *Epicenter*. Epicenter is a very powerful tool, having all what is needed to build an ILE. The selection of Epicenter, in addition to providing a free service plan, was its capability to directly interface Vensim models, and build a GUI for the ILE using web technologies HTML, CSS, and JavaScript.
Furthermore, we have used PHP and MySQL, to log the users' interactions with the ILE. The same rationale behind choosing PHP was mentioned in earlier subsection, the same reason was behind choosing MySQL, according to DB-Engines MySQL is the second popular database engine after Oracle, which makes it the most popular open source database [152]. We wanted to log all policy options chosen by the users while using the ILE, in addition to the results come up from these choices. Figure 1-3 shows the full ILE framework, including the Limesurvey online questionnaire tool mentioned earlier in the questionnaires subsection. The following two subsections give more details about the client-side and the server-side of the framework, however for more technical details; a technical manual is included in Appendix I.

1.3.4.2.1 Client-Side

The GUI of our ILE was coded using web technologies based on Epicenter as mentioned before. Nevertheless for our interface charts, we have replaced Forio's Polymer-based[24] charts with our JavaScript charts. Our JavaScript code for charts is still based

[24] https://www.polymer-project.org

on Forio's charts code, and uses the same powerful open source Forio's Contour library;[25] but in addition, it is capable of showing many scenarios on the same chart. Our JavaScript code for charts is generic, so that others can use it in building their ILEs.[26]

1.3.4.2.2 Server-Side

The ILE is fully functioning by using solely the client-side, yet, as mentioned above, we wanted to log users' interactions with the ILE, i.e. record the decisions they take, and their results. To accomplish such a task, Epicenter uses Node.js[27] for client-server communications, which then could be logged to a database; however, this is limited to paid subscribers. We wanted to have a generic framework that could be used by everyone.

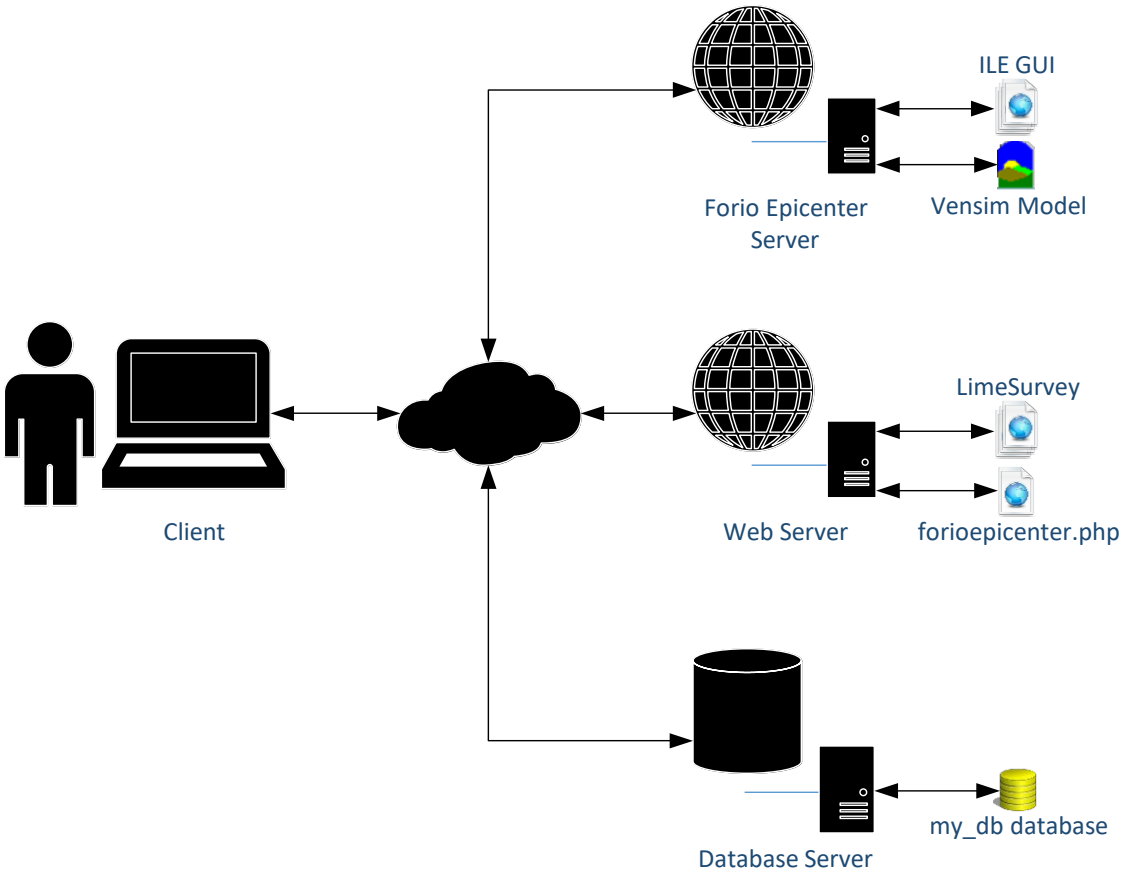

Figure 1-3: Generic ILE framework

[25] https://github.com/forio/contour

[26] Our JavaScript file is available at: https://forio.com/app/ahmedg/eparticipation/elements/contour-chart.js

[27] https://nodejs.org

To log users' interactions, we have developed reusable JavaScript snippets[28] and added them to all decision control elements (representing the policy options available by the SD model) and charts available on the client-side GUI. These JavaScript snippets communicate with a PHP file called forioepicenter.php.[29] We have developed the forioepicenter.php to save the values sent by the client-side to MySQL database.[30] Both forioepicenter.php and MySQL database were hosted on one of UiA servers.

1.3.4.3 SDBILE Experiments

We wanted to know if our SDBILEs are successful in changing their users' mental models or not. To do this, we have conducted three SDBILE experiments with users, in addition to one with experts. Our experiment sessions always started by a presentation to introduce the topic and the SDBILE to the participants. The presentation included the terms the participants would experience during the intervention using the SDBILE. By the end of the presentation, the participants were directed to connect to our Limesurvey server using their web browsers.

The testing session started by asking the participants to answer a pre-test questionnaire. This pre-test questionnaire consists of a number of Likert 5-point scale items (strongly disagree, disagree, neutral, agree, or strongly agree). These Likert items constitute multiple-item scale unidimensional construct as described in [17], designed to test the participants' knowledge about the dynamics of the system in terms of its causal relations and possible policy options.

To build the statements of these Likert items, we have enumerated all model variables affecting the main variable/concept/construct of the SD model behind the ILE. Possible changes in the values of these variables (for example: increase in, decrease in) were listed with different combination of possible resulted changes on the main variable /concept/construct (for example: increase after short delay, no effect, immediate decrease, etc.). These combinations constituted the statements of the Likert items. These statements were ordered according to their importance based on our knowledge of the

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[28] The snippets are available inside the HTML of the ILE. It could be shown by viewing the page source using any web browser. Furthermore, we have made these snippets generic, and marked them by HTML comment "<!--begin " and "<!--end ", to be easily copied to any other ILE.

[29] forioepicenter.php can be deployed to any server/web hotel supporting PHP, downloadable at: https://forio.com/app/ahmedg/eparticipation/helper/forioepicenter.php

[30] MySQL database tables needed by forioepicenter.php, can be reproduced in any MySQL using my_db.sql, downloadable at: https://forio.com/app/ahmedg/eparticipation/helper/my_db.sql

system, what we wanted to show and test, and how much they are clear while using the ILE. Further, to suit the experiment expected possible duration, a reasonable number of these statements were selected, keeping a balance between reversed and non-reversed statements, and mostly following the recommendations stated in [153]. Finally, we polished the wording of the final statements.

The intervention using the ILE or the gameplay started as a participant ended the Pre-test questionnaire, without the option of going back to the Pre-test questionnaire. The gameplay was always time-limited. Afterwards all participants were directed automatically to the post-test questionnaire, without the option of going back to the intervention session. This way we were sure that all participants had not used the ILE for more than the designated duration.

The Post-test questionnaire contained exactly the same Likert items used in the Pre-test questionnaire, however after answering how she/he thinks now about each statement after the gameplay, the participant was asked to think back in time before the gameplay, and report how much she/he agreed or disagreed with the same statement based on her /his new understanding. This is called the Retrospective Pre-test or the Then-test [18]. It is very common that participants change their understanding between the Pre-test and the Post-test [154]. The Then-test gives the participant the opportunity to re-answer the Pre-test based on her/his new understanding/perception after the intervention. In this case, the Post-test and the Then-test have the same base frame of reference [154].

1.3.4.4 α, β, and γ Change

Different SD literature presented methods to measure changes in mental models, or to compare them, for example [155]–[159]. These methods either need a human rater, or require the test subjects to have prior knowledge about certain knowledge elicitation tools, for example, CLD. We were interested in a method free from these requirements. Human raters might cause experimenter bias [160], while there was no guarantee that our experiment subjects would have enough knowledge about any knowledge elicitation tools.

Golembiewski *et al.* in [2] distinguished between three different types of attitude change as a result of an intervention, namely α, β, and γ. α change refers to an absolute quantitative change [1]. For example, a person might "agree" that "spending on an awareness campaign to reach all Persons with Disabilities (PWD) potential employers, to convince them to recruit PWD will immediately cause a decrease in PWD unemployment rates". After the intervention, this person's level of agreement about the same

statement increases to “strongly agree”. This is a real change in her/his opinion on a fixed measurement scale, or α change.

β change refers to a measurement scale intervals recalibration, i.e. a redefinition in the measurement standards. For example, a person has certain understanding of the values of different agreement levels (strongly disagree, disagree … etc.) regarding a claim like “spending on an awareness campaign to reach all PWD potential employers to convince them to recruit PWD will immediately cause a decrease in PWD unemployment rates”. Based on her/his understanding, this person indicates that she/he “strongly agrees” with that claim. After the intervention, this person finds out that what she/he used to interpret as “strongly agree” means just “agree”; consequently his answer to such a claim would change. Nonetheless this does not reflect any change in her/his opinion. This is a change in the measurement continuum, or a change in the measurement standard/scale, or β change.

γ change refers to a conceptual change, i.e. a redefinition of the measurement construct [2]. For example, a person might have no idea that “spending on an awareness campaign to reach all PWD potential employers to convince them to recruit PWD will immediately cause a decrease in PWD unemployment rates” or about “awareness campaigns targeting PWD potential employers” at all. After the intervention, this person was provided with an understanding of the “awareness campaigns” and what they can do, i.e. a new conceptual frame of reference, which causes a meaningful answer based on this new understanding, or γ change.

There are many methods to assess α, β, and γ changes, including the method suggested by Golembiewski *et al.* in [2]. According to a comprehensive literature review conducted in [1], there are five major methods to detect α, β, and γ changes:

1. Ahmavaara's technique [2]
2. Actual-ideal difference measures [161]
3. Retrospective accounts [162]
4. Confirmatory factor analysis [163]
5. Latent growth modelling [164]

Our expectations about the number of participants taking part in our experiment were very modest, because of limited participants’ availability as well as financial support. Based on that, we have opted for using the retrospective accounts method, as it is the only method that does not require a large sample, in addition to that it can test for α, β, and γ changes independently [1]. Furthermore, it's worth mentioning that although we are not aware of any application of this method in assessing ILE effect, using this specific method for that purpose was suggested in [165].

1.3.4.5 Retrospective Accounts

Since Post-test and Then-test are answered based on the same understanding /perception as mentioned earlier, the retrospective accounts method detects α change by detecting the difference between them. Furthermore, Pre-test and Then-test are basically measuring the same thing based on either two different understandings/perceptions or two differently calibrated measurement scales, γ and β change are detected by identifying the difference between Pre-test and Then-test [162].

The retrospective accounts method supports analysis on both group and individual levels. However, we have chosen to focus merely on the individual level analysis, because of the limited number of participants. After all, group change is the sum of its individuals' change. Occasionally, certain individual change could be concealed by detecting just group changes [17], [166]. Furthermore, "a large amount of change exhibited by only a few individuals may be taken as evidence that the intervention had a group effect" [17].

To apply the retrospective accounts method to our collected data, we have followed the practice of [166] in general. Nevertheless, we have opted for following the practice of [17] in detecting γ change first, then remove the participants showing γ change from the process of detecting α and β. According to [167] when γ change is detected, the detection of α or β becomes problematic.

Answers to questionnaire items from Pre-, Post-, and Then-tests of each participant were used as raw data/basic data points [167]. So, for every participant, we have compiled three paired samples **Pre**, **Post**, and **Then**. The first step is to try detecting γ change per participant. In [162], two methods were suggested:

1. Using Correlation:

For every participant, correlations between the following pairs are calculated:

- **Pre** and **Then** ($r_{\text{Pre Then}}$)
- **Post** and **Pre** ($r_{\text{Post Pre}}$)
- **Post** and **Then** ($r_{\text{Post Then}}$)

To test for differences between the pairs $r_{\text{Post Then}}$ & $r_{\text{Pre Then}}$ and $r_{\text{Post Then}}$ & $r_{\text{Post Pre}}$, Williams's test[31] to compare correlations of two paired/dependant samples is used to calcu-

[31] To apply Williams's Test to test the difference between two dependent correlations sharing one variable/two "paired" correlations, we used R (The R project for statistical computing software environment https://www.r-project.org/) function: r.test {package: psych}. See also: http://www.personality-project.org/r/html/r.test.html

late $t_{(r_{\text{Post Then}})(r_{\text{Pre Then}})}$ and $t_{(r_{\text{Post Then}})(r_{\text{Post Pre}})}$ [17]. γ change exists if the following two conditions are met:

a) $r_{\text{Post Then}}$ is substantially greater than $r_{\text{Pre Then}}$

b) $r_{\text{Post Then}}$ is substantially greater than $r_{\text{Post Pre}}$

2. Using Standard Deviation:

Pre, **Post**, and **Then** Standard Deviations are calculated for every participant, yielding s_{Pre}, s_{Post}, and s_{Then} respectively. Morgan-Pitman test[32] to compare variances of two paired/dependant samples is used to calculate $t_{(s_{\text{Post}})(s_{\text{Then}})}$, $t_{(s_{\text{Pre}})(s_{\text{Then}})}$, and $t_{(s_{\text{Pre}})(s_{\text{Post}})}$. γ change exists if the following conditions are met:

a) s_{Post} is not different from s_{Then}

b) s_{Post} is different from s_{Pre}

c) s_{Then} is different from s_{Pre}

The highest level of γ change happens when both correlation and standard deviation methods to detect γ change occur concurrently [162]. If a participant does not show any signs of γ change, we start detecting β or α change.

To test for β or α change, mean values of **Pre**, **Post**, and **Then** are calculated for every participant, yielding $\overline{x}_{\text{Pre}}$, $\overline{x}_{\text{Post}}$, and $\overline{x}_{\text{Then}}$ respectively. Student's t-Test[33] to compare means of two paired/dependant samples is used to calculate $t_{(\text{Then})(\text{Pre})}$ and $t_{(\text{Then})(\text{Post})}$. If $t_{(\text{Then})(\text{Post})}$ is greater than $t_{(\text{Then})(\text{Pre})}$, descriptively speaking there is more evidence of α change than β change, and vice versa [162]. Following the practice of [166], we have focused only on the size to compare $t_{(\text{Then})(\text{Pre})}$ to $t_{(\text{Then})(\text{Post})}$.

In [162], it was emphasised that t-statistics on the individual level analysis should generally be judged descriptively. Although the tests used to compute these statistics are for dependant/paired samples, which is the case, the inter-independency or independency condition inside each participant's **Pre**, **Post**, and **Then** samples is not met. Simply, inside each of them all data points come from the same participant [162].

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[32] To apply Morgan-Pitman test to test for equal variance of two dependent samples, we used R function: var.test {package: PairedData}. See also: http://artax.karlin.mff.cuni.cz/r-help/library/PairedData/html/var.test.html

[33] To apply Student's t-Test to compare means of two paired samples, we used R function: t.test {package: stats}. See also: https://stat.ethz.ch/R-manual/R-patched/library/stats/html/t.test.html

1.4 Thesis Structure

1.4.1 Papers' Map

This thesis is a collection of 11 papers of which eight are published and three of them are not yet published. These papers come under three different themes: *general*, *eParticipation*, and *eAccessibility*. Under the *general* theme, we have Paper A: "*Simulation Models in eGovernment using System Dynamics: A Literature Survey*", which surveyed the literature of **SD** applications in the field of eGovernment, to stand on the current application situation, and identify the insufficiencies. This paper guided our way of applying **SD** in this thesis to a great extent.

Under the *eParticipation* theme, Paper I: "*Attitudes of Disabled People towards Employment in Norway*" and Paper J: "*Attitudes of Employers towards Recruiting Disabled People in Norway*" used **questionnaires** to serve the **SD** model-based Paper B: "*Disabled People from Welfare to Jobs: A Decision Support Tool*". The last paper has answered our second and third partial research questions RQ 2 and RQ 3 respectively. We followed this by developing a **Generic ILE Framework**, which we used to represent the model built in the last mentioned paper as an SDBILE. This SDBILE was used in conducting two **ILE experiments** with users to find out whether it is capable of changing their mental models and consequently supporting *eParticipation*. The results were presented in Paper C: "*Disabled People from Welfare to Jobs: An Interactive Learning Environment Experimental Investigation*". This paper has answered our fourth and fifth partial research questions RQ 4 and RQ 5 respectively.

Under the *eAccessibility* theme, we analysed the data collected from two surveys on eGovernment measurement methods, and the results were presented in papers D: "*A Survey of Current Measurement Methods for eGovernment User-satisfaction*", and E: "*A Survey of Current Measurement Methods for eGovernment Impact*". The results of both papers were –loosely– used with the results of a set of **interviews** we conducted to serve as a basis for Paper F: "*Accessibility of Norwegian Municipalities Websites: A Qualitative System Dynamics Approach*". This paper used **CLD** to represent its findings, and has participated in answering our sixth partial research question RQ 6. Furthermore, the results of this paper and Paper K: "*Classifying the Unified Web Evaluation Methodology Tests According to Barrier Sources in Norwegian Municipal Websites*", in addition to a **questionnaire** that we administered to experts to classify the accessibility barriers to their sources as well, were used as basis for the **SD** model built and presented in Paper G: "*Accessibility of Norwegian Municipalities Websites: A Decision Support Tool*". This paper has participated in answering our sixth partial re-

search question RQ 6 as well, and has answered our seventh partial research question RQ 7. The model used the same **Generic ILE Framework** mentioned earlier to conduct another **ILE experiment** with users to identify any mental model changes. The experiment results were published in Paper H: "*Experimentation with a System Dynamics Based Interactive Learning Environment: A Case* Study of Accessibility of Norwegian Municipalities Websites", which has answered our eighth and ninth partial research questions RQ 8 and RQ 9 respectively.

Figure 1-4 shows a map connecting the papers with the methods/tools they used, and to which theme of the thesis they are related. Furthermore, the figure indicates which partial research questions these papers have answered or participated in answering, with the exception of the first partial research question RQ 1, which is answered in Subsection 1.3.1 of this thesis.

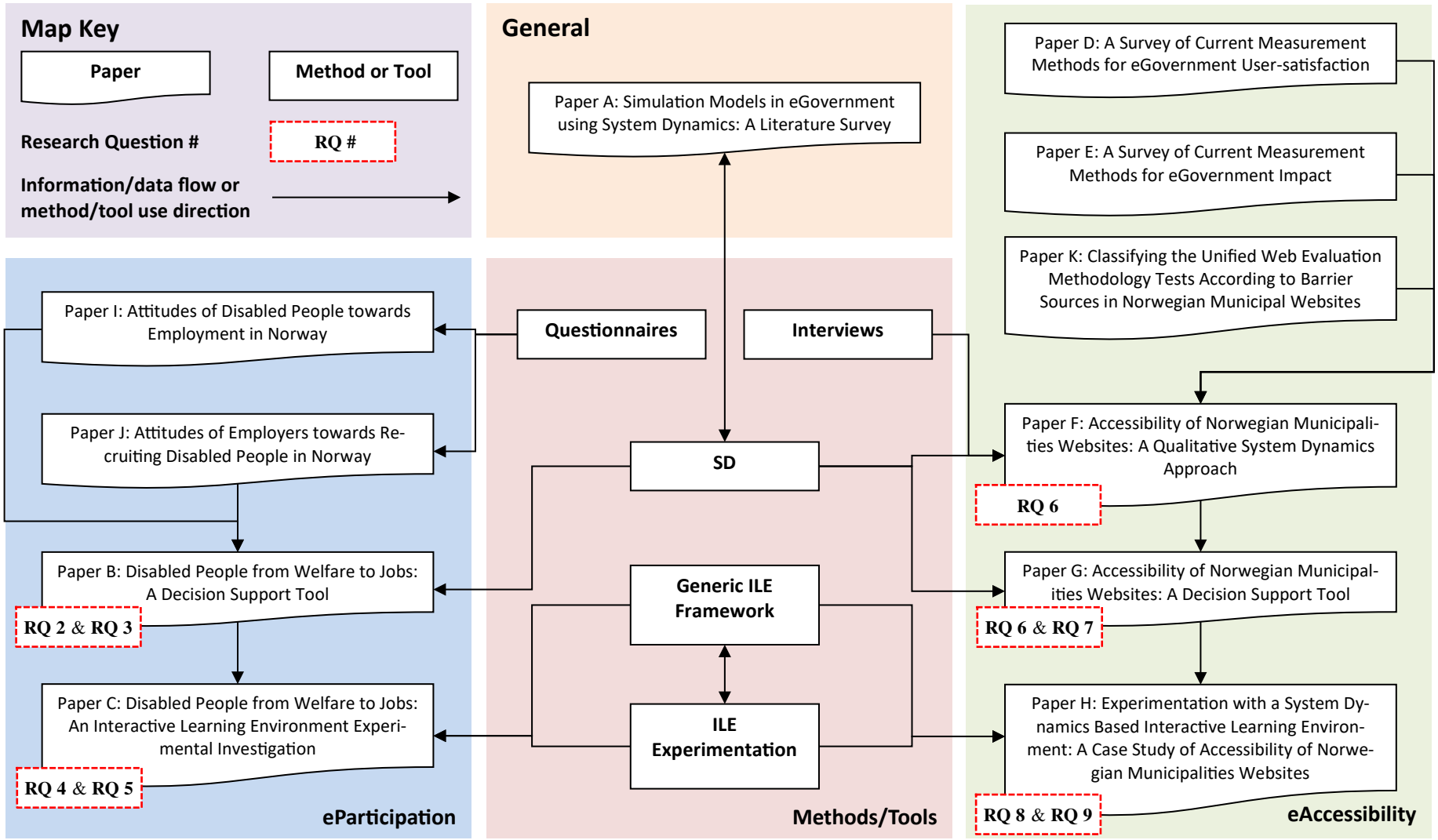


Figure 1-4: Papers and methods/tools connections map, and which partial research questions they answer

1.4.2 Thesis Chapters

The thesis is composed of four parts. Part I –this part– has two chapters including this chapter. Chapter 2 is a state-of-the-art that investigates the use of SD in the eGovernment field. Part II focuses on *eParticipation*, and is composed of four chapters. The first chapter –Chapter 3– introduces the issue of enabling PWD to move from welfare to labour force in Norway. We have used this topic as an application of eParticipation. Chapter 4 presents an SD model built focusing on this topic. Chapter 5 introduces ILE and ILE experiment based on the model presented in the preceding chapter. Chapter 6 concludes this part.

Part III is about *eAccessibility*. It also contains four chapters. The first chapter –Chapter 7– introduces eAccessibility. Chapter 8 presents an SD model built to help decision maker enhancing eAccessibility of Norwegian municipal website. Chapter 9 introduces another ILE and its ILE experiment based on the model introduced in the previous chapter. Chapter 10 concludes this part.

Part IV covers the thesis final conclusion and future work, over Chapter 11 and Chapter 12 respectively. Appendix I presents an SD modelling guide, which aims at introducing how to do mathematical modelling and implementing SD models using Vensim PLE, technical documentation of our SDBILE framework, and the summary of all literature that were reviewed in Chapter 2 and Paper A. Appendix II contains documentation of the two SD models developed for this research, in addition to their sensitivity analysis reports. Appendix III covers all questionnaires that have been used to collect data and information required for all papers. Appendix IV contains the papers published during the course of this research, while Appendix V presents three unpublished papers that were prepared and used to support the published papers.

2 State-of-the-Art: SD Models in eGovernment

2.1 Introduction

To stand on the current state-of-the-art of SD use in the eGovernment field; in this chapter, we would like to investigate the accumulated literature on eGovernment models using SD. In addition to knowing the present situation which could have a great impact on our understanding of the depth of SD use in this field, our main goal is to uncover the possibilities for future research by clarifying the shortage. The following section of this chapter describes the methodology we used to achieve the goal of our investigation. Afterwards we describe the findings and results. In the last section, the chapter concludes.

2.2 Methodology

Our investigation started by searching two popular reference databases; the first is the "E-Government Reference Library (EGRL) version 10.5" published in January 25, 2015, hosted by Hans Jochen Scholl, University of Washington, the other is the SD bibliography database ver. 2015a published in 2015 and hosted by the SD Society. The EGRL includes 7,237 eGovernment related references, 45% of them are journal articles and 51% are conference papers, book sections and edited books. The SD bibliography database contains 11,046 SD related reference, 23% of them are journal articles and 46% are conference papers, book sections and edited books.

Our main search focused on the eGovernment keyword variants: "electronic government", "digital government", "egovernment", "e-government" and "egov" in all fields of the SD bibliography database. Additionally, we added "Information Technology", "IT", "Information and Communication Technology", and "ICT" to "government" as extra search keywords. While for the EGRL database, we used "System Dynamics" and "System Thinking" as search keywords in all fields.

The last step was followed by pairing each eGovernment search keyword with each SD search keyword. These pairs were used to search all databases available from EBSCO Information Services, hosted by EBSCO Information Services.[34] Finally, the search process was wrapped up by using Google Scholar.[35] Many duplicates were found and removed during the process. The resulting references were skimmed to be sure of their

[34] https://search.ebscohost.com

[35] https://scholar.google.com

eligibility for this research. In many cases, it was found out that the paper does not contain any SD application, and the search words appeared in the references section of the paper for example. The final step we conducted on the filtered publications list was reviewing the citations forward and backward as suggested in [168]. This step added few extra publications to the final list.

We excluded a couple of SD Society's conferences papers [169] and [170]. Only the abstracts of these two papers were available in the proceedings. We have contacted the SD Society and the first two authors of both papers; however these attempts were not fruitful. For one conference paper [171] we could find merely a presentation on the conference website, in addition the issue of the paper was republished by the same authors the following year in a different conference, see [172]. Only the latter was taken into consideration.

2.3 Results

2.3.1 Bird's–Eye View

The overall search process resulted in more than 115 publications, of which more than 80% were not related to our topic and thus discarded. For example some of the eGovernment related papers appeared in the search because they quoted one or more SD related references, and vice versa. Only 25 publications were found relevant and included in the final list.[36] Conferences are accounted for 52% of the used publication channels. 28% of the publications reviewed were journal articles. As shown in Figure 2-1, the overall publication rate is increasing over time as indicated by the black linear trendline.[37]

The investigated publications differed in their information sources approaches. 76% and 52% of the reviewed publications used *Case Study* and *Interviews* as a main or one of the main sources respectively, ranking them as the most engaged approaches. *Group Model Building* (GMB) followed with 32%. Using *Workshops* and *Surveys* as main source of information came last.

Authors preferred different tools and methods to analyse and present their results. *Stock and Flow diagram* was the most frequently used tool with 72% of all reviewed publica-

[36] Compared to Paper A, we have excluded three of our own publications, because they are part of this thesis.

[37] Only three publications were published in SD related channel. This could be considered as an indicator on the acceptance of SD in publication channels that are not related to SD domain.

tions. 48% of the investigated publications used *CLD* to present their understanding about the system under investigation. 60% of the reviewed publications have taken one step further and presented their simulation results. None of the reviewed publications used *ILE*.

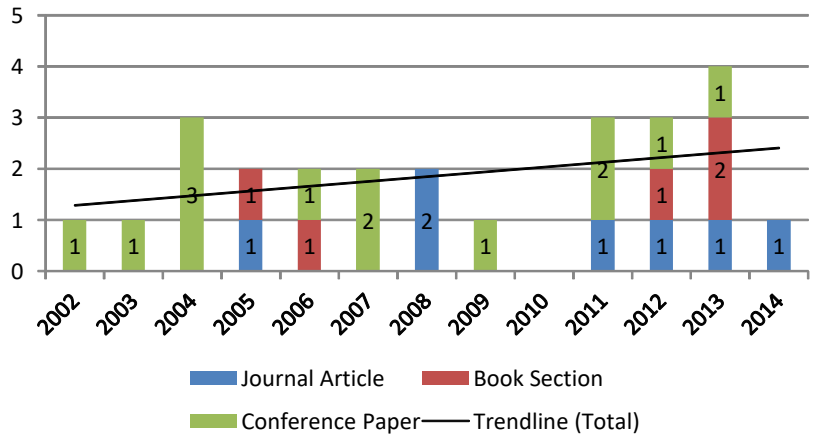


Figure 2-1: Publication frequency by type and total over time

80% of the reviewed publications were used in presenting project cases on the local municipal/territorial/city level, while only 20% addressed national/county-wide level. The reviewed publications were almost equally distributed between being used in supporting specific and general eGovernment projects. Table 2-1 compiles a list of distributions of investigated publications over information sources, used tools, scopes, and usages.

Table 2-1: Filtered publications distribution over information sources, used tools, scope, and usage

Information source(s)*					**Used tool(s)/method(s)***				**Scope**		**Usage**	
Case Study	**GMB**	**Interviews**	**Survey**	**Workshops**	**CLD**	**Stock and Flow diagram**	**Simulation results**	**ILE**	**County Wide /National**	**Local /Municipal**	**General Case**	**Specific Case**
76%	32%	52%	8%	12%	48%	72%	60%	0%	20%	80%	44%	56%

* One paper can use more than one information source, and/or more than one tool/method.

2.3.2 Deeper Look into the Models

We were able to distribute the models presented in the surveyed papers over four different topics:

1. Collaboration and knowledge sharing
2. Development and success/failure factors
3. System security

Collaboration and Knowledge Sharing. Like any other project, a successful eGovernment project requires smooth collaboration among involved parties. This includes aspects like trust and consequently data, information and knowledge sharing among these parities. According to our survey, the first SD model focusing on eGovernment was introduced in 2002 by Cresswell *et al.* [172]. The model explored the dynamics of collaboration and knowledge sharing among different governmental agencies. The model used the data and information retrieved during the implementation of the *Homeless Information Management System* (HIMS) for the state of New York in the United States. Seven other publications explored the HIMS projects and its SD model [173]–[179].

Information integration in the context of inter-governmental agencies collaboration was tackled in another model that was built by Luna-Reyes *et al.* [180], [181]. In 2011, Scholl and Luna-Reyes presented a model envisaging the relationships among different government stakeholders (namely, the Congress, the president, the people, and the press) as controlled by the US constitution [182]. This model focused on the effect of transparency and open government in promoting a less secretive government.

Development and Success/Failure Factors. eGovernment development process is affected by many factors in addition to the actions of several parties. Understanding this process, can help in identifying the leverage points, success and failure factors. A theoretical and an analytical framework explaining eGovernment development was embodied in a causal loop diagram introduced by Martinez-Moyano and Gil-Garcia [31]. Their aim was to find leverage points of intervention. In the following year, Luna-Reyes *et al.* investigated the social and organizational factors causing success and failure of a governmental information systems development based on the New York state's *Multipurpose Access for Customer Relations and Operational Support* (MACROS) project findings [183]. The development of the eGovernment organisational and technological sophistication was explored by Martinez-Moyano [184] via a preliminary causal loop diagram to be used later in group model building sessions. Nevertheless, this was never used further.

Kim *et al.* introduced a model that helps in deciding whether the city of Philadelphia in the United States should compete with private sector providers in the local Wi-Fi market [92]. eMexico program is a Mexican eGovernment initiative that includes different Internet service portals. Luna-Reyes and Gil-Garcia combined the institutional theory and SD to build a preliminary model in order to understand the interactions among institutional, organisational, and technological components of the eGovernment in Mexi-

co based on information recovered from the eMexico program [185]. The model was reintroduced in an extended version of the same paper in 2011 [30].
In a couple of papers, Abdelgawad *et al.* explored the non-technical factors affecting the eAccessibility of Norwegian municipal local government websites. Presenting a causal loop diagram in the first paper, while in the second they introduced a model and an Interactive Learning Environment to be used as a decision support tool [186], [187].
Navarra and Bianchi presented an abstract model to be built and applied in the context of territorial governance, to support sustainable development [188]. They used Hammarby in Sweden as their case-study.
Luna-Reyes, Gil-Garcia and Ramirez-Hernandez proposed a resource-based view of the eGovernment service provider using SD modelling [189]. This was preceded by a preliminary conceptual SD model that renders the fundamental capabilities and resources required to achieve a successful transformation to eGovernment on the local level [190]. This paper was an extended version of the former. The authors used SD and dynamic-capabilities view of the eGovernment service provider [191] to identify the core capabilities and resources necessary to develop a successful eGovernment strategy was introduced as a continuation of the same line of work in and extended version of the two former papers [192].
Rich and Nelson addressed the problems caused by shifting the requirements in large government IT projects using SD modelling [193]. Luis F. Luna-Reyes and Gil-Garcia used SD to present a theory of the co-evolution of technology, organizational networks, and institutional arrangements in government transformation via IT [194]. The same model was reintroduced in an extended version paper [195].
System Security. An eGovernment system is vulnerable to several types of risks. These risks could range from hacking and virus attacks to hardware failures and natural disasters. Understanding the causes and effects of these risks is critical in understanding the ramifications and preparing the mitigation strategies. Tang and Jia constructed an open-loop system model for estimating the risks the eGovernment services face, and how to sustain the security of these services [93]. Open-loop systems ignore information feedback. This prevents the model behaviour from being affected by its past values [11]; consequently ignoring that circular causality.

2.4 Conclusion

The number of identified papers applying SD in the context of eGovernment is not considerably large. Furthermore, it was clear that in the majority of the cases, the SD models use is limited to SD practitioners. Albeit, SD does not aim solely at building

simulation models for the sake of finding optimal policies and test what-if scenarios [11], but also aims at making these policies and their results as well as the system structure easier to comprehend by both users/clients involved in the modelling process, and users/clients of the final model [34].

GMB and workshops are vital tools to involve non-SD practitioners in model building process. Yet, their usage in the surveyed literature is low. The cost of involving people in the modelling process both financially and time-wise cannot be ignored. More focus on using both tools is inevitably required if increasing the base of SD use in the eGovernment field is targeted.

None of the investigated models have introduced an ILE. Consequently, they can neither be used directly by non-technical users to conduct what-if scenarios, nor help them in changing their mental models by uncovering the underlying system structure. Perhaps the time and financial costs involved in developing an ILE play a principal role in such a situation. However, to increase the models usability especially among non-technical users, extra momentum is a needed in this direction.

As a final note, national level related models are few. Further attention could be devoted to building models that are concerned with national level issues.

Part II. eParticipation

3 Introduction

3.1 eParticipation

The European Commission defines eParticipation as “reconnecting ordinary people with politics and policymaking and making the decision-making processes easier to understand and follow through the use of new Information and Communication Technologies” [9]. To apply this concept, we were interested in finding a topic of public interest that needs to be highlighted and promoted. Employment policies for PWD, including the factors that prevent or promote them to move from welfare recipients to join the labour force in Norway, is such a topic.

3.2 PWD Employment in Norway and Government Efforts

Despite repeated statements from successive governments in Norway, the employment rates for PWD remains unchanged since 2000. In the period from 2000 to 2016, on average around 43% of PWD in working age are in employment [196]. In Norway's neighbouring countries, the case is different. In Denmark, around 56% of PWD are in employment [197], and 53% in Sweden [198].[38] These low rates of employment among PWD comes even under the protection of anti-discrimination law and a high governmental expenditure on employment efforts compared to any other country [200].

In general, several factors could be blamed for such a situation. Poor economy causes an enormous degradation on the PWD situation in general [201], however this is not the case in Norway. Norway is one of the countries with the highest social spending.[39] During 2016, Norway has spent 25.1% of its GDP on social spending. The total *Social Spending* of the Organisation for Economic Co-operation and Development (OECD) is 21% in the same year [202]. Furthermore, in 2013, Norway dedicated 3.7% of its GDP to be spent on sickness, disability and occupational injury (or the *Public Spending on Incapacity*) [203]. Although the latter indicator does not include the expenditure on rehabilitation services per se, it is still a good indicator of the high expenditure on PWD taking the high social spending in general. This has been the case for a long period of

[38] Comparing these percentages should be done cautiously. Such employment rates are generally based on different national-level surveys, with different designs, timings, surrounding economic conditions, and definitions of being employed [199].

[39] Social expenditure comprises cash benefits, direct in-kind provision of goods and services, and tax breaks with social purposes [202].

time; Figure 3-1 shows that Norway has always been surpassing the OECD (in total) in both social spending and spending on incapacity over the last ten years.[40]

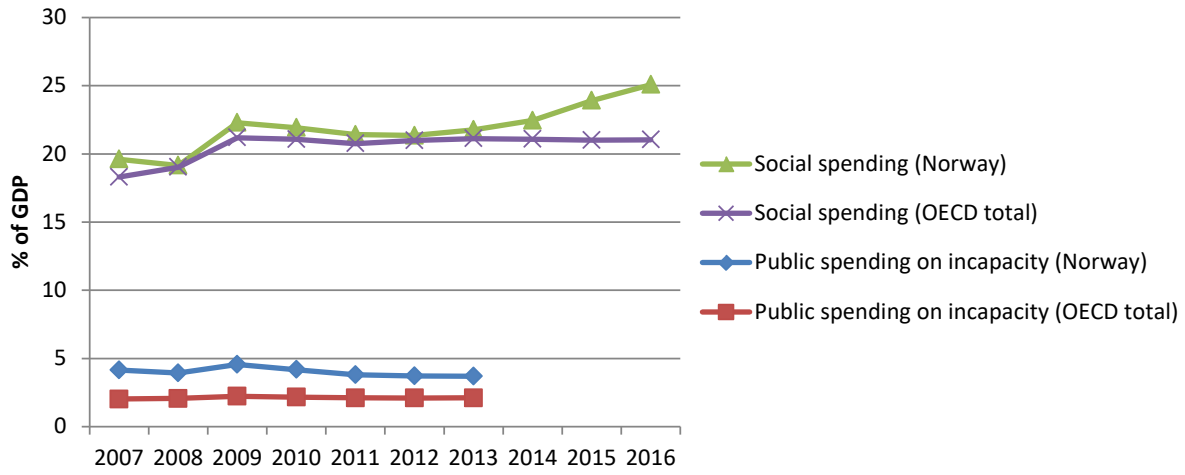


Figure 3-1: Social spending and spending on incapacity, Norway vs OECD

Health is another factor that could have a great effect on the PWD employment. Not every PWD will be able to work in any job, if she/he is capable to work at all. Knowledge of the individual PWD capacities is very important to redirect them towards or create suitable jobs. In Norway there is systematic profiling of PWD in terms of "a comprehensive assessment of their work capacity and, if needed, a swift referral to the most appropriate service" [205].

The PWD environment/geographical residence cannot be excluded from the factors that might have a role in PWD unemployment. For example, in remote and/or isolated areas, it is not expected that services provided to PWD will be the same as those provided in the more accessible areas. Likewise, we cannot expect that commuting PWD to their workplaces would be easy if they live in remote or isolated areas. In certain cases, even an Internet connection suitable for teleworking, would not be possible. However, Norway is in a good position in this regard. In 2016, Norway was ranked the fourth all over the world in the World Economic Forum's Networked Readiness Index (NRI), and the first in its infrastructure and digital content sub-index [206].

Social and psychological factors have serious negative influence on the PWD unemployment as well. In the abstract of [100], prejudices and misconceptions about PWD work abilities were blamed as the cause behind PWD low employment rates. Further-

[40] Worth mentioning that since 2000, Norway reserved the second highest GDP per capita all over the OECD countries with 61,255 US$, with very few exceptions [204].

more, [207] showed that employers find the main reason behind low PWD employment rates to be that PWD are less accepted among their colleagues in workplaces. In the same research, it was also showed that the main reason behind low PWD employment rates according to employees, job-seekers, and many employers who have never met PWD, is that PWD are less efficient in work [207].
Education is another factor that could be causing higher PWD unemployment. In [205], it was shown that PWD have significantly lower levels of education compared to others in all OECD countries. The Norwegian government has introduced different vocational rehabilitation programmes to increase the employment probability of PWD through re-education. However, these vocational rehabilitation programmes suffer from many problems. For example according to [208], although PWD with the lowest work opportunity will benefit the most from the vocational rehabilitation, they have the lowest opportunity to be included in such programmes.

3.3 Telenor's Open Mind Programme

The Norwegian telecommunication company *Telenor*[41] has introduced a very successful two-years vocational rehabilitation programme called *Open Mind* Programme – previously known as *Handicapped-Programme* [15], [16]. Open Mind is operated and mostly executed by Telenor. The programme consists of three months of classroom training, and 21 months of on-the-job training in Telenor or in one of its partner companies [15], [16]. This approach combines on-the-job training with a wage-subsidised programme. Both have proven to be the most effective in increasing the employability of PWD [208]. Furthermore, at least 75% of the trainees have got permanent jobs after finishing the programme [16]. Although the programme is on a very small scale,[42] the results are encouraging. It has been replicated in Sweden and Pakistan [15]. Moreover, in [16] simple calculations were made to show the overall effect on government budget resulted from employing trainees of Telenor's Open Mind until their retirement. It has been shown that the accumulated net savings in terms of saved disability benefits and increased tax revenue after removing Open Mind programme cost is positive.

3.4 PWD from Welfare to Jobs SD Model

Inspired by the success of Telenor's Open Mind, we are interested in exploring factors that can enable more PWD to take up jobs, since this would be a substantial contribu-

[41] http://www.telenor.no

[42] On average eight to 10 persons pass through the Open Mind annually [16].

tion to the individual capacity building, and for the national financial bottom line. To accomplish this, "*PWD from Welfare to Jobs*" SD model was built, intending to facilitate a better understanding of factors that could enable and encourage the currently unemployed PWD to take up jobs, and employers to create jobs for PWD. From the SD viewpoint, the model has to address a particular problem, and not the whole system [209], [210]. Accordingly, we have concentrated on the factors contributing to the problem, or the problematic factors.

In building the model, we have conducted surveys on both PWD and employers. Based on the results of these surveys, we were able to include economic factors that might affect the PWD employment. From the PWD's point of view, among other factors, the possibility for PWD to combine salaries and welfare benefits, the availability of an improved system for keeping disability pensions when having paid jobs for part-time workers, and further the risk of losing current welfare benefits if employed were included in the model. From the employers' point of view, receiving financial support from the government when employing PWD, being provided with assistive technology by the government, receiving financial support to adapt workplaces for PWD, and the effect of general difficult financial situations or crises were included in the model. Likewise, the model takes into consideration the associated costs and savings for individual PWD, employers, and nationally through the Norwegian Labour and Welfare Administration (NAV)[43] and the tax authority.

From the environmental/geographical factors perspective, we have found and included in the model, the effect of the availability of accessible transportation to work and/or PC with assistive technology or human assistance whenever needed on both PWD and potential employers. While from the perspective of the education, the availability of employment training, and the overall idea of generalising the Open Mind-Like programme which the model is based upon were included in the model.

From the health perspective, the model takes care of the effect of the availability of suitable jobs to PWD, in addition to the possibility of having flexible working hours and tasks. Furthermore, in certain cases, disability will totally prevent PWD from taking up any job. This is reflected indirectly in the model. Based on PWD preferences taken from the survey, certain percentage of PWD will not be able to work under all circumstances, i.e. none of the possible options would enable them to work. This percentage was generalised.

[43] http://www.nav.no

From the psychological perspective, the effect of PWD social status and self-fulfilment on their attitude towards being employed, in addition to increasing their social interaction, and furthermore, the effect of the fear from the inability to fulfil the job expectations were added in the model. From the employers' point of view, the model takes into consideration the effect of the overhead expected in dealing with social benefits because of, for example the lack of easily accessible information or the lack of fast response from public authorities when help related to PWD is needed, and the fear of lower efficiency from PWD as employees in addition to the need for more flexible working tasks and hours.

Measures to change the employment situation will often need time to take effect. A well-established model could build a common understanding of the causalities and motivate policymakers and citizens voting for them to keep a selected policy long enough to achieve the anticipated benefits. The model is intended to support more targeted discussions between individual citizens, disability organisations, and policymakers. The envisaged approach promised to contribute in linking ordinary people with policymaking and rendering the decision-making processes easier to comprehend. This model is intended to enable people to get a better understanding of the causalities and policy options in the field to inform better decisions. It is intended to change their understanding, perceptions, and accordingly attitudes, in other words change their mental model [11].

This model was built to help finding an answer to our second partial research question RQ 2 of how SD can be used in modelling and supporting decisions in a case to be promoted via eParticipation, particularly in the case of PWD employment. Furthermore, to build and while building this model we have answered our third partial research RQ 3 concerning the core problems and issues regarding the SD implementation in the eParticipation area, particularly in the case of PWD employment.

3.5 PWD from Welfare to Jobs SDBILE

In addition to the SD model, "*PWD from Welfare to Jobs*" SDBILE was developed based on this model to support more targeted discussions between individual citizens, disability organisations, and policymakers. The anticipated approach can contribute to improve the eParticipation.

Basically, we wanted to know to what extent the SD model is really capable of doing what it promises including changing its users' understanding and perceptions of the system underlying structure and policy options. To do this, we have updated the model and developed an ILE with the model in its core, prepared a testing tool, conducted an

expert opinion poll, as well as two experiments with people using this ILE. This effort was to answer our fourth partial research question RQ 4 of how SDBILE can be used in promoting eParticipation, particularly in the case of PWD employment, and our fifth partial research question RQ 5 of what the impact of using SDBILE in promoting eParticipation, particularly in the case of PWD employment, would be.

3.6 Part Structure

The remainder of this part is organised as follows: The next chapter explores the background and the structure of the SD model, in addition to model testing and behaviour. The following chapter introduces the ILE prepared based on the model, the expert opinion poll, and the experiments conducted using it. The final chapter concludes this part.

4 PWD from Welfare to Jobs SD Model[44]

4.1 Background and Information Sources

4.1.1 Background

The model structure is based on the *Bass Diffusion Model* of Frank Bass [211], and its SD version [11], in addition to different structures taken from the SD molecules [212]. Figure 4-1 presents the subsystems diagram of the model. In the figure, the rounded edge rectangles present the SD model subsystems, which are groups of model variables, while the arrows show the directions of flows of information, money, people, etc. There are two main blocks: PWD and employers. On the PWD block: government decisions and awareness of PWD about their competence and possibilities available for them, are playing a main role in making these PWD using welfare interested in work. By training and enabling them, they are ready to fill potential vacancies.

On the employers block: government decisions and awareness of employers about the possibilities available for them when recruiting PWD, are playing a main role in making these employers interested in recruiting them. By providing reasonable accommodation[45] to employers, vacancies for PWD are created. Both training and vacancy creation for a PWD put pressure on government budget. However, when a disabled person gets a job, she/he leaves the welfare benefits and becomes a tax payer, which accordingly eases the pressure on government budget.

As mentioned in Chapter 1, in this part, the results of Paper I: "*Attitudes of Disabled People towards Employment in Norway*" and Paper J: "*Attitudes of Employers towards Recruiting Disabled People in Norway*" served as one of the information sources that was used in building the SD model presented in Paper B: "*Disabled People from Welfare to Jobs: A Decision Support Tool*".

4.1.2 Information Sources

The main source of information to build the SD model presented in this chapter is disability employment information from both national sources like Statistics Norway

[44] The model (Vensim file format) is available at: https://forio.com/app/ahmedg/eparticipation/helper/

[45] Reasonable accommodation "means necessary and appropriate modification and adjustments not imposing a disproportionate or undue burden, where needed in a particular case, to ensure to persons with disabilities the enjoyment or exercise on an equal basis with others of all human rights and fundamental freedoms" [213].

(SSB),[46] and international sources like the Organisation for Economic Co-operation and Development (OECD).[47] Furthermore, two surveys were conducted; the first was done among PWD to understand their attitudes towards taking up jobs, while the second was conducted on employers to understand their attitudes towards recruiting PWD. For more information, please refer to Papers I and J.

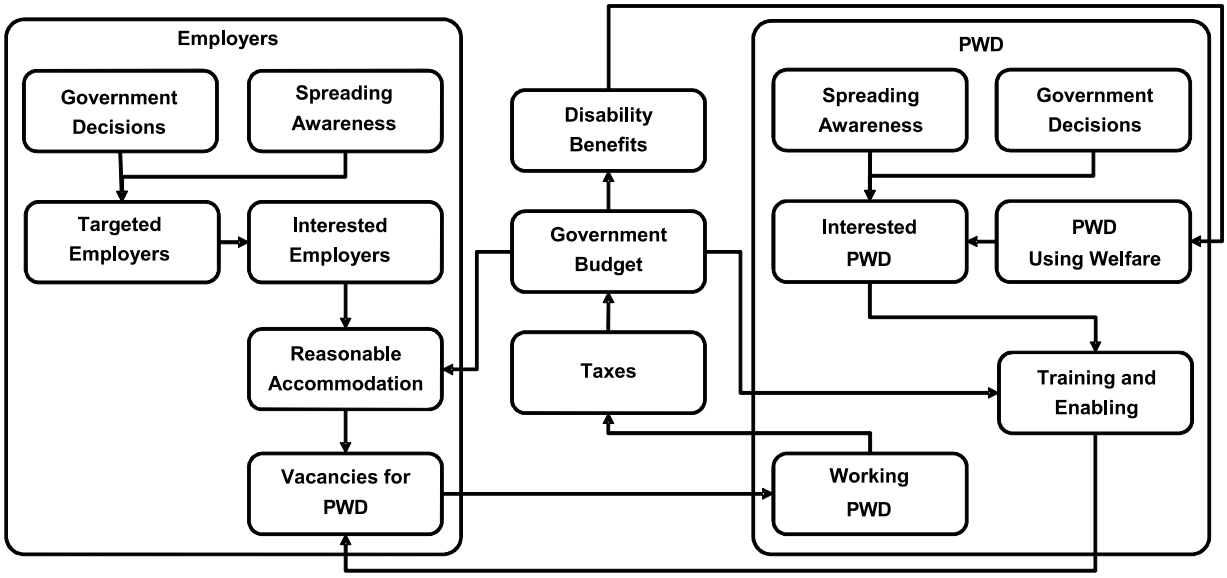


Figure 4-1: Model subsystem diagram

4.2 Current Situation Structure

4.2.1 PWD Subsystem

Figure 4-2 shows our understanding of the current process of enabling PWD to shift from welfare to work.[48] We have assumed that PWD in Norway are either welfare recipients or employees paying taxes. Also, we have assumed that all PWD start first as welfare recipients. The number of welfare recipients is increased by an increase fraction that was computed based on the figures extracted from [214],[49] meanwhile, only a fraction[50] of the welfare recipients becomes interested in work. This conversion is regu-

[46] http://www.ssb.no

[47] http://www.oecd.org

[48] In figures, variables names delimited by pointy brackets are pictures of their corresponding variables. If a variable is computed in a different subsystem, its pictures will be coloured in grey.

[49] The increase rate is not shown in the figure.

[50] The fraction of disabled people who are enabled and encouraged to work will be covered in the attitudes subsystem subsection.

lated by the "social exposure and imitation" effect of the Bass Diffusion Model (usually word of mouth, in this case via day-to-day contacts between working and non-working PWD, especially through disability organisations[51]) [11]. In the current situation, we were not able to identify "external sources of awareness and adoption" (usually advertising) [11].[52] The next normal step is that some of the PWD interested in work can find suitable vacancies and move to work.

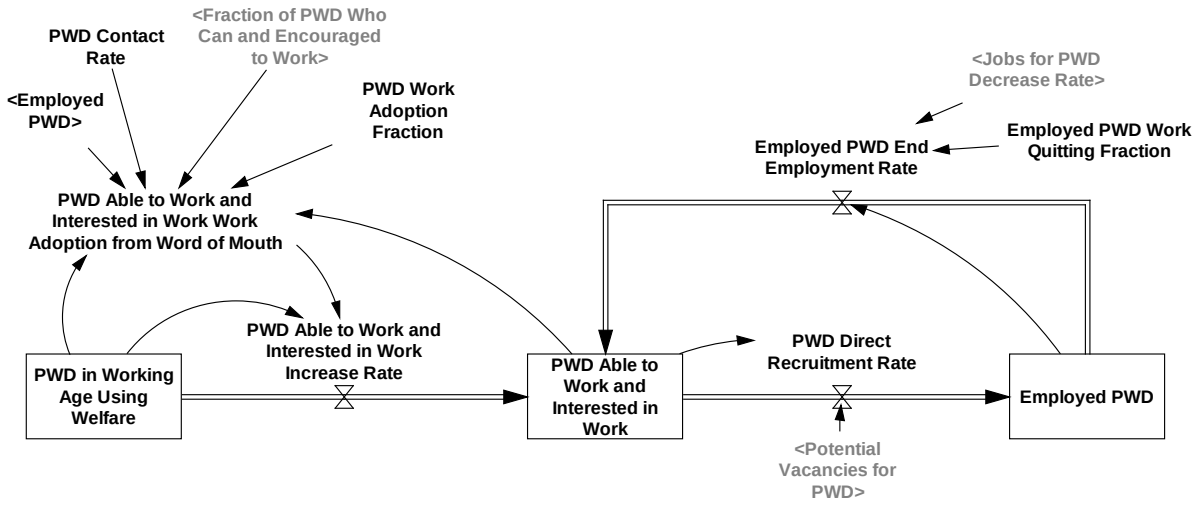


Figure 4-2: PWD shift to work (Current situation)

Intuitively, some of the employed PWD will quit or have their employment ended and revert back to welfare waiting for another potential vacancy.[53] No specific value for PWD employment quitting rate could be identified, so we used the employment quitting rate computed for the general population from [215]. It is worth mentioning that all stocks of PWD shown in the figure, are subject to decrease with the same decrease fraction that was computed based on the figures extracted from [214].[54]

4.2.2 PWD's Employers, Jobs, and Vacancies Sector

Targeted employers are employers that are not currently employing any PWD. They are increased by an increase fraction that was computed from figures provided by [216]

[51] For example, FFO http://www.ffo.no

[52] Older advertising encounter was found, however very limited and for a very short period. So, we felt safe to assume its inexistence in the current situation. More information is available in Subsection 4.3.1.

[53] We have assumed that they will not give up being interested in work.

[54] The decrease rates are not shown to simplify the figure.

and [217].[55] In this subsystem, as shown in Figure 4-3, there is a process similar to the one where PWD shift from welfare to jobs through being interested in work first. Only a fraction[56] of targeted employers becomes interested in recruiting PWD. Similar to the PWD subsystem, this conversion is regulated by the "social exposure and imitation effect" of the Bass Diffusion Model (also, usually word of mouth [11], in this case via interactions between employers recruiting PWD and employers not recruiting PWD). Again, in the current situation, we were not able to identify "external sources of awareness and adoption" (usually advertising) [11].

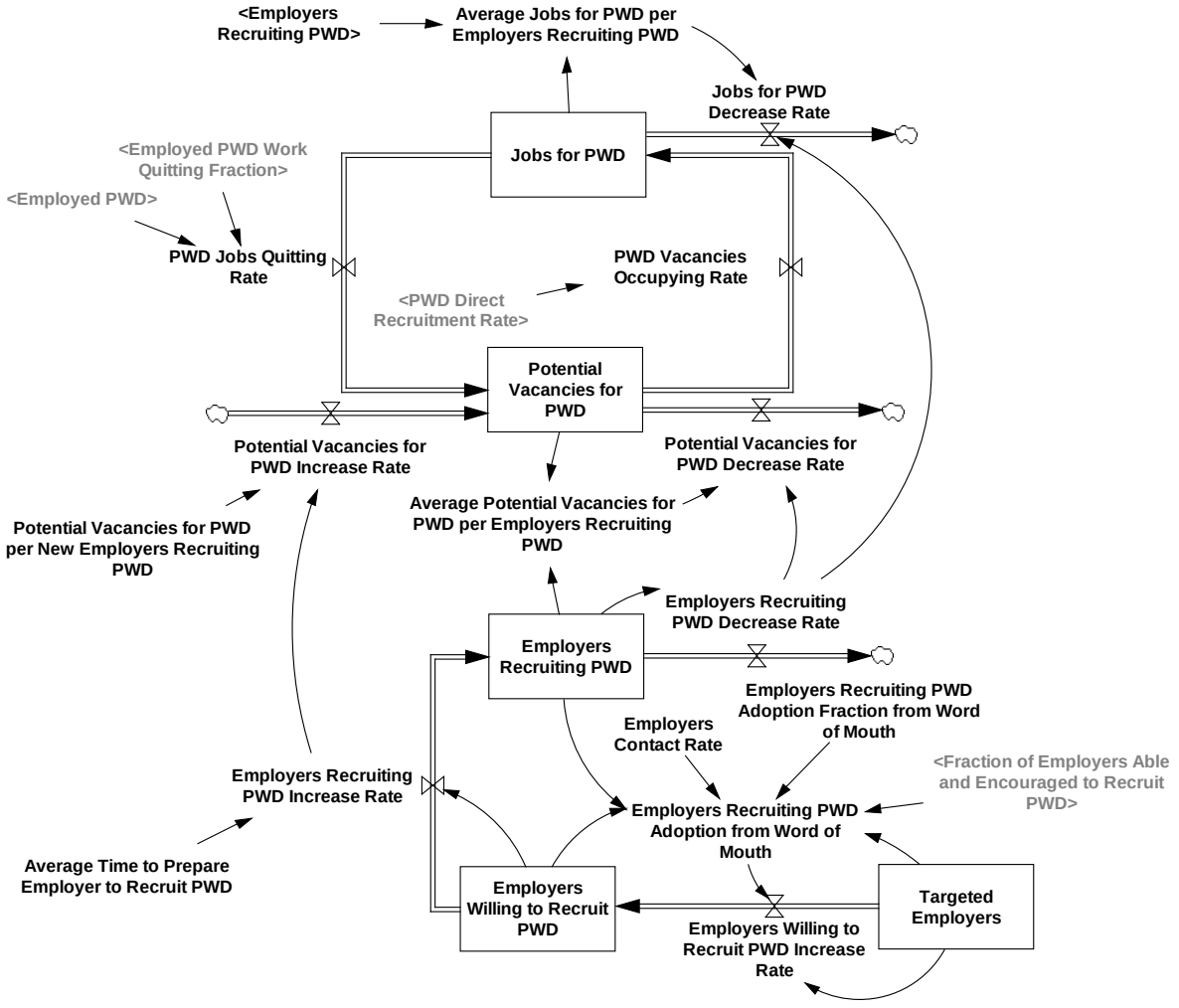


Figure 4-3: Employers preparation and vacancies creation (Current situation)

[55] The increase rate is not shown to simplify the figure.

[56] The fraction of employers that are enable and encouraged to recruit disabled employees will be covered in Subsection 4.3.2.

Employers interested in recruiting PWD will have to wait for the governmental agencies to provide them with the reasonable accommodation required to create vacancies for PWD. After an average waiting time, an employer interested in recruiting PWD is ready, and turns to be an employer able to recruit certain number of PWD,[57] by adding vacancies to the potential vacancies for PWD stock, in a co-flow dynamics style [11]. The stock of potential vacancies for PWD will be depleted in the interest of increasing the stock of jobs for PWD by PWD recruitment rate, which is computed in the PWD subsystem.

We have assumed that an employer recruiting PWD will never stop doing that unless this employer is completely out of business. Employers are out of business with a certain decrease fraction that was computed based on the figures provided in [216] and [217]. All employers stocks are decreased with that decrease fraction.[58] When an employer goes out of business, average vacancies and jobs per employer are removed from vacancies and jobs stocks respectively. Furthermore, when PWD quit jobs, their jobs go back to vacancies stock.

4.3 Open Mind-Like Programme Structure

Figure 4-4 shows additional structure depicting the idea of Telenor's Open Mind-like programme on a larger scale, where the government takes a similar role to Telenor's. The government can invest in creating jobs including training opportunities, by enabling and encouraging employers to do so [218]. As shown in the figure, PWD interested in work are transferred to the new Open Mind-like training according to the availability of vacancies, which will be created in the employers' subsystem.

Around 42% of employed PWD are recruited in the same jobs they had before becoming disabled [200]. In our model, we have assumed that this percentage is the minimum flow that continues to be transferred directly to work. Like Open Mind, our programme training time is two years, after which the fraction of PWD succeeded in passing the training will be employed, save the fraction assumed to fail.

4.3.1 Advertising Subsystem

Although the government has established a system to fund reasonable accommodation to enable employers to recruit PWD, the system is highly underutilised. Employers'

[57] This stock is for employers having jobs, vacancies, or both for disabled employees, as will be shown later.

[58] The decrease rates are not shown to simplify the figure.

lack of knowledge is blamed for this [200]. In 2004, the *Social Security Administration* (Trygdeetaten)[59] had a campaign aiming at sending more PWD to work. Posters were put up on buses and trains with messages conveying that PWD are competent, and challenging the general attitude towards PWD [219]. However, both new PWD and new employers are entering the market every day, while old are exiting, which intuitively emphasises that continuous advertising and information spreading campaigns in different types of media are required to keep a sustainable effect.

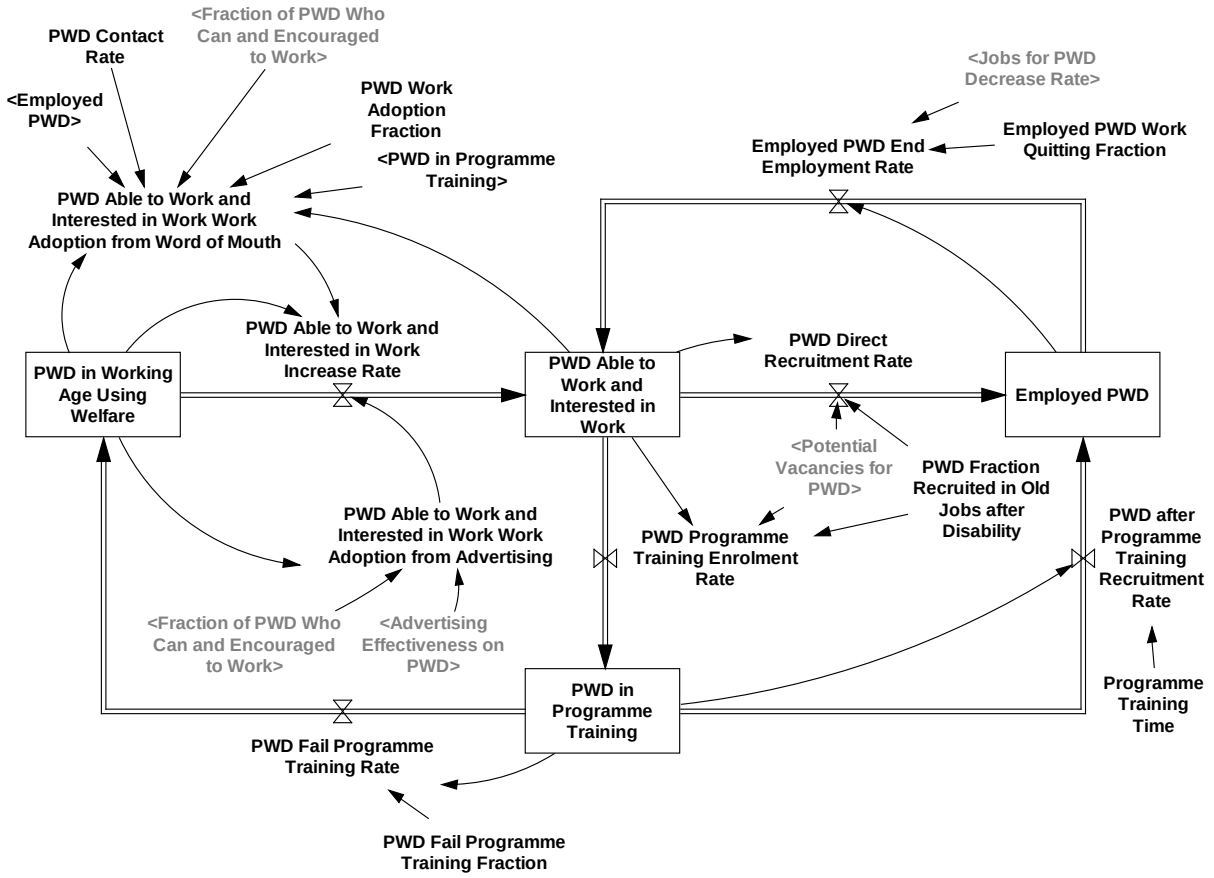


Figure 4-4: PWD shift to work (Proposed programme)

An advertising effort by the government aims at increasing the awareness about competencies of PWD, possibilities for employers, and our Open Mind-like programme for both PWD and employers. Additional advertising structure similar to [11] is suggested for both PWD subsystem (shown in Figure 4-4) and PWD's employers, jobs, and vacancies subsystem.

[59] Currently, Trygdeetaten is part of NAV.

4.3.2 Attitudes Subsystems

Surveys focusing on attitudes of employers towards recruiting PWD are available, for example see [216] and [220]. Moreover, the *Labour Force Survey-Ad hoc module* conducted by SSB has some questions targeting attitudes of PWD towards employment [221]. However, we couldn't use the results of these surveys in our SD model, because the results of both PWD and employers were not consistent with each other. Consequently we have conducted our own set of surveys that has matching encouraging and enabling factors for both PWD and employers. We have administered the two online questionnaires during the first half of 2011. The questionnaires were prepared through literature review and successive discussions with experts in the field. Both samples were convenience samples [222].

The PWD questionnaire was filled out completely by 302 respondents, who were associated with organisations that were members of the "Norwegian Federation of Organizations of Disabled People" (FFO). In addition to the identification information, disability type and level, and benefits received from government, the questionnaire explored factors enabling PWD to work, encouraging them to take available work opportunities, and preventing them from active job application. For more information please refer to Paper I. The questionnaire was filled out completely by 103 respondents that are companies and organisations having their contacts available on finn.no, added to that companies that have relations with staff members of the ICT department at UiA. In addition to the identification information, number of employees and employees with disabilities, awareness and signing status of the *Inclusive Workplace Agreement* (IA-avtale og protokoll) [223], the questionnaire explored employers' awareness of facts about PWD, factors encouraging employers to, and preventing them from recruiting PWD. For more information please refer to Paper J.

Numerous matching enabling[60] and encouraging factors collected from the results of both questionnaires were introduced to the model in the form of *user-defined* decisions and *model-computed* decisions. The user-defined decisions are left to the user to decide during simulation exogenously, while the model-computed decisions are computed by the model equations, based on values of other variables endogenously. In the most updated version of the model, the results of changing these decisions take effect after the

[60] For PWD, enabling factors are the enabling factors set listed in the questionnaire difference the preventing factors set. While for employers, we have assumed that all employers are enabled by default save prevented.

year 2015 of the simulation time.[61] Before 2015, the default values of these decisions predominate.

The results of these decisions were introduced to the model as the fraction of PWD that are enabled and encouraged to work, and the fraction of employers that are enabled and encouraged to recruit PWD. The values of these two fractions were computed, for all the possible values of decisions. These values were connected to the decisions in the model in the form of nested *if-then-else* relations.

4.4 Model Validation and Results

To validate this model, we have used the set of tests introduced by [224] and recommended by [11]. Testing *Boundary Adequacy* [224], [225], [11] is about answering whether "the important concepts for addressing the problem [under investigation are] endogenous to the model" [11]. While *Structure Assessment* [225], [11] is about whether the model structure is "consistent with relevant descriptive knowledge of the system" and whether the level of aggregation is appropriate.

Both tests were done through presenting the model to experts in the field in two different occasions, in addition to exposing the model structure during different development stages to criticism by experts in SD also in two different occasions. The model boundary selection was found to be adequate as it included all necessary components to take into account, and the structure and aggregation level were found to be relevant and appropriate.

Testing *Dimensional Consistency* [224], [225], [11] aims at checking whether all equation are dimensionally consistent, keeping in mind that model parameters should have real system equivalent [11]. This was fully assured using the unit check feature of Vensim DSS [226]. Model documentation covering model's equations and variables' measurement units are included in Appendix II. The documentation was generated from the original model Vensim file by SDM-DOC (the .NET version) [227], described in [228]. Some manual editing and cleaning followed.

Parameter Assessment [224], [225], [11] is very similar to the Structure Assessment, however for parameters, as the test is related to answering whether the values of the model parameter are **consistent with relevant descriptive and numerical knowledge of the system**, and if the parameters have real system equivalents [11]. This was tested via analysing the data retrieved from SSB and NAV. Other parameters were taken from

[61] The first version of this model used to start from year 2012. Please refer to paper B.

different textbooks and published papers. Finally, the model parameters were estimated to tune the results to historical data and constant ratios from the literature using an efficient Powell hill climbing algorithm [229]. The rationale behind selecting and estimating different parameters is shown in the description fields of the respective parameters, included in the model documentation in Appendix II.

Furthermore, the model robustness has been tested under *Extreme Conditions* [224], [225], [11]. Testing Extreme Conditions aims at answering whether "each equation make[s] sense even when its inputs take on extreme values", and whether "the model respond plausibly when subjected to extreme policies, shocks, and parameters" [11]. Accordingly, we utilised the "automatically simulate a model on changes" functionality of Vensim SyntheSim mode to test the consequences of changing model variables and parameters to extreme values. The usual consequence of changing a variable's value to zero, as an extreme value for example, is several dependant equations failing because of division by zero. However, in other cases the consequence could be implausible behaviour. In all cases, multiple iterations of fixing the equations were conducted until reaching plausible behaviour.

Moreover, the model was tested for *Integration Error*, which is interested in checking whether "the results are sensitive to the choice of time step or numerical integration method" [11]. Different time step values (numerical integration step sizes) and different numerical integration methods (Euler and Runge-Kutta) were tested. The combination of *Euler* method and time step of 0.125 was found suitable, as by decreasing the time step and/or using different method, the behaviour of model was found to be insensitive to such changes. In the same time, the time step was not very small rendering the numerical integration process slow. Behaviours of different variables were also compared under different time step, and no difference was spotted.

Moreover, *Sensitivity Analysis* [224], [11], which aims at testing the robustness of the model under assumed uncertainties in parameters and initial values, was applied to the model using Vensim DSS. The detailed sensitivity analysis report is included in Appendix II.

Behaviour Reproduction is related to check if the model reproduces the "behaviour of interest in the system" [11]. This was tested by comparing the available historical time series and their corresponding model generated series, as shown Figure 4-5. However, the calculated R^2 for all three series were low as shown in Table 4-1. To further understand such results, Theil inequality statistics was used as suggested in [230] to decom-

pose the Mean Square Error (MSE) between the simulated S and historical behaviour H.

$$\frac{1}{n}\sum_{t=1}^{n}(S_t - H_t)^2 = (\overline{S} - \overline{H})^2 + (s_S - s_H)^2 + 2(1-r)s_S s_H$$

Where: $\overline{S}$ and $\overline{H}$ are the mean values of the simulated and actual historical behaviour respectively. s_S and s_H are the standard deviation[62] values of the simulated and actual historical behaviour respectively. r is Pearson's correlation coefficient between the simulated and actual historical behaviour.

By dividing all components of the Mean Square Error (MSE) by the total, we compute the inequality proportions: U^M (bias inequality proportion), U^S (variance inequality proportion), and U^C (covariance inequality proportion). Where:

$$U^M = \frac{(\overline{S} - \overline{H})^2}{\frac{1}{n}\sum(S_t - H_t)^2},\ U^S = \frac{(s_S - s_H)^2}{\frac{1}{n}\sum(S_t - H_t)^2},\ \text{and}\ U^C = \frac{2(1-r)s_S s_H}{\frac{1}{n}\sum(S_t - H_t)^2}$$

Numerical results are shown in Table 4-2. Regarding U^M, U^S, and U^C, it must be noted that for the three series, U^S and U^C dominate and complementing each other, which means that simulated and historical series have the same mean values and trends, however they vary point by point. This indicates unsystematic error since the target behind the model was to study the long-term trends [230].

Table 4-1: R^2

Variable	R^2
All PWD in Working Age	0.04922
All PWD in Working Age Using Welfare	0.01215
Employed PWD	0.04843

Table 4-2: Theil inequality proportions

Variable	U^M	U^S	U^C
All PWD in Working Age	0.0011	0.6407	0.3581
All PWD in Working Age Using Welfare	0.0611	0.5950	0.3439
Employed PWD	0.0446	0.7511	0.2044

Nevertheless even after all the precautions that have been taken to guarantee validity of the model, it is still prone to certain validity threats [231] that should be taken into

[62] Note that this is the population standard deviation, and not the sample standard deviation.

consideration when dealing with the model. From a *Population Validity* point of view, the samples of PWD and employers were, as mentioned earlier, convenience samples. Accordingly, these samples are unlikely to be representative of the PWD or employers population respectively. From an *Ecological Validity* point of view, time is a very important factor, because attitudes of PWD and employers may change over time. Furthermore, the current structure of the model does not take into account the effect of sudden crises. One example is the late drop in oil prices that led to a decrease in the available job vacancies in the Norwegian labour market [232]. Others examples could be the refugee movements or Brexit.

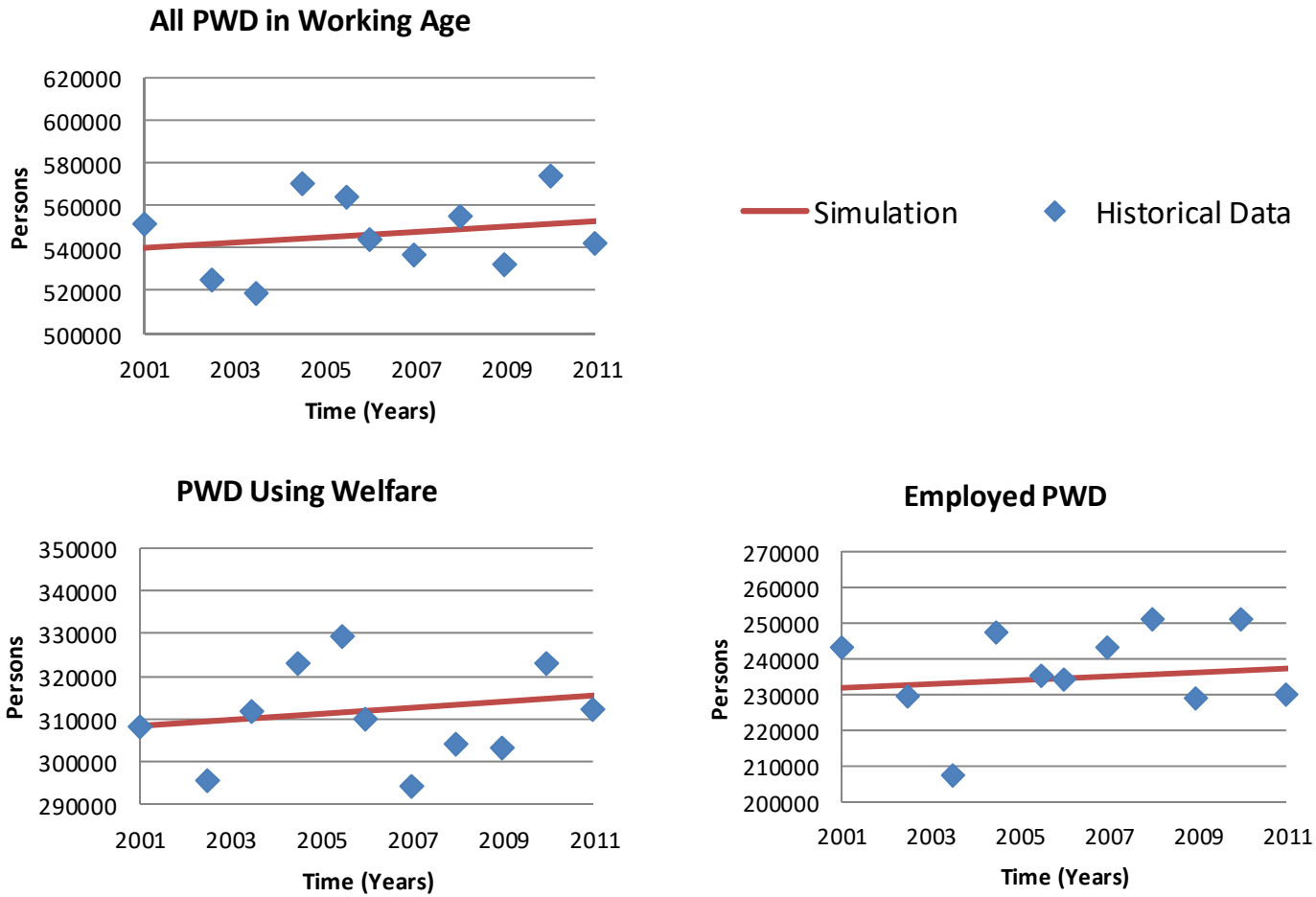


Figure 4-5: Model behaviour

5 PWD from Welfare to Jobs SDBILE

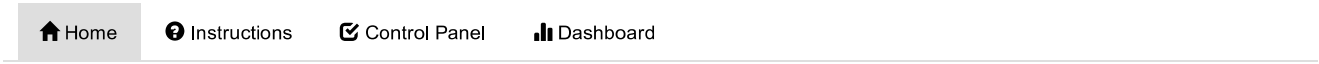
As stated above in Chapter 1, we have used our generic ILE framework to build our ILEs. In this chapter we present the "PWD from Welfare to Job" SDBILE, and the experiments we have conducted using it. More information about this is available in Paper C: "*Disabled People from Welfare to Jobs: An Interactive Learning Environment Experimental Investigation*".

5.1 ILE Interface

The ILE's GUI has four navigation tabs: *Home*, *Instructions*, *Control Panel*, and *Dashboard* shown in Figure 5-1, Figure 5-2, Figure 5-3, and Figure 5-4 respectively. The Home tab briefly introduces the topic of the ILE, including basic knowledge about PWD situation in Norway, Open Mind programme, and other policy options. The Instructions tab puts the user in the context of using the ILE, including specific instructions to guide her/him through the gameplay. The Control Panel tab has all policy options available by the ILE to control the simulation, in addition to simulation time progress buttons.

The simulation starts in the year 2001 and can be progressed up to the year 2050. Nonetheless, the user can control the simulation merely starting from the year 2015. The period from 2001 to 2015 is included in the simulation solely to show the user a comparison between the behaviour of the model and the historical data. In the Control Panel, the user can progress the simulation either for five years ahead or to the end of the simulation time. From there, she/he can also reset the simulation and start a new scenario from the beginning, whether the current scenario reached the year 2050 or not. Policy options available are represented by graphical control elements to operationalise Open Mind-like programme country-wide, including financing awareness campaigns targeting selected ratios of PWD and potential employers, selected PWD preferences, and selected employers' preferences. The Dashboard tab includes charts showing over time behaviour of important simulation variables, needed by the user to stand on the current results reflected by her/his policies entered in the Control Panel.[63]

[63] The ILE is available at: https://forio.com/app/ahmedg/eparticipation/eparticipation.html, its model (Vensim file format) in addition to other supporting files are available at: https://forio.com/app/ahmedg/eparticipation/helper/



In Norway, the employment rates for PWD is only 44% and remains unchanged since 2000. The government has introduced different vocational rehabilitation programmes to increase the employment probability of PWD through re education. However, these programmes suffer from many problems.

Telenor has introduced a very successful 2 years vocational rehabilitation programme called Open Mind Programme. Open Mind consists of 3 months of class training, and 21 months of on the job training in Telenor or one of its partner companies. This approach combines on the job training, with a wage subsidised programme, that were both proven to be the most effective in increasing employability of PWD. At least 75% of the trainees have got permanent jobs after finishing the programme. Although the programme is on a very small scale, the results are encouraging. Simple calculations were made to show the overall effect on government budget resulted from employing trainees of Open Mind till their retirement. It has been shown that accumulated net savings in terms of saved disability benefits and increased tax revenue after removing Open Mind programme cost is positive.

Inspired by the success of the Open Mind, we are interested in exploring factors that can enable more PWD to take up obs. To doj that, we built a decision support tool to simulate the impact of possible government decisions over the next 35 years. The goal is enabling a better understanding of factors that can enable and encourage PWD to take up jobs. In addition, the model takes into consideration the associated costs and savings for individuals, employers, and nationally through NAV and tax authority.

Next step: Select the Instructions tab from the upper tab list, and read carefully.

Figure 5-1: ILE Home tab

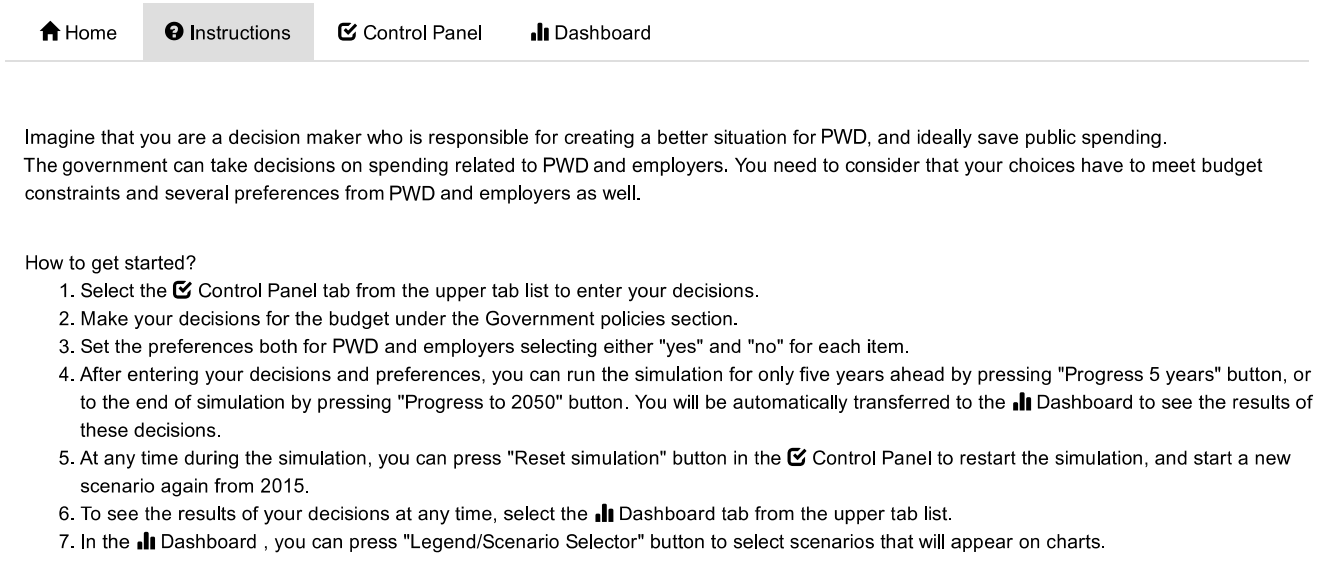


Figure 5-2: ILE Instructions tab

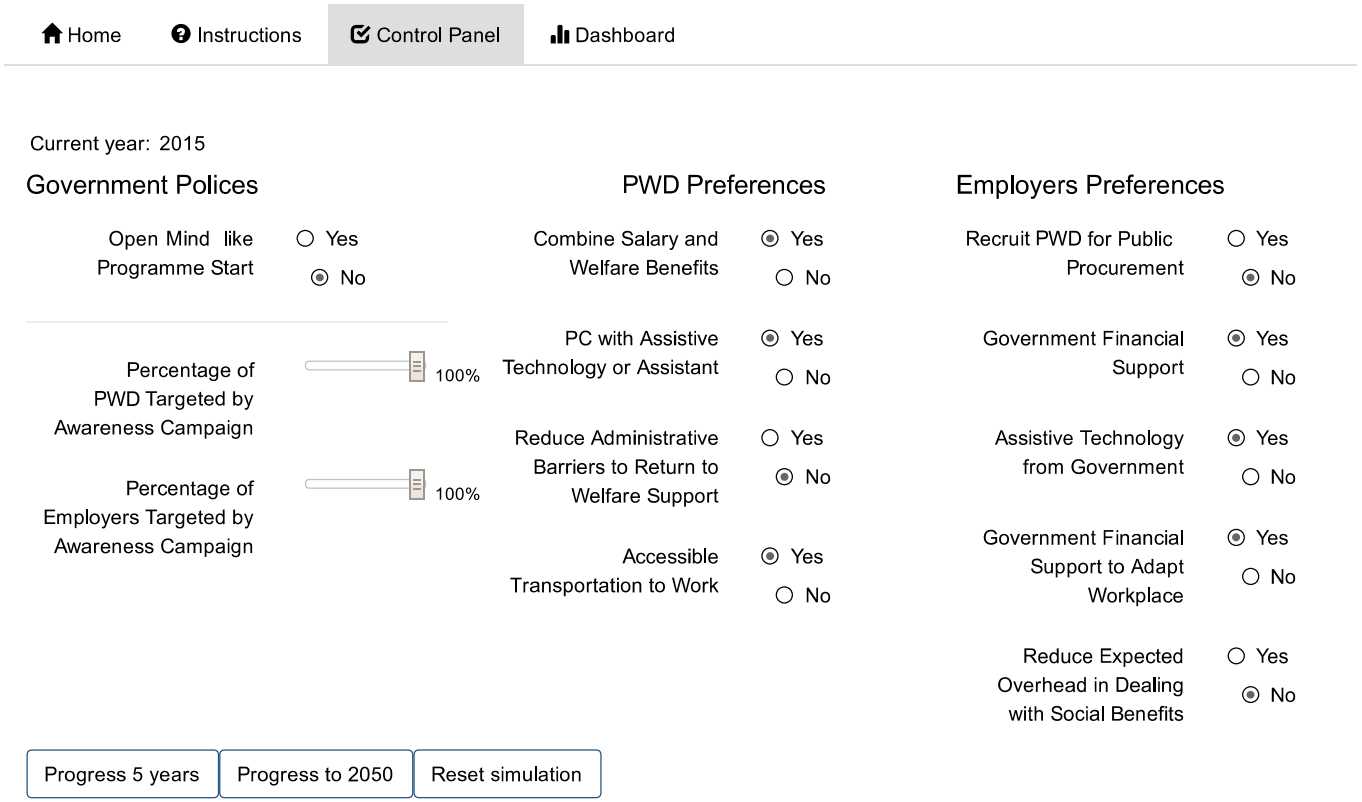


Figure 5-3: ILE Control Panel tab

Figure 5-4: ILE Dashboard tab

5.2 Experimental Procedure

We have conducted an expert opinion poll and two different experiments with users. For our expert opinion poll, we have invited seven experts in the field of disability employment in Norway. The expert opinion poll session was performed online via video conference. Though, only three of the experts could attend the session on the 2nd of September 2015. Their ages covered age groups of 35-44, 45-54, and 55-64. While their educational degrees ranged between bachelors and doctorate degrees, and their years of experience in the field of disability employment in Norway ranged between seven and 20 years. The poll began by a presentation of around 30 minutes about the SD model, the ILE, and the experimental setting. The presentation was ended by sending a URL invitation to each expert to connect to our experiment server via her/his web browser. We have stopped the video conference during the experiment session that was supposed to take no more than 40 minutes to answer the questionnaires and use the ILE. The video conference was resumed afterwards to discuss the experts' experience and hear their comments on the text of the experimental questionnaires and the ILE interface, which were used afterwards to enhance these texts. It was discovered that not all of them had finished the whole experiment; so based on where each of them has stopped in the experiment, we followed up by customising a continuation session and sending her/him its URL. The last response collected was on the 7th of September 2015. In addition to their answers to the experimental questionnaires, they answered an additional set of questions about the usefulness and expected use of the ILE. Table 5-1 summarises the dates and number of participants in our expert opinion poll and experiments.

We have started inviting participants to our experiments in UiA by the first third of 2015. The numbers of interested students was very humble by that time, and it was clear that recruiting candidates to participate in these experiments is not going to be easy. Meanwhile, the Information Technology Institute (ITI)[64] in Egypt was very supportive, and provided a great help in conducting our first experiment. Although by the time of this experiment, it was already the time off between intakes of students in the ITI, we were directed to conduct the experiment with the available students attending a course provided by the Education Development for the Universities of Egypt (EDUEgypt), which is one of the ITI external programmes. Accordingly, this first ex-

[64] http://www.iti.gov.eg

periment was conducted on the 13th of July 2015 in Cairo University, Egypt. The students available by that time were 14. By the end of the experiment, we could extract 11 completed and useful surveys. Table 5-2 shows the demographic data of these participants. Participants of our second experiment were volunteer students from UiA, on the 8th of September 2015. A couple of weeks earlier we started spreading the invitation for a gameplay session with free pizza in Grimstad campus of UiA. At the day of the experiment, 17 students showed up. Some faced technical troubles with the experimentation system, and by the end we could extract 10 useful finished surveys. Their demographic data are presented in Table 5-3.

Table 5-1: ILE Testing accepted surveys

Survey	Date	Participants	
Experts (online), Norway	02.09.2015/07.09.2015	7 invited	3 attended
EDUEgypt, Cairo University, Egypt	13.07.2015	14 attended	11 accepted surveys
UiA	09.09.2015	16 showed-up	10 accepted surveys

Table 5-2: Properties of participants whose surveys were accepted – EDUEgypt experiment

Property	Value	%
Age Group	18-24	91%
	25-34	9%
Gender	Female	64%
	Male	36%
Field of Study/Work (specialisation)	Pharmacy	100%
Knowledge of Math Modelling	Yes	0%
Knowledge of System Thinking/Dynamics	Yes	0%

Table 5-3: Properties of participants whose surveys were accepted – UiA experiment

Property	Value	%
Age Group	18-24	70%
	25-34	30%
Gender	Male	80%
	Female	20%
Field of Study/Work (specialisation)	ICT	30%
	Computer Engineering	20%
	Economics	20%
	Engineering	10%
	Mechatronics	10%
	Renewable Energy	10%
	Mechatronics	10%
Knowledge of Math Modelling	Yes	40%
Knowledge of System Thinking/Dynamics	Yes	30%

In all cases, the experimental session took around one hour. For 20 minutes, we gave a presentation to introduce the participants to the topic and the ILE. The presentation included the terms which the participants would experience during the intervention using the ILE. By the end of the presentation, the participants were asked to connect to our experiment server prepared earlier using their web browsers. In the case of EDUEgypt experiment, the text of the presentation and the ILE referring to the Norwegian case was changed to a general case to decrease any probable confusion; also participants were informed about an honorarium of 150 Egyptian pounds for the three highest-performing participants. In the case of UiA, in addition to the free pizza that was promised to everyone, the two highest-performing participants were promised a piece of Egyptian pharaonic collectable each.

The testing session started by a pre-test questionnaire that was consisted of 13 Likert 5-point scale items (strongly disagree, disagree, neutral, agree, or strongly agree).[65] These Likert items constitute multiple-item scale unidimensional construct as described in [17], designed to test the participants' knowledge about the system's causalities and possible policy options.

As described in the methodology section in Chapter 1, to build the statements of these Likert items, we have enumerated all model variables affecting the PWD employment rate. Possible changes in the values of these variables (for example: increase in, decrease in) were listed with different combination of possible resulted changes on the PWD employment rate (for example: increase after short delay, no effect, immediate decrease, etc.). These combinations constituted the statements of the Likert items. These statements were ordered according to their importance based on our knowledge of the system, what we wanted to show and test, and how much they are clear while using the ILE. Further, to suit the experiment duration, 13 of these statements were selected, keeping a balance between reversed and non-reversed statements, and mostly following the recommendations stated in [153]. Finally we polished the wording of the final statements, for example, participants were asked to report their level of agreement or disagreement with this statement: "Allowing PWD to combine both salary and welfare benefits in the same time, will immediately increase employed PWD".

[65] Only in the case of EDUEgypt, the Likert items consisted of 15 items; they were decreased afterwards to limit the questionnaire time. All the Likert statements used in the questionnaire are available at Appendix III

The Pre-test questionnaire was supposed to take no more than seven minutes; nevertheless it was left to the participants to take as much time as they needed. The participants were informed that they could ask us for help all the time; however we abstained from providing any help that could lead to biases in participant answers to the questionnaire.
For a participant, the intervention using the ILE or the gameplay started as she/he ended the Pre-test questionnaire, without the option of going back to the Pre-test. The gameplay was limited to 25 minutes. During these 25 minutes, participants were instructed to imagine themselves as decision makers responsible for creating a better situation for PWD, and ideally save public spending. After finishing the gameplay, all participants were automatically directed to the post-test questionnaire, without the option of going back to the gameplay session. This way we were sure that all participants had not used the ILE for more than the designated duration.
The Post-test questionnaire contained exactly the same Likert items used in the Pre-test questionnaire. However once finished answering how she/he thinks now about each statement after using the ILE (Post-test), the participant was asked to think back and report how much she/he agreed or disagreed with the same statement in the beginning of the session, based on her/his new understanding (Then-test).

5.3 Results and Discussion

The expert opinion poll provided us with a qualitative measure to assess the ILE, whereas the two experiments conducted with users from two different backgrounds and different geographical areas provided us with a quantitative measure. Our expert opinion poll results show that 67% of the experts think that the ILE achieves its intended goals.
We have applied α, β, and γ change analysis on the results of both experiments. 33% of the participants who were included the analysis of both experiments have shown a change in their understanding and perceptions of the system's causal relations and policy options. Moreover, 38% have redefined/recalibrated the standards they use to assess or evaluate these relations and policy options. In total, 71% of the participants have redefined certain knowledge as a result of using the ILE, achieving the ILE's intended goals. Table 5-4 and Table 5-5 show the final results of both experiments, for more detailed results please refer to Paper C.
From an internal validity point of view [160], to minimise testing validity threat, in all cases we have kept the questionnaires as merely Likert-scale items, and emphasised to participants that there is no right or wrong answer, they need to report what they think /believe. Furthermore, we made sure that all participants have fully understood the

questionnaire items since the pre-test, to account for any misunderstanding that could be automatically clarified during the post-test solely because of repetition. The same questionnaire was administered during pre- and post-test sessions to account for any instrumentation validity threat. Moreover, to eliminate experimenter bias, we have chosen the self-report questionnaire type, and kept the whole experiment computerised without any human rater interactions.

Table 5-4: α, β, and γ change results vs participants' properties – EDUEgypt experiment

	Knowledge of Math Modelling	**Knowledge of System Thinking and SD**	**γ Change**	**β Change**	**α Change**
P1	--	--	Yes	--	--
P2	--	--	--	Yes	--
P3	--	--	--	Yes	--
P4	--	--	--	Yes	--
P5[x]	--	--	--	--	--
P6	--	--	--	Yes	--
P7	--	--	--	Yes	--
P8	--	--	--	--	Yes
P9	--	--	--	--	Yes
P10	--	--	Yes	--	--
P11	--	--	Yes	--	--

[x] Participant removed because of showing no variance in Pre, Post, and/or Then

Table 5-5: α, β, and γ change results vs participants' properties – UiA experiment

	Knowledge of Math Modelling	**Knowledge of System Thinking and SD**	**γ Change**	**β Change**	**α Change**
P1	Yes	Yes	Yes	--	--
P2	Yes	--	--	--	Yes
P3	--	Yes	--	Yes	--
P4	--	Yes	--	--	Yes
P5	--	--	Yes	--	--
P6	Yes	--	--	--	Yes
P7	Yes	--	Yes	--	--
P8	--	--	Yes	--	--
P9	--	--	--	Yes	--
P10	--	--	--	Yes	--

To account for possible history validity threat, participants were asked to report their prior knowledge of mathematical modelling and system thinking and SD. Furthermore, the experiment time was limited to almost one hour, eliminating maturation or mortality validity threats. Nevertheless, we have to admit that the research suffered from selection validity threat due to the availability of participants as previously mentioned.

Furthermore, from the external validity perspective [231], although participants of both experiments were few and limited to university students, they were from two different backgrounds and different geographical areas. Yet, other experiments with different samples are necessary. Furthermore, longer periods between pre-test, treatment, and post-test should be examined. Other sets of questionnaire items describing the model's causal relations and policy option should be used in other experiments as well.

6 Part Conclusion

6.1 PWD Employment in Norway

In Norway, the unemployment rate of PWD is unchanged since 2000, and it is not as high as the neighbouring countries, in spite of repeated governmental promises. These low rates prevail even under the protection of anti-discrimination law and high governmental expenditure on PWD employment efforts compared to any other country. To increase PWD employment probability, the Norwegian government has introduced different vocational rehabilitation programmes. Unfortunately, these programmes suffer from many problems. On the contrary Telenor's small-scale Open Mind programme is a very successful rehabilitation programme.

6.2 PWD from Welfare to Jobs SD Model

We have developed an SD model titled "PWD from Welfare to Jobs". It incorporates the effect of possible decisions inspired by the attitudes of PWD towards employment, and of employers towards recruiting PWD, on transferring PWD from welfare recipients to jobs. The model was inspired by the idea of operationalising an Open Mind-like programme country-wide. The model is intended to help policymakers in taking more informed decisions, and to give them knowledge about the underlying structure of the system. Furthermore, policymakers, disability organisations, and individual citizens can use the model to understand how the suggested policies and decisions interact with the underlying structure of the system to influence system behaviour. Most importantly, the model enables applying different what-if scenarios, for different sets of policies aiming at comparison and achieving optimal policy design.

The model parameters were estimated to tune the results to historical data and constant ratios from the literature using an efficient Powell hill climbing algorithm [229], in addition to selecting a suitable time step to take care of integration error. The model passed boundary adequacy, structure assessment, and dimensional consistency validity tests. Moreover, the model proved its robustness under extreme conditions. Finally, the model successfully reproduced the historical behaviour of major PWD employment variables like the number of PWD using welfare, and the number of employed PWD. In view of this, the "PWD from Welfare to Jobs" SD model answers our second partial research question RQ 2 of how SD can be used in modelling and supporting decisions in a case to be promoted via eParticipation, particularly in the case of PWD employment. Further, in developing this model, our third partial research RQ 3 concerning the

core problems and issues regarding the SD implementation in the eParticipation area, particularly in the case of PWD employment, was answered.
Certain limitations should be taken into consideration when dealing with the model. Both samples of PWD and employers are not representative, apart from that the attitudes might change over time. Furthermore, the current structure of the model does not take into account the effect of sudden crises. One example is the late drop in oil prices that led to a decrease in the available job vacancies in the Norwegian labour market [232]. Others examples could be the refugee movements or Brexit.

6.3 PWD from Welfare to Jobs SDBILE and eParticipation

The PWD from Welfare to Jobs SD model is intended to support policymakers and disability organisations in policy design and decision-making. In general, this model is supposed to be able to change how its users think and take decisions. It is intended to change their understanding, perceptions, and accordingly mental models and attitudes.
Furthermore, the envisaged approach is intended to render the decision-making processes easier to comprehend. This way, the ILE can promote eParticipation by helping ordinary citizens to understand the policymaking process and participate in politics [9]. This will consequently support more targeted discussions between individual citizens, disability organisations, and policymakers. To test whether this model is really capable of doing what it is intended to or not, we have further developed a generic ILE client-server framework, which we used as a base in creating the "PWD from Welfare to Jobs" SDBILE, and used it conducted two experiments with people using this ILE, as well as an expert opinion.
67% of the expert of our expert opinion poll thinks that the ILE achieves its intended goals. Furthermore, we have conducted α, β, and γ change analysis on the results of the two experiments, on the individual level. 33% of the participants who were included in the analysis of both experiments have shown a change in their understanding and perceptions of the system's causal relations and policy options. Meanwhile, 38% have redefined/recalibrated the standards they use to assess or evaluate these relations and policy options. In total, 71% of the participants have redefined certain knowledge as a result of using the ILE, achieving the ILE's intended goals, and consequently answers our fourth partial research question RQ 4 of how SDBILE can be used in promoting eParticipation, particularly in the case of PWD employment, and further the fifth partial research question RQ 5 focusing on the impact of using SDBILE in promoting eParticipation, particularly in the case of PWD employment.

We have to admit that the research suffered from selection validity threat, due to the availability of participants. Although participants of both experiments were from two different backgrounds and different geographical areas, they are still few and limited to university students. Other experiments with representative samples are very necessary. Furthermore, longer periods between pre-test, treatment, and post-test should be examined. Other sets of questionnaire items describing the model's causal relations and policy option should be used in other experiments as well.

Part III. eAccessibility

7 Introduction

7.1 eAccessibility

eAccessibility refers to the ability of all people to use a website irrespective of their disabilities or the client devices they use to access the Internet [3]. Accessibility[66] is an important aspect of websites in general and of public websites in particular, to be able to serve all citizens equally. For example if a webpage is designed to retrieve user input merely through mouse clicks, then persons with disabilities preventing them from using a mouse or people using e.g. mobile phones to browse the Internet, will not be able to use this webpage.

7.2 Measuring eAccessibility

Accessibility of a website can be assessed in terms of compliance with a set of accessibility metrics defined by guidelines like the Web Content Accessibility Guidelines (WCAG) 1.0 and 2.0 [3], and ISO 9241-20 [233].[67] It may be evaluated quantitatively, for more information see [235]. Many researches and projects have addressed evaluation of public websites accessibility, for instance, see [236] and [237]. In addition, governments carry out benchmarking and pass laws to increase public websites accessibility. In Norway, the Norwegian Agency for Public Management and eGovernment (DIFI) used to evaluate governmental websites annually [238]. For a long period, web-accessibility indicator (tilgjengelegheit) was one of three indicators used to be measured by DIFI annually to encourage governmental agencies to increase the accessibility of their websites.

7.3 eAccessibility of Norwegian Municipal Websites

The United Nations has been issuing the eGovernment Development Index (EGDI) since 2003. EGDI for Norway as both value and rank has been very high since then [21]. However, according to DIFI, from the eAccessibility perspective, the results were not as high as Norway's EGDI. Both indicators are shown in Table 7-1.

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[66] We will use the terms eAccessibility, Web-Accessibility, or Accessibility interchangeably to refer to the same thing.

[67] A comparison of WCAG 1.0 and 2.0 indicates that evaluation results from using WCAG 1.0 will still be relevant to a large extent for WCAG 2.0 [234].

Table 7-1: Norway EGDI and DIFI Tilgjengelegheit (web-accessibility indicator)

	United Nation's eGovernment Development Index (EGDI) - Norway		DIFI's web-accessibility indicator (Average score of public websites)	
	Value	Rank	All	Municipal only
2016	0.8117	18	--	--
2015	--	--	--	--
2014	0.8357	13	--	--
2013	--	--	58.86%	60.26%
2012	0.8593	8	--	--
2011	--	--	61.15%	62.21%
2010	0.8020	6	64.75%	66.20%
2009	--	--	63.56%	64.08%
2008	0.8921	3	54.03%	51.99%
2007	--	--	51.36%	48.49%
2006	--	--	68.99%	66.89%
2005	0.8228	10	64.54%	60.74%
2004	0.8178	10	62.82%	59.11%
2003	0.7781	7	-	-

Several factors from inside the municipalities could be held accountable for this situation. A public website, as an Information System, consists of people (like web-masters, editors, developers, etc.) and procedures, besides telecommunications, hardware, software, and data [36]–[38]. When considering the planning and management processes of such a system, several ways could be proposed to enhance the eAccessibility like consulting experts, replacing the Content Management System (CMS), recruiting, and training workforce. Nonetheless, factors from outside the municipalities should be taken into consideration when enumerating factors affect eAccessibility as well, for example factors related to the economy, pressure from the service receivers, and the legal system.

The economy needs to be in a good shape, so that the municipalities are able to finance or priorities financing enhancing their eAccessibility. For example one of the challenges that cannot be ignored could be the recent peak of refugees coming to Norway. It is very probable that some of the municipalities might stop focusing or perhaps suspend spending on their websites' accessibility to allow for more resources to be spent on supporting these refugees.

The municipalities should be interested in satisfying their citizens, i.e. the receivers of their services including the websites'. Anecdotal evidence indicated that immediately before the annual public websites assessments used to be done by DIFI, some munici-

palities used to rush to consult their vendors to fix website problems, aiming at getting a better ranking in this assessment. Moreover, the legal system should enforce or at least support using eAccessibility measures when designing public websites. In Norway conforming to eAccessibility measures is a legal obligation for new websites since 2014 [239].

7.4 eAccessibility of Norwegian Municipal Website SD Model

Motivated by the decision-making challenges in the context of planning and managing eAccessibility, and trying to find how SD can be used in modelling and supporting decisions in the case of eAccessibility, we have explored different factors and cause-effect relations governing the processes that have an impact on the accessibility of Norwegian municipal websites. The results we came up with are based on a set of interviews with web-masters and web-editors from different Norwegian municipalities in addition to related literature. The identified structure has subsequently been compiled into "*eAccessibility of Norwegian Municipal Website*" SD model.

This SD model includes factors –other than just technical– affecting the accessibility of an eGovernment website. The model provides its users with the detailed costs of their decisions, aiming at supporting them to find a better economic way in planning and managing their public website for a better eAccessibility results. Since conforming to eAccessibility measures is a legal obligation in Norway, in addition to the European directive that has an extended scope and also covers mobile apps recently approved [240], it was taken for granted that this is a target for the municipality. For the same reason, the municipality interest in satisfying its citizens concerning eAccessibility was taken for granted as well. Accordingly, the last two factors were considered exogenous to the model, and more focus was devoted to the municipality website internal processes.

The SD model is intended to help the eGovernment websites managers to take more informed decisions, by giving them knowledge about the underlying structure of their systems, and about how their actions impact the system and the results. More importantly, an array of instances of this model applied to several municipalities, or an aggregate nation-wide application of the model that covering the granularity of the municipalities should be able to help senior decision makers to think about different ways to enable governmental organisations to enhance the accessibility of their eGovernment websites and to find more efficient policies. Generally speaking, users of this model will be able to conduct what-if scenarios to compare the impact trends of different proposed solutions have on accessibility.

This model was built to help finding an answer to our sixth partial research question RQ 6 of how SD can be used in modelling and supporting decisions in the case of eAccessibility. Furthermore, to build and while building this model we have answered our seventh partial research question RQ 7 about the core problems and issues regarding this SD implementation.

7.5 eAccessibility of Norwegian Municipal Website SDBILE

From another angle, the model is supposed to be able to change how its users think and take decisions. It is allegedly capable of changing their understanding and perceptions about the system's causal relations and policy options, in other words changing their mental models. Based on that, we can expect that by using this model, the websites' managers and decision makers will be able to take more informed decisions. To find whether this SD model is really capable of changing its users' understanding and perceptions about the system's causal relations and policy options as promised or not, we have developed "*eAccessibility of Norwegian Municipal Website*" SDBILE, to be an interface for the model. We have also conducted an experiment with users to understand the effect of using this SDBILE and accordingly the SD model on them, in order to ultimately find an answer to how SDBILE can be used in changing eGovernment managers' mental models in the case of eAccessibility.

Mainly, we wanted to know to what extent the SD model is really capable of doing what it promises including changing its users' understanding and perceptions of the system underlying structure and policy options. To do this, we have updated the model and developed an ILE with the model in its core, prepared a testing tool, conducted an experiment with people using this ILE. This effort was to answer our eighth partial research question RQ 8 of how SDBILE can be used in changing eGovernment managers' mental models in the case of eAccessibility, and our ninth partial research question RQ 9 concentrating on the impact of using SDBILE in enhancing the eAccessibility of eGovernment websites.

7.6 Part Structure

The remainder of this part is organised as follows: Chapter 8 –the next chapter– outlines the information sources used in building "*eAccessibility of Norwegian Municipal Website*" SD model, and explores its background and structure, in addition to its behaviour when applied to two different Norwegian municipalities. Chapter 9 introduces the "*eAccessibility of Norwegian Municipal Website*" SDBILE built based on the model

presented in the previous chapter and the experiments conducted using it. Chapter 10 concludes this part.

8 eAccessibility of Norwegian Municipal Website SD Model[68]

8.1 Background and Information Sources

8.1.1 Background

To understand the system structure inside Norwegian municipalities' websites, we have conducted a set of personal interviews with web-editors and web-masters from four different Norwegian municipalities, namely *Hole*, *Holmestrand*, *Grimstad*, and *Trondheim*. The group spans both small and large municipalities.[69] Figure 8-1 shows the subsystems diagram of the model constructed based on these interviews. In the figure, the rounded edge rectangles present the SD model subsystems, which are groups of model variables, while the arrows show the directions of flows of information, money, people, etc. The main block is the website, in which components of webpages: articles and templates are produced. A template is the base code for an article, and together they provide the webpage displayed in the Internet browser when browsing a website. Accessibility barriers can be part of the article, template, or even the technology used in terms of CMS.

Editors and main editors are the workforce responsible for editing the webpages and publishing them on the municipal website. They have varying levels of experience; accordingly their productivity and the accessibility of the webpages they edit vary as well. Regularly, a municipality is required to publish its news, new instructions, new decisions, etc. on its website to the public. The website workforce will work to fulfil this need. Webpages will be produced, with certain level of accessibility measured in UWEM score.[70] The rate of producing these webpages will be affected by the experience and productivity levels of the workforce. The level of accessibility of these webpages will also be affected by the work quality and experience of the workforce.

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[68] The model (Vensim file format) is available at: https://forio.com/app/ahmedg/eaccessibility/helper/

[69] Trondheim is an example of a large municipality, where the number of website editors exceeds 500, while Hole, Holmestrand, and Grimstad are examples of smaller municipalities employing less than 20 active editors.

[70] In the first version of the model –described in this chapter– the UWEM score was used as an indicator of website accessibility. However, in the second version –described in following chapter– the UWEM score was replaced with "Site Score" as defined in [241].

Furthermore, consultancies with technology providers and the technology itself will have different effects on the accessibility level of these webpages as well.

8.1.2 Information Sources

In addition to the personal interviews mentioned earlier, we have arranged another personal interview afterwards with Grimstad followed by a phone interview with Trondheim. Additionally, emails with both municipalities provided us with more information and certain data items. The interviews were accompanied by literature review on management applications from areas possessing similarities to website development and management, such as software development, web maintenance and online community networks [11], [123], [242]–[244], in addition to the SD molecules [212].
Furthermore, additional data items could be collected from Norwegian sources about universal design and DIFI web-quality assessment like [245]–[247]. Other partial information sources will be mentioned in the following subsections.

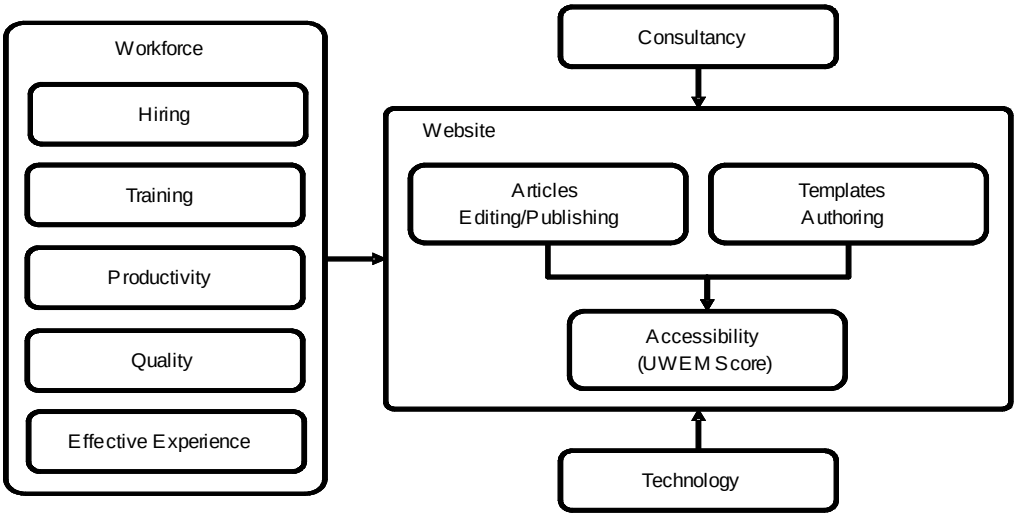

Figure 8-1: Model subsystem diagram

8.2 eAccessibility of Norwegian Municipality Website

8.2.1 Articles, Templates, and Accessibility Subsystems

In the model, the process of editing and publishing articles, and that of authoring templates are depicted in two identical subsystems. Figure 8-2 compiles the cause-effect relations governing articles editing and publishing process. [71] The required articles are

[71] Only one instance of identical subsystems will be displayed to save space.

edited by editors and main editors,[72] and transferred to published articles stock. Meanwhile, accessibility barriers introduced with every newly added article cause failures of UWEM accessibility tests.[73] Both articles failed tests and all applied tests are accumulated in two different stocks, in coflow dynamics with article publishing rate [123]. The published articles can go through an enhancement process to remove some of their existence accessibility barriers.[74]

UWEM tests can detect barriers in articles, templates, or barriers caused by CMS limitations. In order to compute the values of failed tests and all applied tests related to article, template, and CMS, we need to classify the applied UWEM tests according to their most frequent source of failure. Therefore, we have inspected three to five randomly selected webpages from seven Norwegian municipalities as an example,[75] with the help of eGovMon page checker.[76] Based on these inspections, barriers were classified to be related to either articles or templates and CMS. However, these inspection results were not very satisfactory. Obviously, the number of inspected pages was too few, in addition to the human error in classification. For more information please refer to Paper K.

For better classification, we have administered a 7-point Likert type scale questionnaire to eGovMon project team experts on the former results [249].[77] In addition, the questionnaire contained objective and subjective measures of expertise of the respondent [250]. These two measures of expertise were used as weights to the responses of the respective respondent following the practice of [250]. For more information, please refer to the questionnaire in the appendix.

Classifying tests failures to CMS limitations requires very thorough knowledge about the CMS. Furthermore, in Norwegian Public Sector there are about 57 different CMSs in use [245]. Consequently, the tests failure due to CMS was not part of the question-

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[72] Different types of web-editors; refer to Workforce Subsystem subsection.

[73] The accessibility tests that can be automated represent about 20% of all the conceivable tests [248]. Only this set of automated UWEM tests are considered in the model.

[74] Templates are authored and can be enhanced by vendors' developers. However in certain municipalities, main editors are able to author templates as well e.g. Hole municipality.

[75] Classification would have been easier if we had access to templates.

[76] http://accessibility.egovmon.no/en/pagecheck. Since this work was carried out, the eGovMon checker has been re-implemented and the new checker "the European Internet Inclusion Initiative page-checker (EIII Page Checker)" is available at: http://checkers.eiii.eu/en/pagecheck2.0

[77] Midpoint was removed to have respondents to choose one side (agree or disagree).

naire. However, classification was merely possible in the case of EPiServer™ CMS, because of the availability of a report evaluating EPiServer™ compliance to WCAG 1.0 and the Authoring Tool Accessibility Guidelines (ATAG) 1.0 [251] by the time of building the model, which we used in the final classification as our best guess.

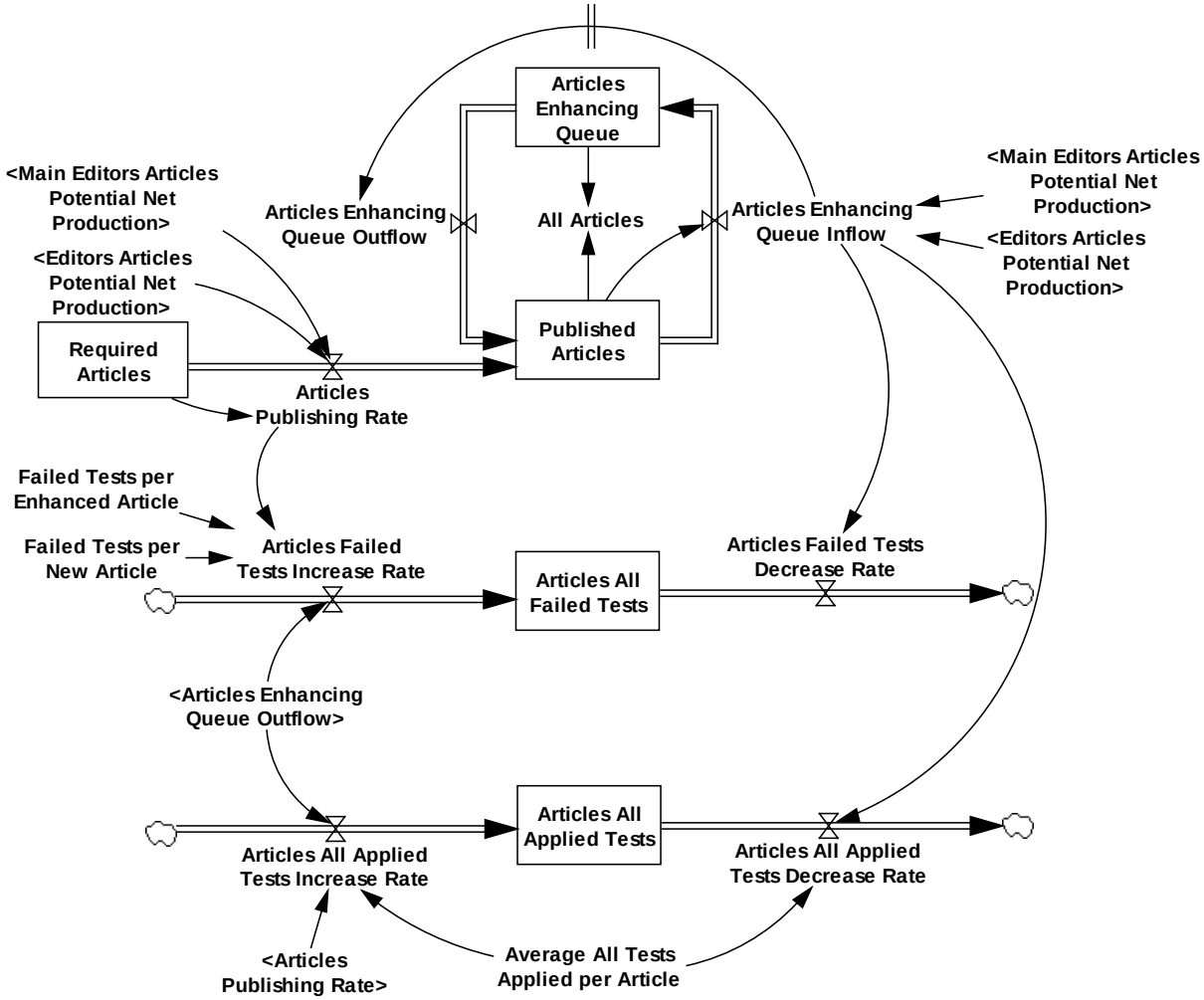


Figure 8-2: Dynamics of articles editing/publishing process

The database of eGovMon project [41] keeps records of the barriers identified in the checked Norwegian municipal websites.[78] We have used the final tests failure sources classification criterion with the data extracted from this database to compute values of averages of failed and all applied tests related to articles, templates and CMS separately, which were used afterwards in tuning the model.

[78] eGovMon tool tests webpages of Norwegian public websites against the set of fully automated UWEM tests.

Lastly, in the accessibility subsystem of the model, the UWEM score is calculated as the summation of averages of failed test due to articles, templates, and CMS divided by the summation of averages of all test applied to articles, templates, and CMS [252].

8.2.2 Workforce Subsystem

The main editors are more experienced and qualified so that in general their task is to supervise and train the editors. The dynamics of website workforce depicted in Figure 8-3 is very similar to workforce dynamics presented in [242], [11], and [123]. The main editor job requires qualified people who have certain knowledge about web editing and management. They are hired and leave through a normal hiring process, for example announcing a vacancy. The required number of main editors is decided by the municipality based on needs. In the model, the average hiring or firing time constant equals 11 weeks, which is the average of hiring period suggested in [123] for a senior technical person, and one month firing notice. In general, civil servants leave rate is from 5% to 10% [123]. However, through the interviews it was clear that main editors are not changing jobs very often.

Editors are workforce from different municipal departments who have been trained to be web-editors. The policy –especially in big municipalities– is to have at least two or more editors in a department, so that at least an editor capable of publishing material related to that department is available all the time. Furthermore, editors will not be busy with the website all the time. They work in the website as part-timers, while they are still working in their original jobs with reduced work percentages.

It was obvious through the interviews that any employee who is capable of using the Internet and computers will be qualified to be an editor. Consequently, their hiring process is just controlled by the availability of qualified employees in a department. Also, they will leave normally, or by being transferred to another work or department whenever they are not needed anymore. Therefore, the time constant to add or transfer an editor is kept as short as one week. Moreover, in the interviews, it was very clear that editors leaving rate is much higher than main editors'. Although in the normal case the leave rate would be equal to 10% [123].

The editors' gap can be positive or negative according to the management policy. When the editors gap is positive implying that the required editors are more than both available editors and new editors –newly recruited editors– together, only new editors adding rate will have a positive value to close the gap. On the contrary, when the gap is negative, referring to excess of editors and new editors together, editors leave and transfer rate will have a positive value. Additionally, new editors need an assimilation period

before they are capable working editors. This assimilation period includes training by main editor(s) who have to undertake such training tasks beside other original tasks [123], [242].

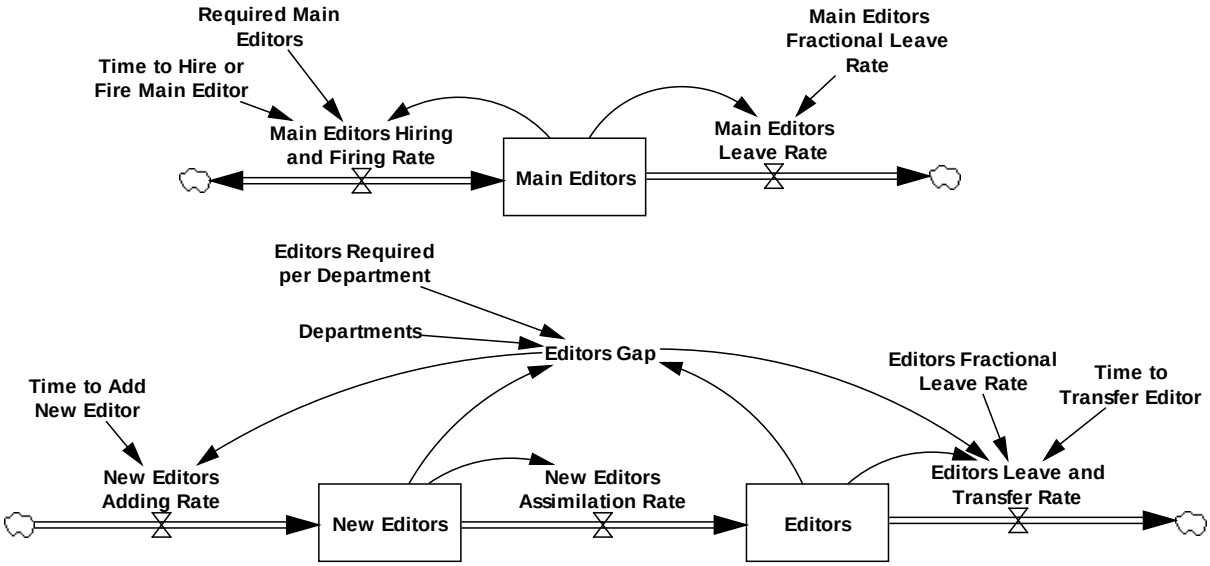


Figure 8-3: Website workforce dynamics

Moreover, at least one main editor should be supervising and responding to questions of editors in a certain department, constituting staff communication overhead inside this department. This overhead is calculated in the model using SD graphical function version of Brooks' Law [123], [242], however taking team partitioning into consideration [123]. Generally, as received through the interviews, editors from one department do not need to interact with editors from other departments to publish articles.

Editors' and main editors' overall potential net production is computed by subtracting all the overheads from the overall productivity, taking time fractions dedicated to website into consideration. Furthermore, main editors will divide their time between article production and template production according to management decision.

8.2.3 Training Subsystem

Both editors and main editors can take training to enhance their performance. According to the interviews, twice or thrice annually, training is provided to groups of around 20 editors for three to five hours sessions. Furthermore, main editors take training supplied by the CMS vendor. Unfortunately, training –especially to recently hired editors– is limited to providing knowledge about how to edit and publish an article using the publishing tools. Therefore, editors hardly know about HTML. Even though HTML is the language of the techniques provided by the World Wide Web Consortium (W3C) to ensure that webpages conform to their WCAG [253].

According to experts, examples of the positive effect of HTML knowledge on website accessibility exist. Our interviews results are consistent with that. Out of the interviewed municipalities, only the workforce in Hole municipality had good knowledge of HTML and WCAG, which enabled them not only to edit/publish articles but also create templates. This knowledge was reflected in their successful ranks in the annual public websites assessments by DIFI [238]. In the model, training is suggested for both editors and main editors (separately in articles and templates). Decision switches are provided to enable or disable each type. Training duration, frequency per year, and fraction of employees to be trained are left to model user as well.

8.2.4 Effective Experience Subsystem

Workforce effective experiences is measured in person-weeks [11]. The model accumulates all effective experiences of all editors and of all main editors (separately in articles and templates) in different stocks, similar to the structure shown in Figure 8-4.

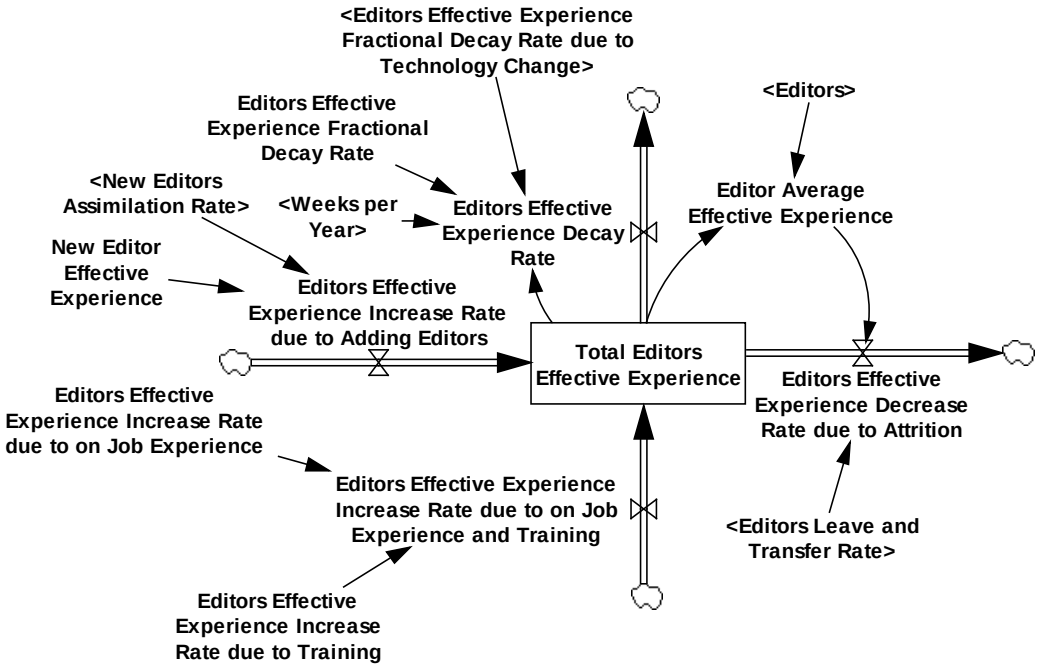


Figure 8-4: Editors effective experience

Effective experience stocks are increased by hiring new workforce members and decreased by attrition. Furthermore, these stocks are increased by on job experience and training. The effective experience increase rate due to training value was estimated so that one day of training would cause an average of 9% increase in both productivity and quality as estimated in [254]. In general, the effective experience is decreased by regular experience decay rate which equals 10% annually as suggested in [11]. In this subsystem, the rest of the parameters were arbitrary chosen to reproduce the historical

UWEM score and number of webpages in the website computed and maintained by the eGovMon project [41].

8.2.5 Workforce Productivity and Work Quality Subsystem

Editors and main editors effective experience (both in articles and templates separately) affect the productivity and quality of the editors and main editors (both in articles and templates separately) respectively. Non-linear SD graphical functions for both productivity and quality were adapted from the productivity and quality SD molecules [212].

8.2.6 Consultancies Subsystem

Municipalities consult their website technology vendors or experts to solve their websites accessibility issues. As mentioned earlier, anecdotal evidence showed that just before the annual public websites assessments used to be done by DIFI, some municipalities used to rush to consult their vendors to fix website problems, aiming at getting a better ranking. This is very obvious in the historical data chosen to calibrate the model in the model testing and validation section; which can be seen in Figure 8-5.
In the model, a decision switch is provided to control the consultancy process. Moreover, consultancy start time and duration are provided in addition to consultancy frequency per year. In reality not all the consultancy time is devoted to solve accessibility issues in templates, so that the model is equipped with another decision variable to control the consultancy time fraction that will be dedicated to templates and templates enhancement in terms of accessibility.

8.2.7 Technology Subsystem

Updating the website technology or the tool used to build and publish the website (CMS), enables the website to satisfy its users' evolving needs, as well as to comply with the up-to-date IT security requirements. Furthermore, experts in the accessibility field claim that using the appropriate web technology greatly affects accessibility.
The technology update process is reflected in the model as a decision switch that is provided to enable the technology update, in addition to the possibility of choosing the time to start the process. The primary expected effect from updating the technology is removing the barriers related to the CMS totally. However as a side effect, this will disturb the editors' and main editors' learning curves. This was incorporated in the model through decreasing the effective experience steeply, to reproduce behaviour similar described in [255].

8.2.8 Costs Subsystem

In the model, the accessibility related spending on wages, training, consultancies, and technology update, in addition to the overall spending are calculated for the whole simulation period and for every quarter separately as well.

8.3 Model Validation and Results

To validate this model, we have used the same set of tests we used in Section 4.4 of this thesis. For more information about the tests, please check that section. *Boundary Adequacy* was tested through presenting the model to experts in website accessibility in at least four different occasions related to the eGovMon project. In addition to being presented to representatives from municipalities that were involved in the personal interviews after giving a brief introduction on Stock and Flow diagram notation in all cases. *Structure Assessment* test was conducted through exposing the model in different development stages to criticism by experts in SD in two different occasions.

Dimensional Consistency was fully assured using the unit check feature of Vensim DSS [226]. Model equations including their measurement units are included in Appendix II. While *Parameter Assessment* was taken care of using data retrieved from the eGovMon. Furthermore, we used parameters values whenever available from the municipalities. Other parameters were taken from different text books and papers. Finally, the rest of the parameters were estimated to tune the results to historical data when the model was fed with data from Grimstad and Trondheim municipalities separately using an efficient Powell hill climbing algorithm [229]. The rationale behind selecting and estimating different parameters is shown in the description fields of the respective parameters, included in the model documentation in Appendix II.

The model has been tested under *Extreme Conditions*, and problems were taken care of the same way mentioned Section 4.4 . The model was tested for *Integration Error*. Different time step values (numerical integration step sizes) and different numerical integration methods (Euler and Runge-Kutta) were tested. The combination of *Euler* method and time step of 0.0625 was found suitable, as by decreasing the time step and/or using different method, the behaviour of model was found to be insensitive to such changes. In the same time, the time step was not very small rendering the numerical integration process slow. Moreover, *Sensitivity Analysis* was applied using Vensim DSS. The results were totally agreeing with experts' claims and DIFI's [245]. The detailed sensitivity analysis report is included in Appendix II.

Behaviour Reproduction was tested using data from Trondheim municipality, as shown in Figure 8-5. An additional test that we have used to test this model is the *Family*

Member [11], [224], which is a test that aims at answering whether the model can "generate the behavior observed in other instances of the same system" [11]. So that in addition to the case of Trondheim, we have tested the case of Grimstad municipality. R^2 for Website UWEM Score All Webpages series for the cases of both municipalities are reported in Table 8-1 and Table 8-2.

Table 8-1: R^2 —Trondheim

Variable	R^2
Website UWEM Score	0.95678
All Webpages	0.90110

Table 8-2: R^2 —Grimstad

Variable	R^2
Website UWEM Score	0.91069
All Webpages	0.90078

Even after all the precautions that have been taken to guarantee validity of the model, it is still prone to certain validity threats [231]. From *Population Validity* point of view, the interviewed municipalities are few, although they range in size suitably.[79] From *Ecological Validity* point of view, time is a very important factor as technology in such a field is changing fast. Furthermore, because of information availability about accessibility issues of EPiServer CMS, it was taken as a sort of convenience sample to represent accessibility issues in CMSs in general, which is a very limiting factor. EPiServer CMS is just one of many CMSs used by Norwegian municipalities; accordingly, the results are unlikely to be representative of all other CMSs.

[79] From population point of view: Trondheim is one of the big 10, Grimstad is more than 10,000 inhabitants, while Hole and Holmestrand are less than 10,000 inhabitants [245].

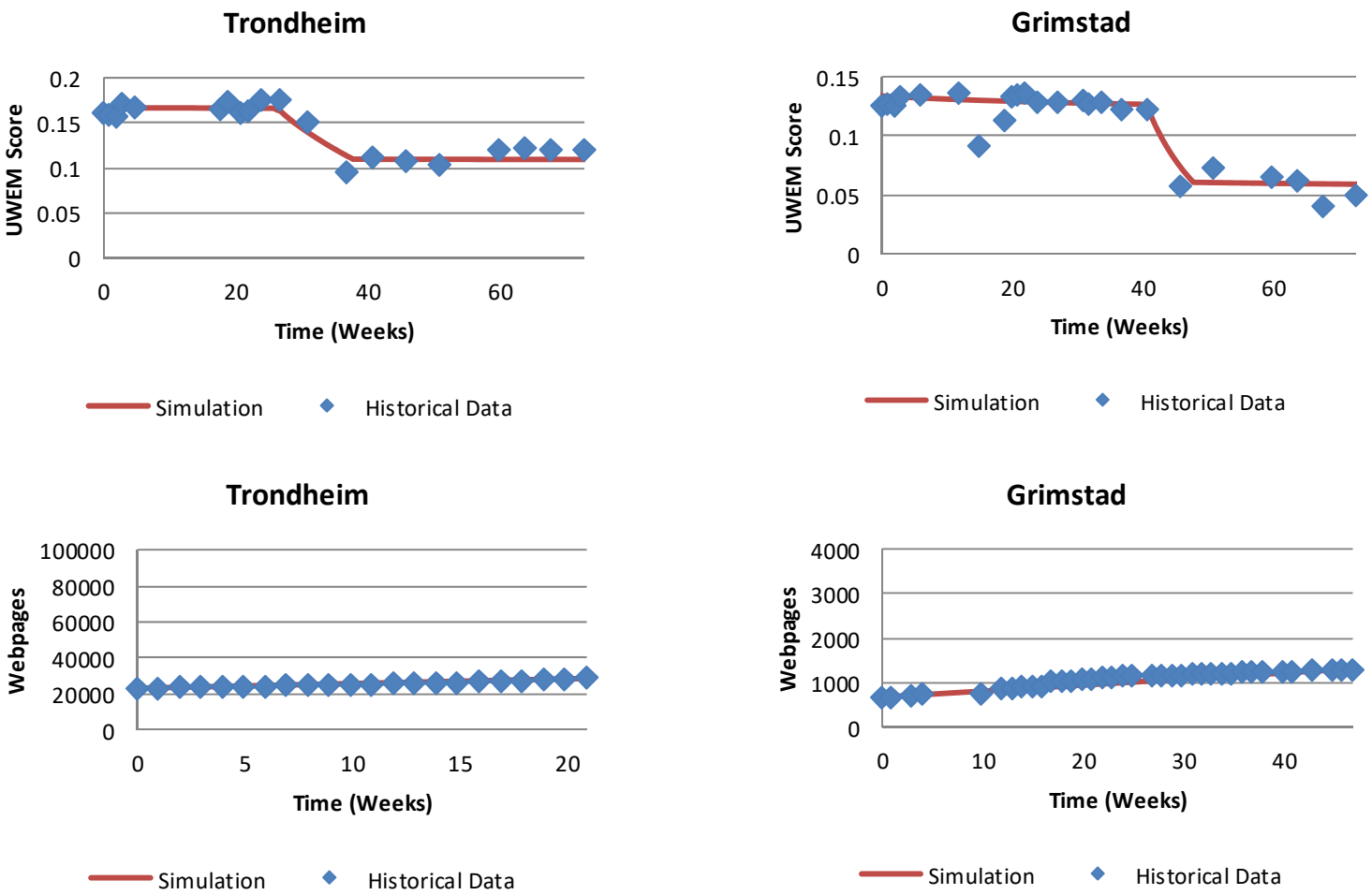


Figure 8-5: Model behaviour for Grimstad and Trondheim municipalities

9 eAccessibility of Norwegian Municipal Website SDBILE

As stated previously in Chapter 1, we have used our generic ILE framework to build our SDBILEs. In this chapter we present the "eAccessibility of Norwegian Municipal Website" SDBILE, and the experiment we have conducted using it. More information about this chapter is available in Paper H: "*Experimentation with a System Dynamics Based Interactive Learning Environment: A Case* Study of Accessibility of Norwegian Municipalities Websites".

9.1 ILE Interface

This ILE is similar to the ILE we have presented in Chapter 5. It is based on the same technology and uses our same base code. It has four tabs: Home, Instructions, Control Panel, and Dashboard shown in Figure 9-1, Figure 9-2, Figure 9-3, and Figure 9-4 respectively. The Home tab gives a brief introduction to the topic of the ILE, including basic knowledge about website's accessibility and policy options. The Instructions tab puts the user in the context of using the ILE, including specific instructions to guide her/him through the simulation or gameplay. The Control Panel tab has all policy options provided by the ILE to control the simulation, in addition to simulation time progress buttons.

The simulation starts at year 0 and can be progressed year by year or to the end of the simulation at year 6. In the Control Panel, the user can reset the simulation and start a new scenario from the beginning, whether the current scenario reached the sixth year or not. Policy options available are represented by graphical control elements for managing workforce, managing workforce time, training workforce, consulting vendor and upgrading website technology (CMS). The Dashboard tab has charts showing over time behaviour of important simulation variables, needed by the user to stand on the results reflected by her/his policies entered to the Control Panel.[80]

In the first version of the model which was described in the last chapter, we used the UWEM score as an indicator of website accessibility. However, in the second version, which we used inside this SDBILE, the UWEM score was replaced with "Site Score" as defined in [241]. This "Site Score" was implemented in the model and shown on the charts of the SDBILE interface under the name "Website Accessibility Indicator". Fur-

[80] The ILE is available at: https://forio.com/app/ahmedg/eaccessibility/eaccessibility.html, its model (Vensim file format) in addition to other supporting files are available at: https://forio.com/app/ahmedg/eaccessibility/helper/

thermore, in the second version WCAG 1.0 evaluation results collected from the eGovMon project were taken as a proxy for WCAG 2.0. There were no available time series of results based on WCAG2.0, in addition a comparison of WCAG 1.0 and 2.0 indicates that evaluation results from using WCAG 1.0 will still be relevant to a large extent for WCAG 2.0 [234]. The next step for this development is to upgrade the current implementation to adapt to the evaluation methodology to be used for the European directive on the accessibility of the sector bodies' websites and mobile apps. The EU study "Monitoring methodologies for web-accessibility in the European Union" is expected to form the basis for this methodology. The results of the proposed European web accessibility monitoring methodology are expected to combine the results of both manual and automatic accessibility assessments. It will include expert assessment and self-declaration in addition to facilitating involving users. Furthermore, it will follow the sampling approach of the Website Accessibility Conformance Evaluation Methodology (WCAG-EM) [256], [257].

Accessibility of a webpage can be assessed in terms of compliance with a set of guidelines like for example w3c technical specifications and guidelines. Consequently, accessibility of a webpage can be evaluated quantitatively. Accessibility is an important aspect of websites, so that they are able to provide users with good service.

Usually, a website will be built by web editors, developers, etc. (people component) besides software, hardware, data and internet (computer component). Considering the management process of people component of a website, many ways could be proposed to enhance accessibility of webpages, like training people, recruiting new ones, replace the current Content Management System CMS and consulting experts. These measures range from slow to immediate effect, from cheap to expensive and from short term to long term from sustainability point of view. This diversification and contradiction of properties make the decision of adopting only one way to do the task a challenge. More challenging is how to prioritise limited resources to achieve the best effect.

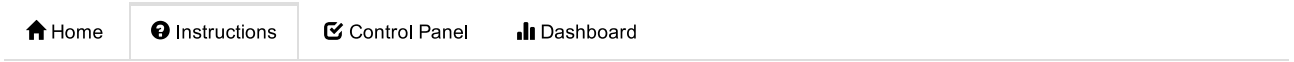
In your website, different departments need to publish articles related to their work on the website. Each department will assign one or more of its regular employees to be web editors. The website has also main editors who are totally dedicated to run the website. They may also publish articles. Main editors are also responsible for training the departments' new editors when they are assigned to the web editing task.

The CMS runs on your web server and replies to users browsing your website with the required webpages. These webpages are based on the templates that were built by the developers of a certain vendor (usually the vendor which sold the CMS to you). An editor selects one of these templates and adds her/his content required by the department into an article. Finally, an articles based on a template composes a webpage in the website.

Accessibility issues of such a website can be the result of CMS inability to follow certain accessibility guidelines, accessibility issues in templates, or accessibility issues in articles edited by editors. Accordingly, one accessibility issue in the CMS can affect many templates and consequently all articles based on these templates, while accessibility issues in one template will affect all the articles that are based on this specific template. Only accessibility issues of an article will affect this specific article.

Upgrading or replacing the CMS might solve accessibility issues that affect many webpages. Fixing template's accessibility issues can solve accessibility issues of all webpages that are based on this template. Fixing article's accessibility issues will solve accessibility issues of this specific article. Moreover, editors and main editors can be trained to produce more accessible articles. Although editors do not generally author templates, there is a possibility to train main editors to produce higher accessibility templates, or fix issues in the existing templates. Otherwise, you can consult certain vendor to author new needed templates or fix the accessibility issues in old ones.

Figure 9-1: ILE Home tab



Imagine yourself as the decision maker in an organisation. You would like to provide your users with better service through a high accessibility website, and ideally decrease spending. There are 5 departments that need to publish articles related to their work on the website. You will have the opportunity to go through a simulation for 6 years. During this simulation, you will be able to take decisions on spending related to the website management.
The organisation management board wants to improve the website accessibility, with efficient budget You can manage the website through the combination of one or more of the following options:

- Hire or fire employees by deciding the number of main editors; in addition to the number of editors you want per department.
- Divide editors and main editors time between editing newly required articles and fixing accessibility issues of existing articles.
- Decide the time fraction (percentage of time) the editors and main editors will devote to enhancing existing articles, noting that the rest of their time will be devoted to editing new required articles.
- Decide if main editors should devote certain amount of their time to author templates, while the rest of their time will be devoted to articles.
- Decide time fraction that main editors should devote to enhancing existing templates vs. producing newly required templates.
- Decide to train your workforce, and then you can decide the number of training hours every this year.
- Consult your vendor to help with your templates, and then you need to decide the consultancy duration in hours, and the vendor time fraction devoted to enhancing templates vs. authoring newly required templates.
- Upgrade your CMS. This can be done only once during the simulation run.

How to get started?

1. Select the Control Panel tab from the upper tab list to enter your decisions.
2. Make your decisions for the workforce, workforce time management, workforce training, consulting your vendor and updating your CMS.
3. After entering your decisions, you can run the simulation for only 1 year ahead by pressing "Progress 1 year" button, or to the end of simulation by pressing "Progress to the end" button. You will be automatically transferred to the Dashboard to see the results of these decisions.
4. At any time during the simulation, you can press "Reset simulation" button in the Control Panel to restart the simulation, and start a new scenario again from beginning.
5. To see the results of your decisions at any time, select the Dashboard tab from the upper tab list.
6. In the Dashboard , you can press "Legend/Scenario Selector" button to select scenarios that will appear on charts.

Good luck in helping your website users and managing the budget wisely!

Figure 9-2: ILE Instructions tab

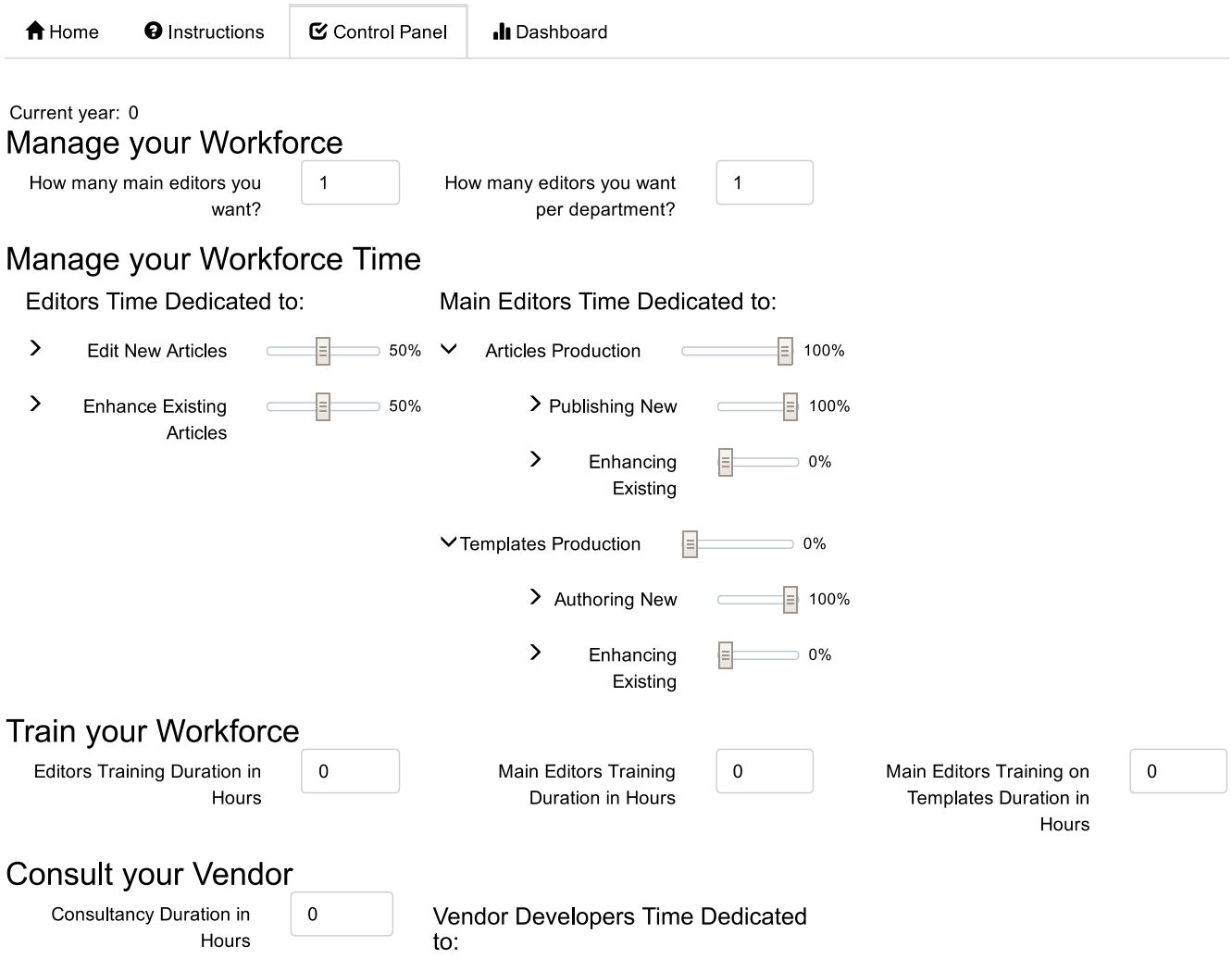


Figure 9-3: ILE Control Panel tab

Figure 9-4: ILE Dashboard tab

9.2 Experimental Procedure

We have conducted our experiment with volunteer students at UiA, on the 8th of September 2015. A couple of weeks earlier we started spreading the invitation for a gameplay session with free pizza in Grimstad campus of UiA. At the day of the experiment, 17 students showed up.[81] Some faced technical troubles with the experimentation system, and by the end we could extract 12 useful finished surveys. Properties of the participants are presented in Table 9-1.

Table 9-1: Participants whose results were accepted

Property	Value	%
Age Group	18-24	67%
	25-34	25%
	35-44	8%
Gender	Male	67%
	Female	33%
Field of Study/Work (specialisation)	ICT	92%
	Mechatronics	8%
Knowledge of Math Modelling	Yes	25%
Knowledge of System Thinking/Dynamics	Yes	17%

The experiment session took one hour. For 20 minutes, the experiment supervisor gave a presentation to introduce the topic and the ILE to the participants. The presentation included the terms the participants would experience during the intervention using the ILE. By the end of the presentation, the participants were asked to connect to the experiment server prepared earlier via their web browsers. In addition to the free pizza that was promised to everyone, the two highest-performing participants were promised a piece of Egyptian pharaonic collectable each.

The testing session started for everyone by answering a pre-test questionnaire. The pre-test questionnaire consists of 10 Likert 5-point scale items (strongly disagree, disagree, neutral, agree, or strongly agree). These Likert items constitute multiple-item scale unidimensional construct as described in [17], designed to test the participants' knowledge about the system's causalities and possible policy options.

As described in the methodology section in Chapter 1, to build the statements of these Likert items, we have enumerated all model variables affecting the municipal website

[81] To avoid any bias, members of this group of participants are totally different from those of the group participated in the experiment mentioned in Chapter 5.

accessibility. Possible changes in the values of these variables (for example: increase in, decrease in) were listed with different combination of possible resulted changes on the municipal website accessibility (for example: increase after short delay, no effect, immediate decrease, etc.). These combinations constituted the statements of the Likert items. These statements were ordered according to their importance based on our knowledge of the system, what we wanted to show and test, and how much they are clear while using the ILE. Further, to suit the experiment duration, 10 of these statements were selected, keeping a balance between reversed and non-reversed statements, and mostly following the recommendations stated in [153]. Finally we polished the wording of the final statements, for example, participants were asked to report their level of agreement or disagreement with this statement "Upgrading CMS takes long time to show an effect on the value of website accessibility".[82]

The Pre-test questionnaire was supposed to take no more than five minutes; nevertheless it was left to the participants to take as much time as they needed. The participants were informed that they could ask the supervisor for help at any time; however we abstained from providing any help that could lead to biases in their answers.

The intervention using the ILE or the gameplay started as the participant ended the Pre-test questionnaire, without the option of going back to the Pre-test questionnaire. The gameplay was limited to 25 minutes. Afterwards all participants were directed automatically to the post-test questionnaire, without the option of going back to the intervention session. This way we were sure that all participants had not used the ILE for more than the designated duration.

The Post-test questionnaire contained exactly the same Likert items used in the Pre-test questionnaire, however after answering how she/he thinks now about each statement after the gameplay (Post-test), the participant was asked to think back in time before the gameplay, and report how much she/he agreed or disagreed with the same statement based on her/his new understanding (Then-test) [18].

9.3 Results and Discussion

Table 9-2 shows the overall α, β, and γ changes detected for all participants in comparison to their answers about mathematical modelling and SD knowledge. 50% of the participants who were included in the analysis have shown γ change, reflecting a change in their understanding and perceptions about the system's causal relations and policy op-

[82] All the Likert statements used in the questionnaire are available at Appendix III.

tions. 30% have redefined/recalibrated the standards they use to assess or evaluate these causal relations and policy options exhibiting β change. In total, 80% of the participants have redefined certain knowledge as a result of using the ILE, achieving the ILE's intended goals. For more detailed results please refer to Paper H.

Table 9-2: α, β, and γ change results vs participants' properties

	Knowledge of Math Modelling	**Knowledge of System Thinking and SD**	**γ Change**	**β Change**	**α Change**
P1	Yes	Yes	--	Yes	--
P2	--	--	Yes	--	--
P3	--	--	--	Yes	--
P4	--	--	Yes	--	--
P5	Yes	--	Yes	--	--
P6[X]	--	--	--	--	--
P7	--	--	--	Yes	--
P8	--	--	--	--	Yes
P9	Yes	Yes	Yes	--	--
P10	--	--	--	--	Yes
P11[X]	--	--	--	--	--
P12	--	--	Yes	--	--

[X] Participant removed because of showing no variance in Pre, Post, or Then

From an internal validity point of view [160], to minimise testing validity threat, we have kept the questionnaires as merely Likert-scale items, and emphasised that there is no right or wrong answers, and participants needed to report what they thought /believed. Furthermore, we made sure that all participants have fully understood the questionnaire items since the pre-test, to account for any misunderstanding that could be automatically clarified during the post-test solely because of repetition. The same questionnaire was administered during pre- and post-test sessions to account for any instrumentation validity threat. Moreover, to eliminate experimenter bias, we have chosen self-report questionnaire type, and kept the whole experiment computerised without any human rater interactions.

To account for possible history validity threat, participants were asked to report their prior knowledge of mathematical modelling and system thinking/SD. Furthermore, the experiment time was limited to almost one hour, eliminating maturation or mortality validity threats. We have to admit that the research suffered from selection validity threat, due to the availability of participants as previously mentioned. Nevertheless, this was somehow mitigated by the fact that participation was totally voluntary.

From external validity perspective [231], participants were few, and limited to university students, yet they are mostly ICT students, who are expected –to some extent– to fill positions like website managers and decision makers in the future. These are the users' positions originally targeted by the model. Other experiments with different samples are necessary. Longer periods between the pre-test, the treatment, and the post-test should be examined. Other sets of questionnaire items describing the model's causal relations and policy option should be used in other experiments.

10 Part Conclusion

10.1 eAccessibility of Norwegian Municipal Website

Accessibility is an important aspect of websites in general and public websites in particular. The achievement of public website accessibility offers various opportunities for various groups of people, while lack of public website accessibility deprives these groups not only of these opportunities but also of the services that they should normally receive.

Many ways could be proposed to enhance accessibility. However the expected impact of selected actions is hard to predict due to diversification and contradiction, in addition to the existence of the time factor, which makes decision-making a challenge.

10.2 eAccessibility of Norwegian Municipal Website SD Model

We have developed an SD model titled "eAccessibility of Norwegian Municipal Website". This SD model incorporates the effects of managerial decisions on the accessibility of Norwegian municipal websites. It is intended to help public websites managers in taking more informed decisions, and to give them knowledge about the underlying structure of their systems. More significantly, an array of instances of this model applied to several municipalities, or an aggregate nation-wide application of the model that covering the granularity of the municipalities should help senior decision makers in finding different ways to enable public organisations to enhance accessibility of their websites. In addition, the SD model can be used to explain very useful policies that are based on non-straight forward cause-effect relations hidden in the system to decision makers.

The model parameters were estimated to tune the results to historical data and constant ratios from literature using an efficient Powell hill climbing algorithm [229], in addition to selecting a suitable time step to take care of integration error. The model passed boundary adequacy, structure assessment, and dimensional consistency validity tests. Moreover, the model proved its robustness under extreme conditions. Finally, the model successfully reproduced the historical behaviour of two different size Norwegian municipalities, after feeding it with their respective parameters. This answers our sixth partial research question RQ 6 of how SD can be used in modelling and supporting decisions in the case of eAccessibility, in addition to the seventh partial research question RQ 7 about the core problems and issues regarding this SD implementation.

From population validity point of view, although the interviewed municipalities range in size suitably, they are few. While, from ecological validity point of view, time is a

very important factor, as technology in such a field is changing fast. Furthermore, depending only on the known issues of EPiServer CMS is a very limiting factor.

10.3 eAccessibility of Norwegian Municipal Website SDBILE

eAccessibility of Norwegian Municipal Website SD model is supposed to be able to change how its users think and take decisions. It is intended to change their understanding, perceptions, and accordingly attitudes and mental models. To test whether this model is really capable of doing what it is intended to or not, we have developed an ILE with this model in its core, and conducted an experiment with users using this ILE.

The results were that the ILE/model was successful in changing its users' understanding and perceptions about the system's causal relations and policy options 50% of the time, and helping them in redefining the standards they use to assess or evaluate these relations and policy options 30% of the time. In total, 80% of ILE users have redefined certain knowledge as a result of using it, achieving the ILE's intended goals. Accordingly, the experiment and results answer our eighth partial research question RQ 8 of how SDBILE can be used in changing eGovernment managers' mental models in the case of eAccessibility, and the ninth partial research question RQ 9 concentrating on the impact of using SDBILE in enhancing the eAccessibility of eGovernment websites.

We have to admit that the research suffered from selection validity threat, due to the availability of participants as previously mentioned. Nevertheless, this was somehow mitigated by the fact that participation was totally voluntary. Participants were few, and limited to university students, yet they are mostly ICT students, who are expected –to some extent– to fill positions like website managers and decision makers in the future, which are the users' positions originally targeted by the model. Other experiments with different samples are necessary. Longer periods between the pre-test, the treatment, and the post-test should be examined. Other sets of questionnaire items describing the model's causal relations and policy option should be used in other experiments.

Part IV. Thesis Conclusion and Future Work

11 General Conclusion

11.1 eGovernment and SD

Due to either poor implementation [26], or poor management practices [26], [27], many eGovernment projects fail to achieve their goals [23]–[25]. Methods, models, and decision support tools can help in examining the results of starting projects or taking decisions in the planning phase, in order to increase the success probability [24], [28], [29]. However, not many mathematical models or modelling frameworks to support eGovernment decisions exist [33].

System Dynamics (SD) is a method to build simulation models using computers [11], [34], [35], for systems with dynamically interacting and complex components, that are changing over time [13], [36]. The SD model facilitates the understanding of how different policies and decisions interact with the underlying system structure, and influence the system behaviour [34]. It also facilitates applying different what-if scenarios searching for an optimal policy [11]. An SD model could be encapsulated in software called System Dynamics Based Interactive Learning Environment (SDBILE). The SDBILE is an easy interface used by decision makers or the non-technical users in general, to support them in making decision, or to educate them about the system [11], [13].

The eGovernment system is a dynamically changing [32], and complex socio-technical system [36]–[38]. Considering the interactions among its components especially the management process and the people component, many ways could be proposed to enhance its performance [11], [34], [35], [39], [40]. Furthermore, the interactions among these components are dynamically complex and changing over time, making SD one of the most suitable methods to be used in modelling them [36].

The main goal of this thesis is to show how SD can be used in modelling and supporting decisions in the field of eGovernment, focusing on two eGovernment areas that SD models have not been built for previously, specifically *eParticipation* and *eAccessibility* as examples. To accomplish this goal, we have broken the main research question into nine partial research questions. One partial research question about our rationale behind selecting SD and its suitability in modelling our targeted application areas, four in relation to eParticipation, and other four concerning eAccessibility. Through reviewing different literature comparing mathematical modelling methods, and mathematical modelling methods suitable for modelling complex systems we were able to answer our first partial research question RQ 1 of why SD is selected to model and support deci-

sions in the field of eGovernment, and how to justify that SD is an appropriate method to model decisions in the eGovernment and the selected application areas.

11.2 eParticipation

We have chosen the issue of PWD employment in Norway to be used as the topic to apply the eParticipation concept on. We have administered two questionnaires to PWD and potential employers. The PWD questionnaire covered their attitudes towards employment, including information about the factors enabling them to work, encouraging them to take an available work opportunity, and preventing them from active job application. Correspondingly, the second questionnaire covered the attitudes of employers towards recruiting PWD in Norway, including information related to employers' awareness of facts about PWD, as well as factors encouraging employers to, and preventing them from recruiting PWD. The results were incorporated in the "*PWD from Welfare to Jobs*" SD model which focuses on enabling PWD to move from welfare to work. To build and while building this model we were able to answer our third partial research question RQ 3 concerning the core problems and issues regarding the SD application in the eParticipation area, particularly in the case of PWD employment.

The "*PWD from Welfare to Jobs*" SD model could successfully reproduce the historical behaviour until 2015, as well as forecasting the future values until 2050. Furthermore, we were able to use it to test different what-if scenarios. Based on such results, this model –as intended– could be used by policymakers, disability organisations, and individual citizens, showing how SD can be used in modelling and supporting decisions in a case of shifting PWD from welfare to labour market, and answering our second partial research question RQ 2 of how SD can be used in modelling and supporting decisions in a case to be promoted via eParticipation, particularly in the case of PWD employment.

To answer the fourth and fifth partial research questions RQ 4 and RQ 5, the "*PWD from Welfare to Jobs*" model was encapsulated in a System Dynamics based Interactive Learning Environment (SDBILE). To explore how the model could change how its users think and take decisions, the SDBILE was assessed by an expert opinion poll, and tested with users in two different experiments. 67% of the sample of our expert opinion poll thinks that this SDBILE achieves its intended goals. Furthermore, 71% of the participants of both experiments have redefined certain knowledge as a result of using the SDBILE, i.e. changing the participants' mental models, and showing how SDBILE can be used in promoting eParticipation, particularly in the case of PWD employment, and

what the impact of using SDBILE in promoting eParticipation, particularly in the case of PWD employment would be.

Certain limitations should be taken into consideration when dealing with the "*PWD from Welfare to Jobs*" model. Attitudes of PWD and employers may change over time. Furthermore, the current structure of the model does not take into account the effect of sudden crises. One example is the late drop in oil prices that led to a decrease in the available job vacancies in the Norwegian labour market [232]. Others examples could be the refugee movements or Brexit.

As a final point, we have to admit that our experiments were based on convenience samples, and suffered from selection validity threat; and although all our efforts to mitigate that, trying to generalise the results should be done in a very conservative manner.

11.3 eAccessibility

eAccessibility of a website refers to the ability of all people to use this website irrespective of their disabilities, or the client devices they use to access the Internet. It is an important aspect of websites in general and of public websites in particular. Access to public websites is crucial to assure equal opportunities for all citizens to participate in the society. The government exerts efforts to enhance accessibility, yet there is still room for improvement. Many ways could be proposed to enhance accessibility. However the impact of selected actions is hard to predict due to diversification and contradiction, in addition to the continuous change of the system over time. Under this topic, we have analysed the data collected via a couple of questionnaires on eGovernment measurement methods in general.

In addition, we have collected a sample of webpages from different Norwegian municipal websites, to classify the different accessibility failures, according to their original causes. The findings including factors affecting the accessibility of the municipal websites were compiled into an SD model, titled "*eAccessibility of Norwegian Municipalities Websites*". The model parameters were adapted to two different Norwegian municipalities, namely Grimstad and Trondheim. In both cases, the model successfully reproduced the historical behaviour over time. We were able to test various what-if scenarios, demonstrating how to use the model as a decision support tool –as intended, for policymakers and website managers, answering the sixth partial research question RQ 6 of how SD can be used in modelling and supporting decisions in the case of eAccessibility, in addition to the seventh partial research question RQ 7 about the core problems and issues regarding applying SD in the case of eAccessibility.

To answer our eighth partial research question RQ 8 of how SDBILE can be used in changing eGovernment managers' mental models in the case of eAccessibility, and the ninth partial research question RQ 9 concentrating on the impact of using SDBILE in enhancing the eAccessibility of eGovernment websites, the "*eAccessibility of Norwegian Municipalities Websites*" model was also encapsulated in an SDBILE, which was used in an experiment with users. The results indicated that 80% of the experiment participants have redefined certain knowledge as a result of using this SDBILE, i.e. changing the participants' mental models.

The "*eAccessibility of Norwegian Municipalities Websites*" model suffers from certain limitation as well. The interviewed municipalities are few, in addition to depending solely on the known accessibility issues of the EPiServer CMS which is very limiting, and should be taken into consideration when applying the model to municipalities other than the two examples we have provided: Grimstad and Trondheim. Furthermore, technology in such a field is changing fast. To coping with that, regular updates to the model parameters, and perhaps certain model structure changes should be done regularly as well.

Finally, experiments in this part were based on convenience samples as well, and suffered from selection validity threat as well. We have exerted our efforts to moderate this problem. Nevertheless, we should be very conservative when trying to generalise the results.

11.4 Our Contribution

This thesis has introduced both substantive and methodological contributions. On the substantive contribution side, we have elicited new knowledge about system structure (including knowledge about system causalities and policy options) in two new fields, namely the PWD employment in Norway and the accessibility of Norwegian municipal websites. Furthermore, we have applied the SD method in the two eGovernment areas, where up to our knowledge it has never been applied before. This has produced two SD model "*PWD from Welfare to Jobs*" as an eParticipation application, and "*eAccessibility of Norwegian Municipalities Websites*". Our SD application was extended further to developing an SDBILE for each of these models. We are not aware of any previous publication in the field of eGovernment that use any real SDBILE.[83] Moreover, these two SDBILE have proven successful in modifying their users' mental models.

[83] Conceptual ILE was introduced By Navarra and Bianchi in [188].

On the methodological contribution side, we have developed a generic reusable SDBILE framework, and provided instructions on how it could be used by others in creating their SDBILEs. Furthermore, we have adapted the α, β, and γ change typology and the retrospective accounts method to test the effect of using an SDBILE on its users. We have also introduced our suggested approach to create the questionnaires needed to apply the α, β, and γ change and the retrospective accounts method in testing an SDBILE effect on its users, as well as our suggested steps and statistical tests needed in conducting the statistical analysis for the retrospective accounts method in such a case.

12 Possible Future Extensions

In the description of a roundtable in the context of ICT development in developing countries, held by the Global ICT Unit of the World Bank, Dahan wrote that "[SD] technique is increasingly proving its applicability and relevance to developing work. Policymakers need to look for innovative approaches that offer guidance on improving the design and implementation of development programs, and help identify critical activities, knowledge gaps, as well as the highest payoffs to filling those gaps. [SD] seems to be a good candidate in addressing these challenges" [258].

Intuitively these expected benefits are not limited to developing countries. Around the world, many universities and institutions teach and use SD in research. Their wide range of SD modelling knowledge and experience could greatly help the growing eGovernment field, in building useful SD models, and SD based decision support tools. A number of researchers and practitioners have applied SD in the eGovernment field (please refer to the literature review in Chapter 2, and literature review concept matrix in Appendix I); yet more effort in conducting more practical research covering more eGovernment topics and areas (both horizontal and vertical expansions) would be very beneficial to the field.

From a practitioner's point of view, using Group Model Building (GMB) and workshops as tools to collect information to build and reviews SD models, and involve clients in the model building process, and perhaps using workshops as a way to promote SD models among decision makers and practitioners, still has a lot of potential. Yet the cost of involving people in the modelling process both financially and time-wise cannot be overlooked.

Furthermore, in the context of SDBILE testing, we have followed a black-box [259] approach in building our SDBILEs, which does not show the underlying model structure to users. On the contrary a glass-box [259] approach requires the SDBILEs to provide the users with some model representation, by using SD tools, like for example CLD. Testing glass-box versions of our SDBILEs should provide us with different insights into the extent of the benefits expected from using such SDBILEs. Although it will require longer time spans to provide the SDBILEs users with the needed SD concepts prior the experimentation.

Finally, applying α, β, and γ change analysis to test the effect of using SDBILE was easy and straight forward. However, more experimentation with larger samples, ideally including control groups, to test for group changes in addition to individual changes, over longer time spans, and longer questionnaire seems to be a very promising and

highly recommended future research. Furthermore, comparing the α, β, and γ change results with results from other mental model change measurement methods more common among SD practitioners is a very important validation requirement for applying the method in the SD field.

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Appendix I. General

A System Dynamics Modelling Using Vensim PLE

A.1 Introduction

System Dynamics (SD) is an application of Servomechanism or Information Feedback Systems Theory (Control Theory) [34], [128] to almost all kinds of systems. SD model is no different from other mathematical models, as it is an abstraction of the reality into a system of simultaneous non-linear first order differential equations. SD finds any system to consist of only two main types of variables; the first type is called *Flow*, which accumulates into the other type which is called *Stock* or *Level* over time. In mathematical terms, a *Stock* is the integration of a *flow*, i.e.:

$$Stock = \int_{t_0}^{t} Flow \cdot dt + Stock_0$$

The other variables that might exist in the SD model are auxiliary variables that contain additional algebraic expressions needed to compute the flows from the other variables in the model.

The SD model is of a mathematical nature in its core. Nonetheless, it uses graphical representations to show the models, and hence in the real world. One type SD graphical representation type is the *Stock and Flow* diagram [11], shown in Figure A-1, where stocks are distinguished from flows with rectangles around them. In addition, there are two kinds of connectors, single lined and double lined arrows to transfer information and material flows respectively. The other variables that are shown in the figure are auxiliary variables. Moreover, whenever the cloud symbols are shown in the *Stock and Flow* diagram, they indicate that we do not care about the source of the sink of the material flow in this specific case [11].

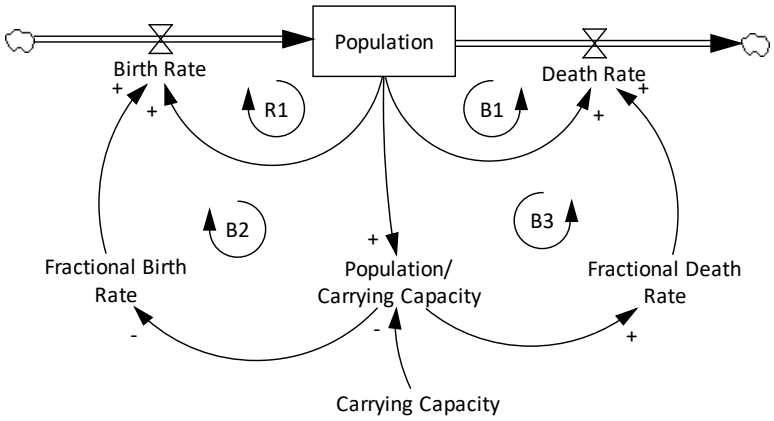


Figure A-1: Simplified population model—adapted from [11]

In this appendix, we would like to introduce the reader to how to do mathematical modelling and implementing models using one of the popular SD core tools: Vensim [136]. For more details about SD, graphical representation and Vensim, please refer to Chapter 1. The rest of this appendix will go like a tutorial. We aim at building the simplified population model we have used as an example in Chapter 1. The model is an adapted version of a model presented in [11]. We will go step-by-step in building the model, meanwhile explaining the main functionalities of Vensim PLE [140]. PLE is Vensim's free version for educational and personal use [140]. It is fully functional and capable of building and simulating SD models [260]. It could be downloaded freely from this link: https://vensim.com/free-download/. Installation instructions will be available with the download.

A.2 Population Model Using Vensim PLE

After installing and running, the main Vensim PLE window shown in Figure A-2 appears. Vensim PLE has a multiple document interface (MDI) application.

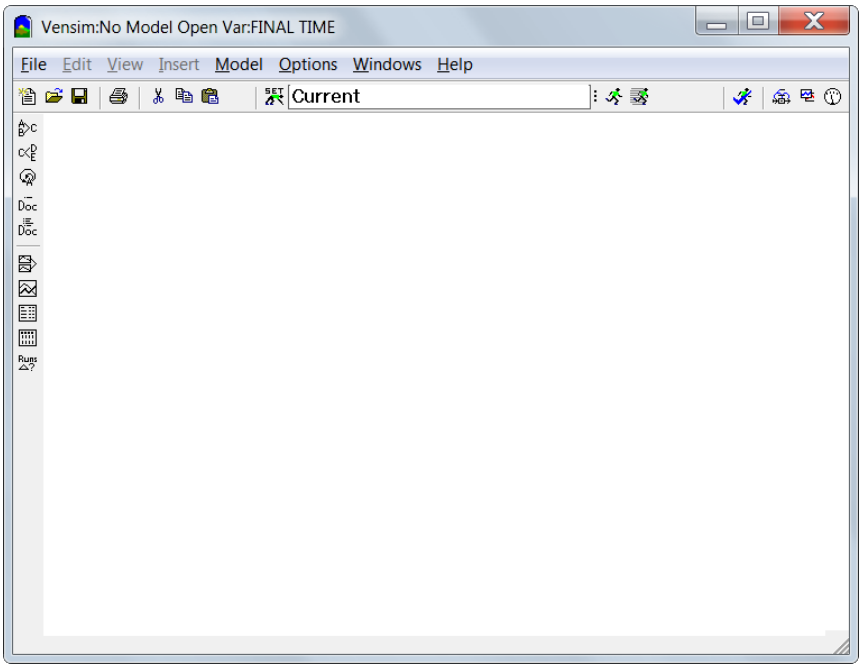


Figure A-2: Vensim PLE main application window

We either select *New Model* menu item from *File* menu, or directly press the *New Model* icon –the first icon– in the main toolbar –the horizontal toolbar. The model settings dialogue box shown in Figure A-3 appears. We will use this dialogue box to enter the time specifications of our model.

We will keep the INITIAL TIME at zero –as the default, while changing the FINAL TIME to 200. The time step will be changed to 0.125. Units for time will stay in

Months –as per default. We will also keep using the default numerical integration method (Euler), and press OK.

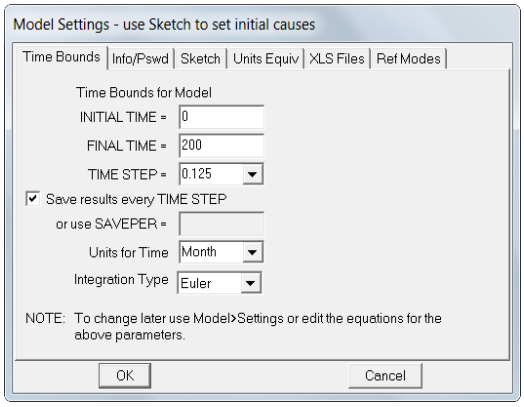


Figure A-3: Model settings dialogue box

After pressing OK in the Model settings dialogue box, the "Sketch Tools" appears under the main toolbar, and the "Sketch drawing area" becomes active, as shown in Figure A-4.

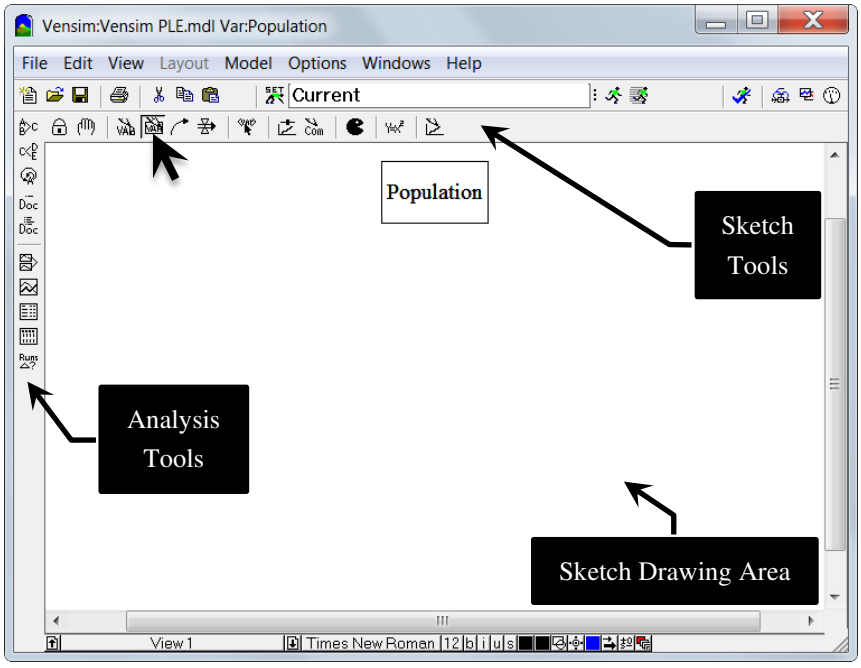


Figure A-4: Add "Population" stock variable

The first step in building our population model is to add the "Population" stock; The "Box Variable – Level" button becomes activated by pressing its button in the Sketch Tools, as shown in Figure A-4. At any empty area in the sketch drawing area, we press the left mouse button; an empty box with a cursor inside appears. We use the keyboard to enter the stock variable name "Population", and press the enter key in the keyboard, or press any mouse button outside the stock box to finish the stock adding process.

Now a variable named “Population” surrounded by a box appears in the sketch drawing area.

The next step is to add an in-flow to the “Population” stock. We press the “Rate” button in the Sketch Tools, as shown in Figure A-5. “Rate” button becomes activated. At any empty area, not very far from the “Population” stock, we press the left mouse button; an arrow coming out of a cloud symbol appears. The head of this arrow moves with our mouse movement. At the “Population” stock box, we press the left mouse button once more, and then a new box appears in anticipation for supplying the in-flow name via the keyboard. We write “Birth Rate”, and press the enter key.

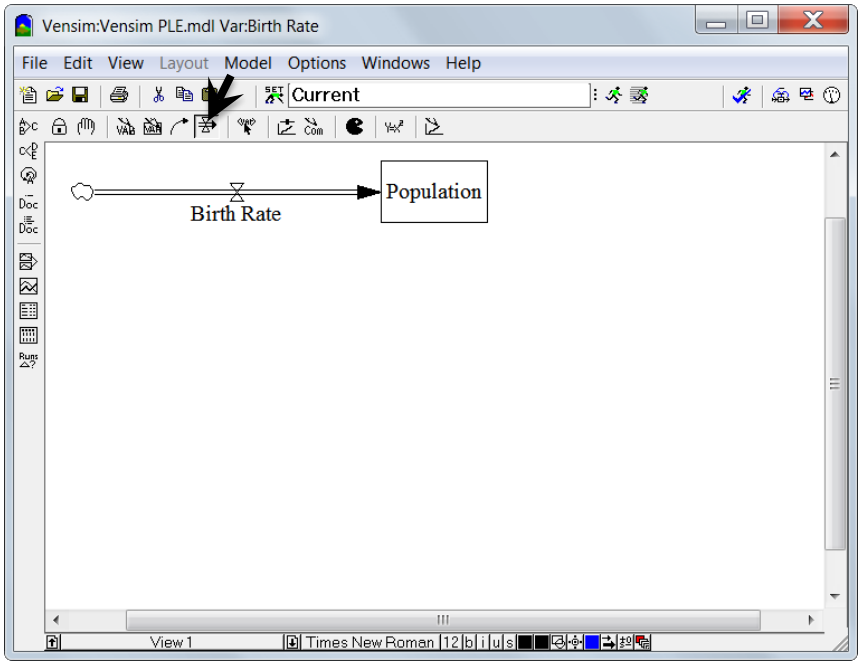


Figure A-5: Add “Birth Rate” in-flow

The next step is to add an information arrow from the “Population” stock to the “Birth Rate”. We activate the “Arrow” button from the Sketch Tools, and press the left mouse over the “Population” stock box, then press the left mouse button again on the “Birth Rate”. The arrow connecting both variables appears as shown in Figure A-6. As far as the “Arrow” button in the Sketch Tools is activated, the drawn arrows are editable in addition to the possibility of adding new arrows. We can make our new arrow more curved for drawing clarity by pressing our left mouse button on the small circle in the middle of the arrow, then drag and drop a little bit away from the original position inside the Sketch drawing area.

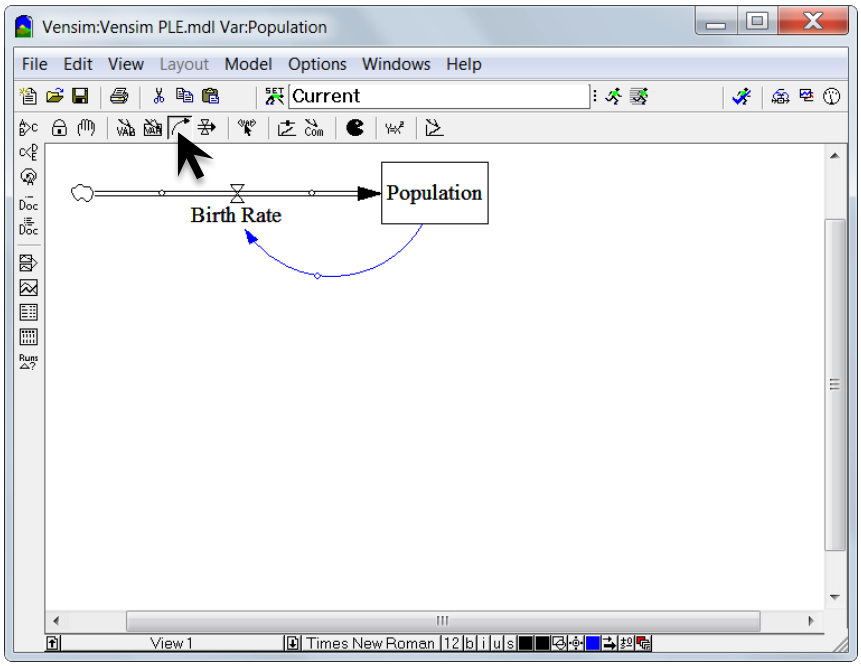


Figure A-6: Add information arrow

We will follow similar steps to add the out-flow "Death Rate". Nevertheless, after activating the "Rate" button from the Sketch Tools, we press the left mouse button over the "Population" stock box, then move the mouse a little bit away and press again inside the Sketch Drawing Area. Then follow the same steps to give the out-flow its name. We also add information arrow from "Population" to "Death Rate" as shown in Figure A-7.

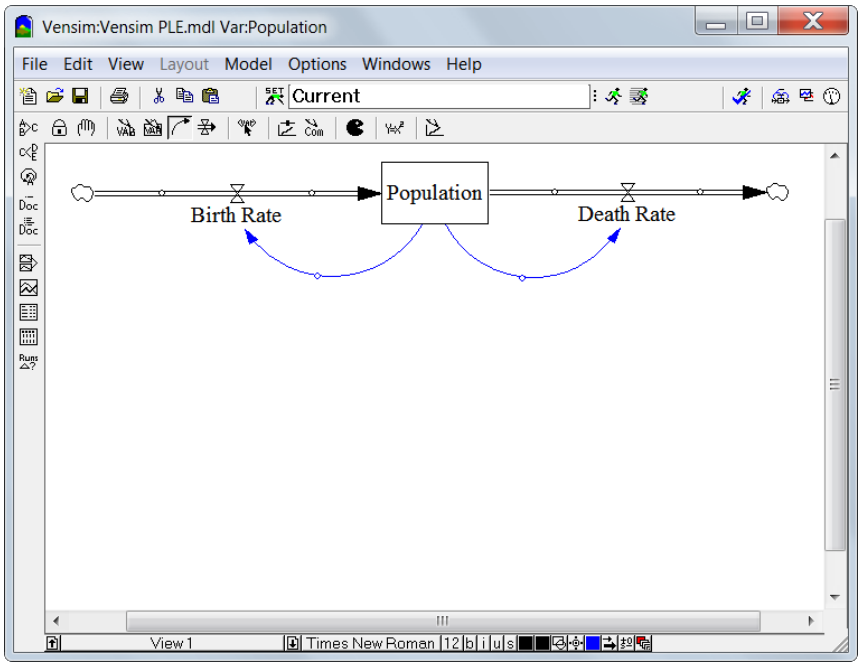


Figure A-7: Add "Death Rate" out-flow

The "Carrying Capacity" of any environment is "the number of organisms of a particular type it can support and is determined by the resources available in the environment

and the resource requirements of the population" [11]. In our simplified population model example, the "Carrying Capacity" is constant. Our next step is to add this "Carrying Capacity" to our model. A left mouse click on the "Variable-Auxiliary/Constant" button in the Sketch Tools activates it. Another left mouse click on the Sketch Drawing Area where we want to add the "Carrying Capacity", then enter the name via the keyboard, as shown in Figure A-8.

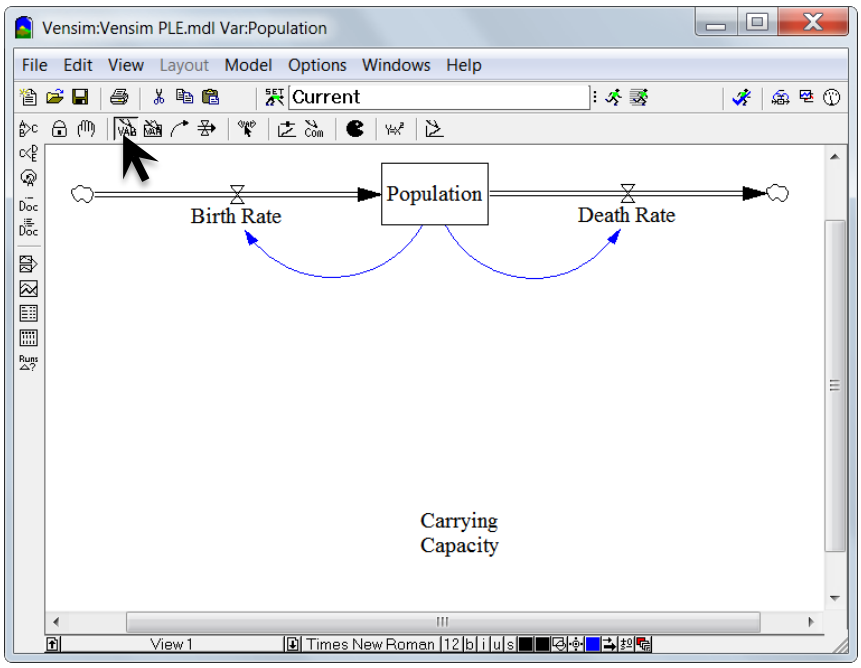


Figure A-8: Add "Carrying Capacity" constant

Now we have both "Population" and "Carrying Capacity" in our model. The next step is to add the ratio "Population/Carrying Capacity". In SD jargon this is called an auxiliary variable. To accomplish this, we will use "Variable-Auxiliary/Constant" button once again to add the "Population/Carrying Capacity" auxiliary variable, as shown in Figure A-9.

As the value of the auxiliary variable "Population" and "Carrying Capacity" will be calculated based on the values of the "Population" and the "Carrying Capacity", we will need to add two information arrows to make a connection from the "Population" to the "Population/Carrying Capacity" and from "Carrying Capacity" to "Population /Carrying Capacity". This is done using the "Arrow" button from the Sketch Tools as done previously.

The same last steps should be followed to add two other auxiliary variables called "Fractional Birth Rate" and "Fractional Death Rate", and connect them to the rest of the model variables as shown in Figure A-10.

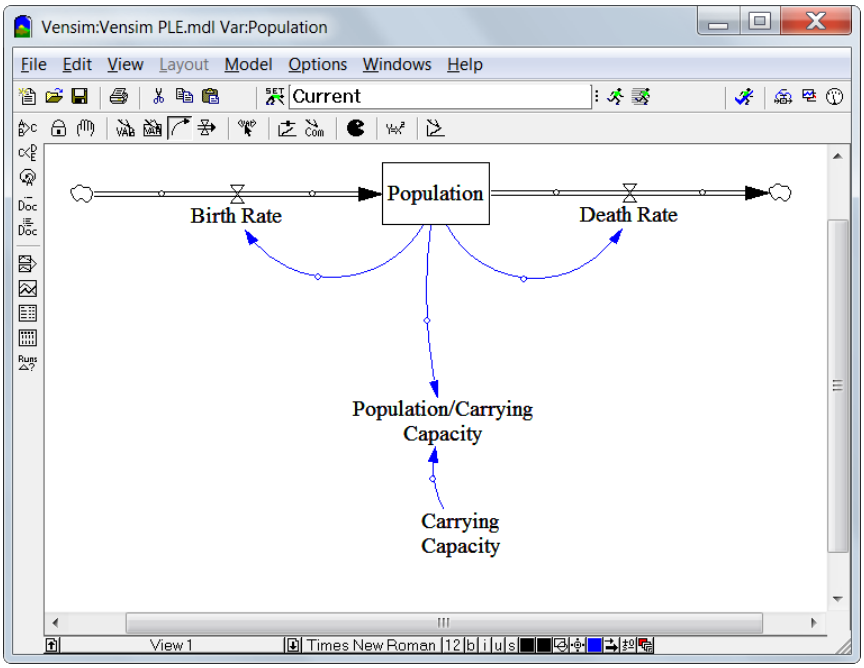


Figure A-9: Add "Population/Carrying Capacity" auxiliary variable

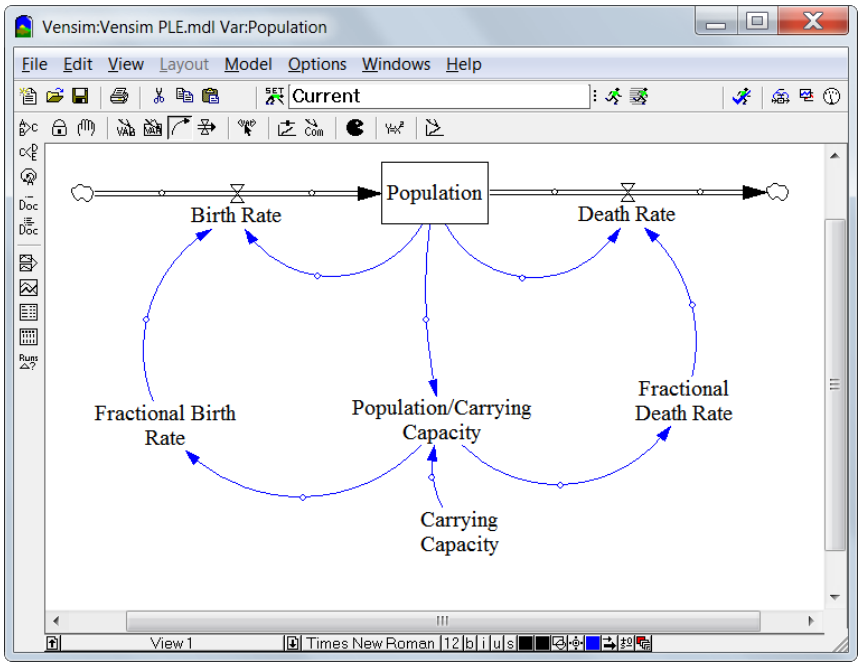


Figure A-10: Complete Population model

Now we have a complete model drawing, and we need to enter the equations. As shown in Figure A-11, when we active the "Equations" button from the Sketch Tools, all variables without equation appear within black boxes. Left mouse clicking any of these variables, causes the editing equation dialogue box shown in Figure A-12 to appear.

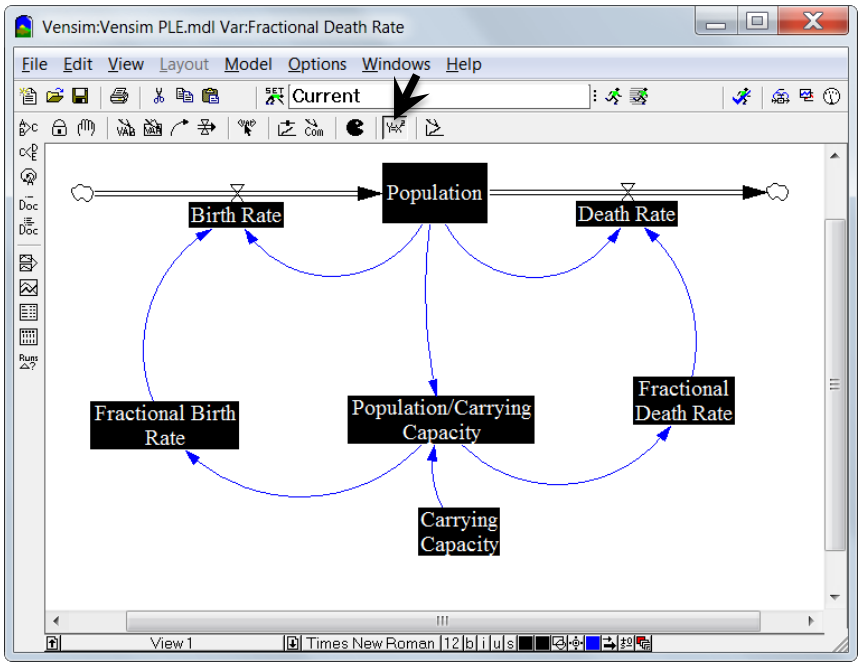


Figure A-11: Adding equations to the model

We start by left mouse clicking the "Population" variable, as shown in the following figure. The integration equation of any stock appears by default, which will not be the case for other variable types.

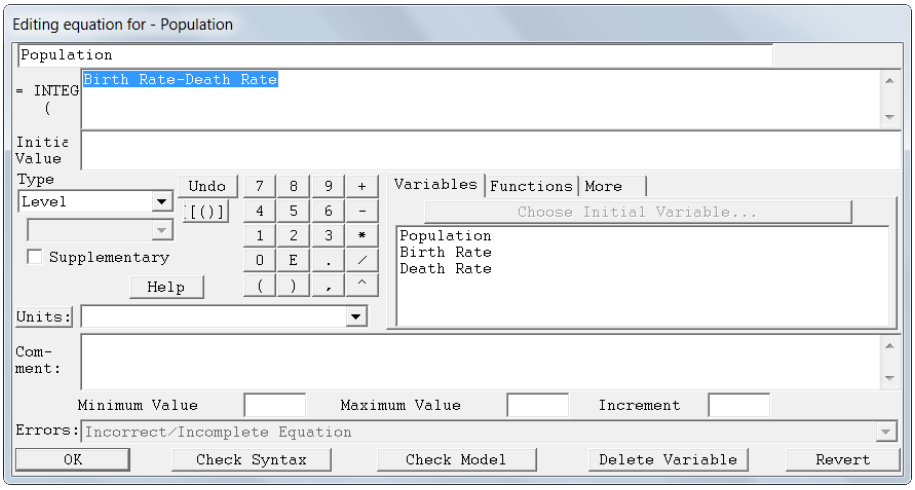


Figure A-12: Equation editor

Our population equation should be as follows:

$$Population = \int_0^{200} (Birth\ Rate - Death\ Rate) \cdot dt + 1000$$

So, we still need to enter the initial value of 1000, as shown in Figure A-13. Additionally, we should add the measurement units, which is "Creatures" in this case. Then press OK to close the dialogue box.

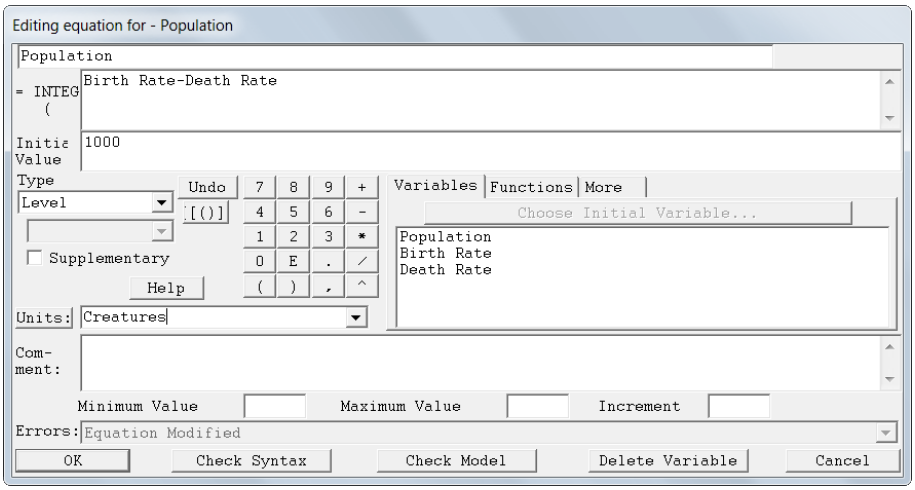


Figure A-13: Editing the "Population" stock equation

The same process of entering equations applies for all variables included in the following table.

Equation	Units
"Carrying Capacity" = 15000	Creatures
"Population/Carrying Capacity" = Population/Carrying Capacity	Dimensionless
$Fractionl\ Birth\ Rate = 0.04 \cdot \left(1 - \frac{1}{1 + e^{-7 \cdot (Population/Carrying\ Capacity - 1)}}\right)$ Or, Fractional Birth Rate = 0.04*(1-(1/(1+exp(-7*("Population/Carrying Capacity"-1)))))	1/Month
"Birth Rate" = Fractional Birth Rate*Population	Creatures /Month
$Fractionl\ Death\ Rate = 0.01 \cdot \left(1 + \left(Population\ /\ Carrying\ Capacity\right)^2\right)$ Or, "Fractional Death Rate" = 0.01*(1+"Population/Carrying Capacity"^2)	1/Month
"Death Rate" = Fractional Death Rate*Population	Creatures /Month

At this point, the model is ready for simulation. Vensim PLE has two modes of simulation; both of them can be activated from the main toolbar as shown in Figure A-14: "Run a simulation" – pointed to by the black arrow to the left, and "Automatically simulate on change" – pointed to by the black arrow to the right. We will start by trying the "Run a simulation". To show the simulated behaviour of one of the model varia-

bles, we can select these variables by left mouse click it. In this case, we select “Population”, and it will be highlighted by a black box. Then from the Analysis Tools, we press “Graph” button, as shown in Figure A-15.

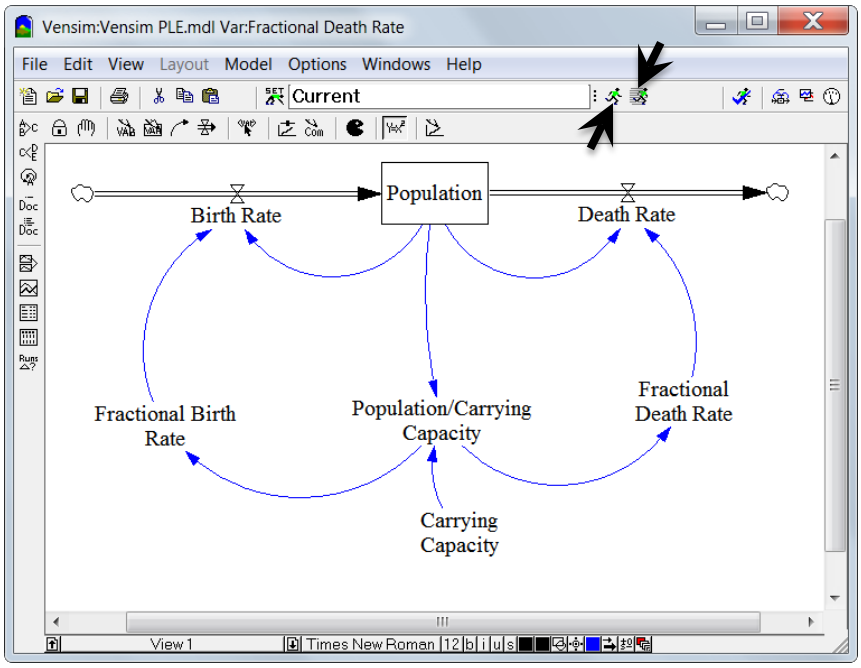


Figure A-14: Vensim simulation modes

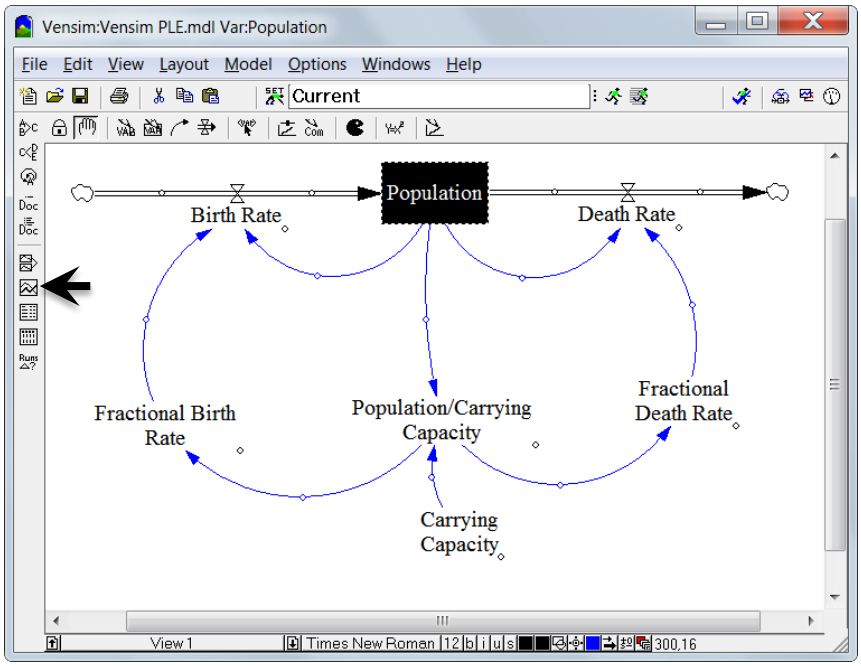


Figure A-15: Showing simulation results

By pressing the “Graph” button, a graph showing the time behaviour for the selected variable “Population” appears in over the Sketch Drawing Area as shown in Figure A-16.

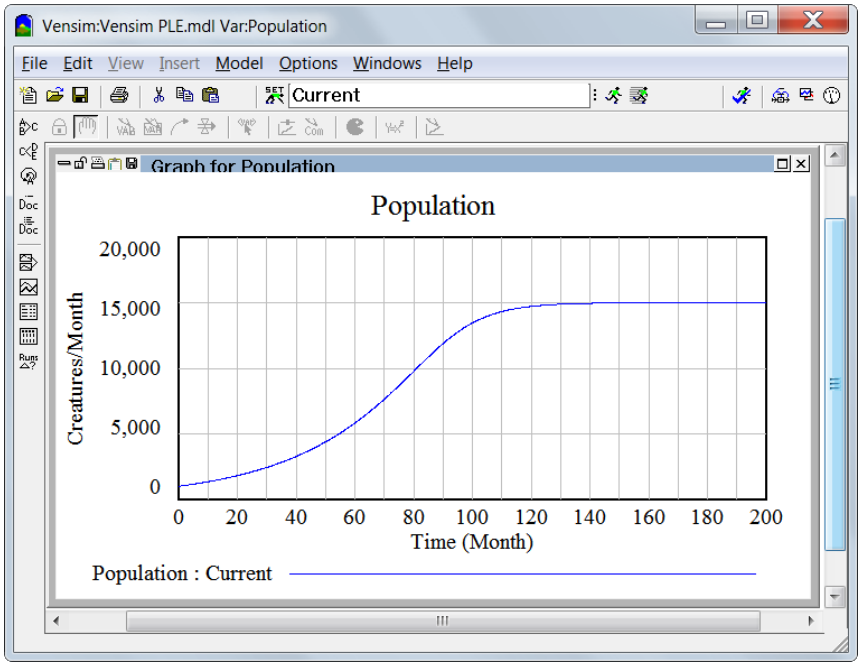


Figure A-16: "Population" stock over time graph

Otherwise, the values of the variable behaviour could be shown instead of the graph. By selecting "Table" or "Table time down" from the Analysis Tools, a table with values appear as shown in Figure A-17.

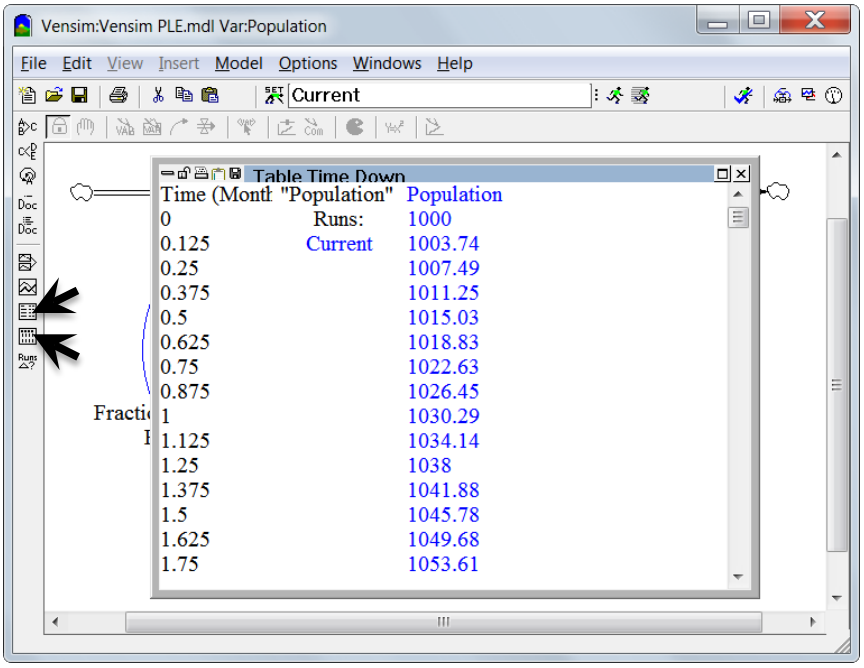


Figure A-17: "Population" stock time series

More than one variable could be selected together to compare their behaviour, by pressing the keyboard "Shift" button while selecting the variables, then use the "Graph" button from the Analysis Tools, as shown in Figure A-18.

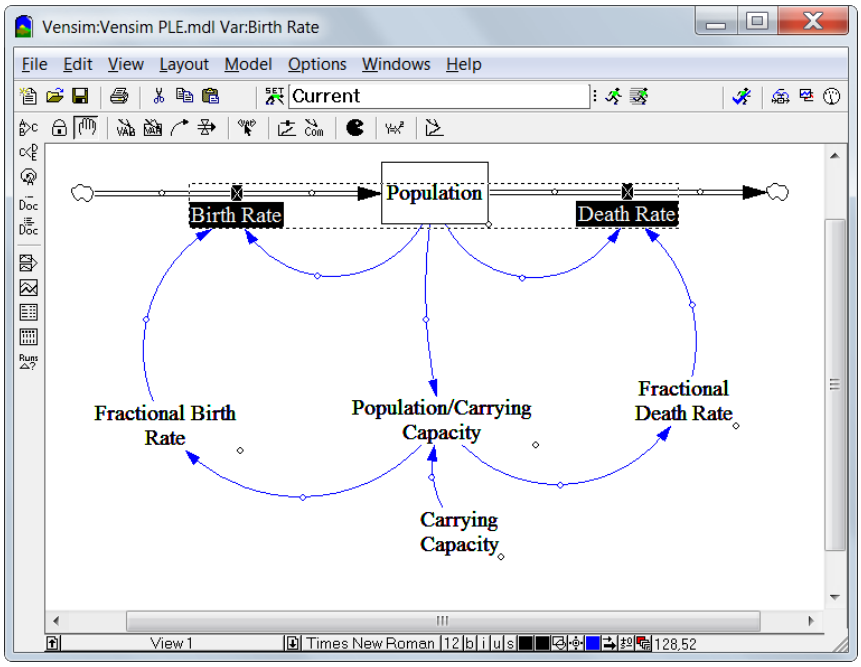


Figure A-18: Selecting multiple variables

Figure A-19 shows a graph window on Vensim PLE showing the behaviour of two selected variables.

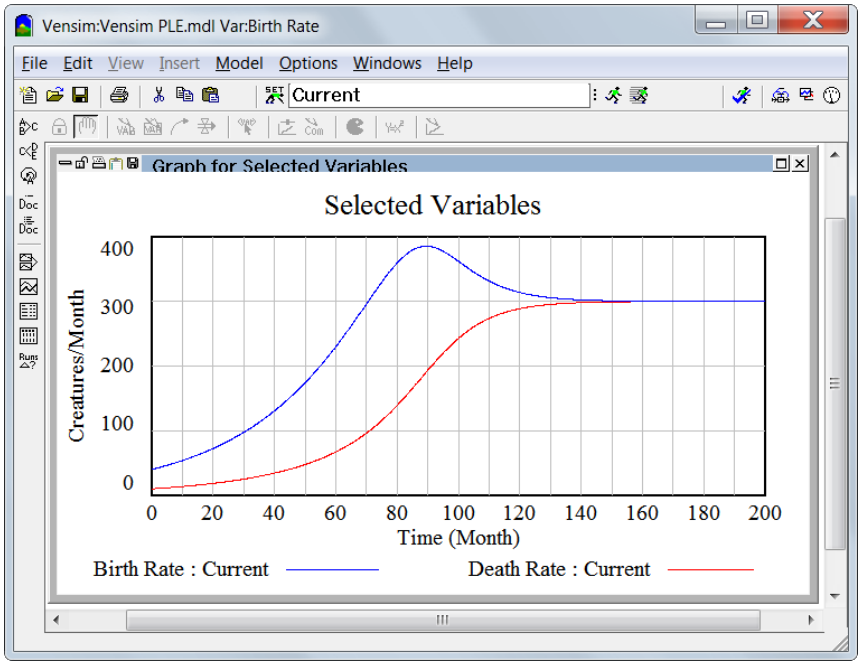


Figure A-19: Multiple variable graph

The other simulation mode "Automatically simulate on change" referred to above, when activated Vensim PLE looks like what is shown in Figure A-20. Variables behaviour appear over the variable names. Furthermore, sliders will appear near the changeable variables, like the "Carrying Capacity" in our model.

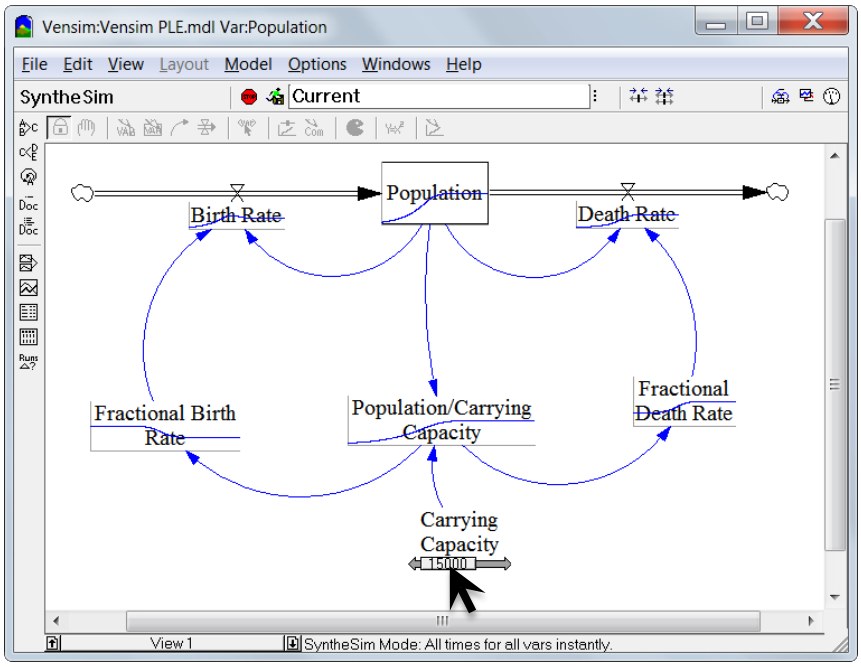


Figure A-20: "Automatically simulate on change" mode

Using left mouse click, we can change the "Carrying Capacity" value from 15000 to 60000 and see other dependant variables behaviour changing instantaneously, as shown in Figure A-21.

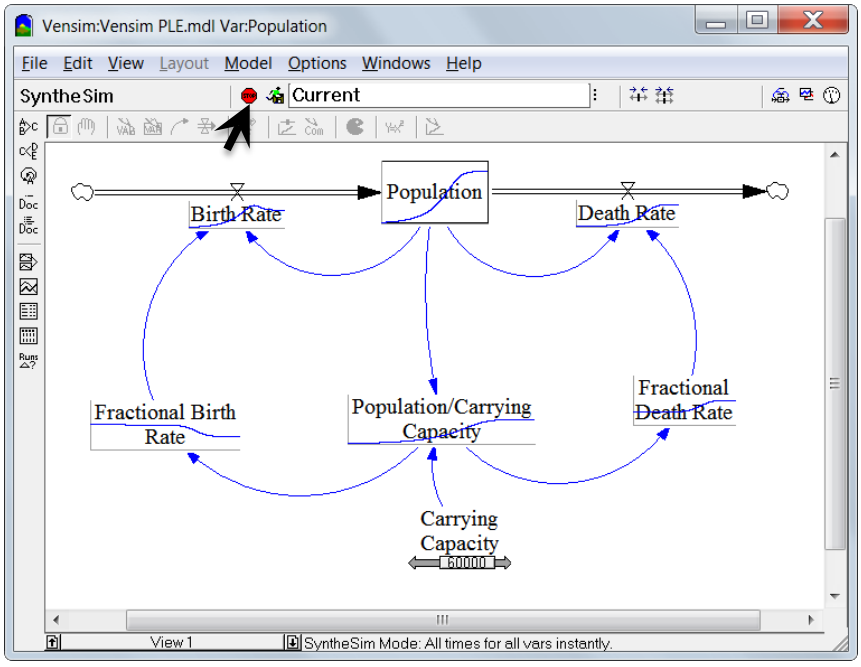


Figure A-21: Turn "Automatically simulate on change" mode off

We can turn this simulation mode off, by pressing stop button in the main toolbar, pointed to in the above preceding figure.

This concludes our tutorial. Vensim PLE has more functions that could be found in the help. We have focused only on the main functionalities need to build, simulate a model,

and show its behaviour. The following section presents the population model documentation.

A.3 Population Model Documentation

Symbols, and Types, and abbreviations used in the model documentation

Types:	**C** : Constant (4)	"A variable whose value does not change over time." [229]
	L : Level (1)	"Levels (also called accumulations, stocks and states). These change only over time and the values they take on at any time depend on the value they (and other variables) took on at previous times. … The Level variables ultimately determine the dynamic behaviour of a system." [229]
	F : Flow (2)	Also called Rate. "These are the variables that directly change the Levels. Rates are essentially the same as Auxiliaries and differ only in the way they are used in a model." [229]
	A : Auxiliary (6)	"Any dynamic variable that is computed from other variables at a given time. Auxiliaries are typically the most numerous variable type. An auxiliary variable has an expression involving other variables in its equation." [229]

Group	Type	Variable Name and Description
Default	#1 F,A	**Birth Rate** (Creatures/Month) = Fractional Birth Rate*Population **Description:** *Births are proportional to the population. Those born immediately add to the population, and can reproduce and die.* **Present in 1 view:** • View 1 **Used by:** • Population - The population is increased by births and decreased by deaths.
Default	#2 C	**Carrying Capacity** (Creatures) = 15000 **Description:** *The carrying capacity defines the equilibrium or maximum sustainable population.* **Present in 1 view:** • View 1 **Used by:** • "Population/Carrying Capacity" - The ratio of population to carrying capacity determines the fractional birth and death rates.
Default	#3 F,A	**Death Rate** (Creatures/Month) = Fractional Death Rate*Population **Description:** *Deaths are proportional to the population.* **Present in 1 view:** • View 1 **Used by:** • Population - The population is increased by births and decreased by deaths.
Default	#5 A	**Fractional Birth Rate** (1/Month) = 0.04*(1-(1/(1+EXP(-7*("Population/Carrying Capacity"-1))))) **Description:** *The fractional birth rate is a declining function of the population relative to the carrying capacity. A logistic function is used.* **Present in 1 view:** • View 1

Group	Type	Variable Name and Description
		Used by: • Birth Rate - Births are proportional to the population. Those born immediately add to the population, and can reproduce and die.
Default	#6 A 	**Fractional Death Rate** (1/Month) = 0.01*(1+"Population/Carrying Capacity"^2) **Description:** *The fractional death rate is an increasing function of the ratio of population to carrying capacity. A power function is assumed.* **Present in 1 view:** • View 1 **Used by:** • Death Rate - Deaths are proportional to the population.
Default	#8 L 	**Population** (Creatures) = $\int$ (Birth Rate-Death Rate) $\cdot dt$ + [1000] **Description:** *The population is increased by births and decreased by deaths.* **Present in 1 view:** • View 1 **Used by:** • Birth Rate - Births are proportional to the population. Those born immediately add to the population, and can reproduce and die. • Death Rate - Deaths are proportional to the population. • "Population/Carrying Capacity" - The ratio of population to carrying capacity determines the fractional birth and death rates.
Default	#9 A 	**"Population/Carrying Capacity"** (Dmnl) = Population/Carrying Capacity **Description:** *The ratio of population to carrying capacity determines the fractional birth and death rates.* **Present in 1 view:** • View 1 **Used by:** • Fractional Birth Rate - The fractional birth rate is a declining function of the population relative to the carrying capacity. A logistic function is used. • Fractional Death Rate - The fractional death rate is an increasing function of the ratio of population to carrying capacity. A power function is assumed.

B System Dynamics Based Interactive Learning Environments (SDBILE) Framework–Technical Documentation

B.1 Introduction

During the course of this research, we have built two System Dynamics models with the intention to serve users both for decision making and mental model enhancement. To be able test the effect of these models on users, we have chosen to encapsulate them in Interactive Learning Environments (ILEs). An ILE is "software for educational purposes, for supporting the process of learning, where the focus is on learning through the interaction with the computer (human-computer interactivity)" [11]. To develop our ILEs, we have developed a generic ILE framework, which we can use as a base for our ILEs, and it could be further used by others to develop theirs.

This appendix aims at presenting this ILE framework from the technical point of view. As a technical manual, this appendix explains the setup and the functionalities of the ILE framework from different perspectives in details; data flow, used/developed packages and functions, directory and database structures. Moreover, to compile this appendix, we have developed a simple ILE based on the ILE framework to be used as a running example. The appendix shows this example in different running phases, and scrutinises its communications over the network in addition to the data resulting from its activities whenever available. Finally, the appendix tests the eAccessibility of all our ILE interfaces. All abbreviations and definitions used in this appendix are listed in the last section.

B.2 ILE Framework Overview

The ILE framework is web-based, and it was built using *Forio Epicenter*. Epicenter is a very powerful tool, having all what is needed to build an ILE. As mentioned earlier in Chapter 1, the selection of Epicenter, in addition to providing a free service plan, was its capability to directly interface Vensim models, and build a Graphical User Interface (GUI) for the ILE using common standard web technologies HyperText Markup Language (HTML), Cascading Style Sheets (CSS), and JavaScript [261], [262]. For more details, please refer to Chapter 1.

Furthermore, because the system is web-based, we were able to build our PHP web-service, to log the users' interactions with the ILE. The rationale behind selecting the PHP as the programming language for this web-service is basically the popularity of PHP. According to the W3Techs (World Wide Web Technology Surveys) "PHP is used

by 82.3% of all the websites whose server-side programming language [they] know" [146], therefore it becomes easier for others to use our code in their implementations in terms of the probability of them knowing how to write programmes using PHP, and more importantly the availability of web hosts—including free hosts— that support PHP. Back to our web-service description, it is invoked via the ILE web interface to archive both users' inputs (decisions) and variables' behaviour (simulation results) to a database. We wanted to log all policy options chosen by the users while using the ILE, in addition to the results come up from these choices.

Figure B-1 shows the layers diagram of our ILE framework, including the Limesurvey online survey tool that we have used to administer our experiments' questionnaires online. Please refer to Chapters 5 and 9 for further information about these experiments. The left hand side of Figure B-1 shows the Epicenter stack (Coloured layers are implemented by Forio; some of the internal details were omitted from the diagram). The middle stack in Figure B-1 presents our PHP web service, while the right hand side of the figure shows the stack of Limesurvey (All layers –coloured– are provided by Limesurvey). All uncoloured layers were developed by us during the course of this research.

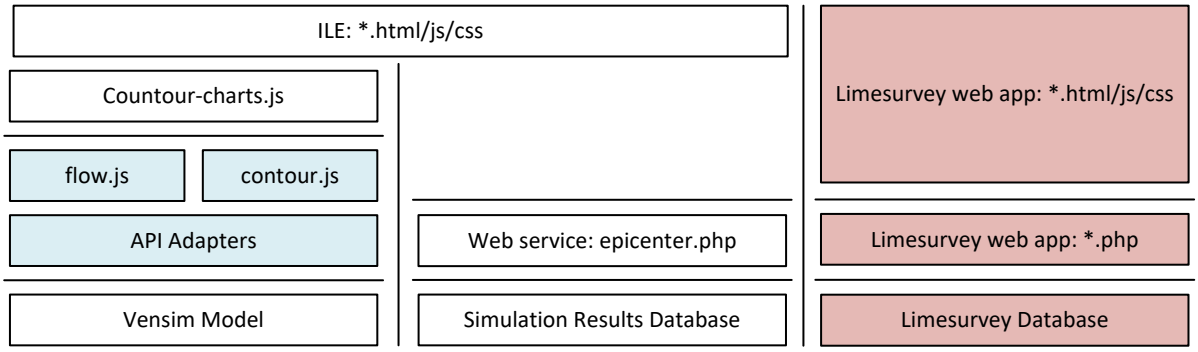


Figure B-1: System's layers diagram

The GUI of our ILE was coded using web technologies based on Epicenter as mentioned before. Epicenter made it possible to use HTML input controls to take ILE users' decisions and show their results using Polymer-based [263] version of their open source Contour charts library [264]. However, this chart implementation has a couple of problems: First, it does not show results of simulations other than of the current, which makes scenarios comparisons very difficult. Second, Polymer-based implementation did not work correctly on Windows Safari and Internet Explorer during our experiments. Accordingly, we have implemented a JavaScript based charts. Our charts are still based on Forio's charts code, and use the same powerful Contour library; but in addition, they are capable of showing many scenarios, and normally work on all web

browsers. We took care of keeping our ILE JavaScript code including charts generic and not model dependant, so that others can use it in building their ILEs.[84]

Figure 1-3 shows the system's overall environment, in terms of physical servers. Using Forio Epicenter is not arbitrary in this implementation, and this why its name appears on the figure, this is not the case for the other web and database servers, at which both Limesurvey and our web-service are running on, as they could be running from anywhere on the Internet.[85]

In the following subsections, we will focus merely on our framework architecture (the uncoloured layers) in Figure B-1. For further information about Limesurvey, or Forio Epicenter's internal processes, reader can check their respective websites.

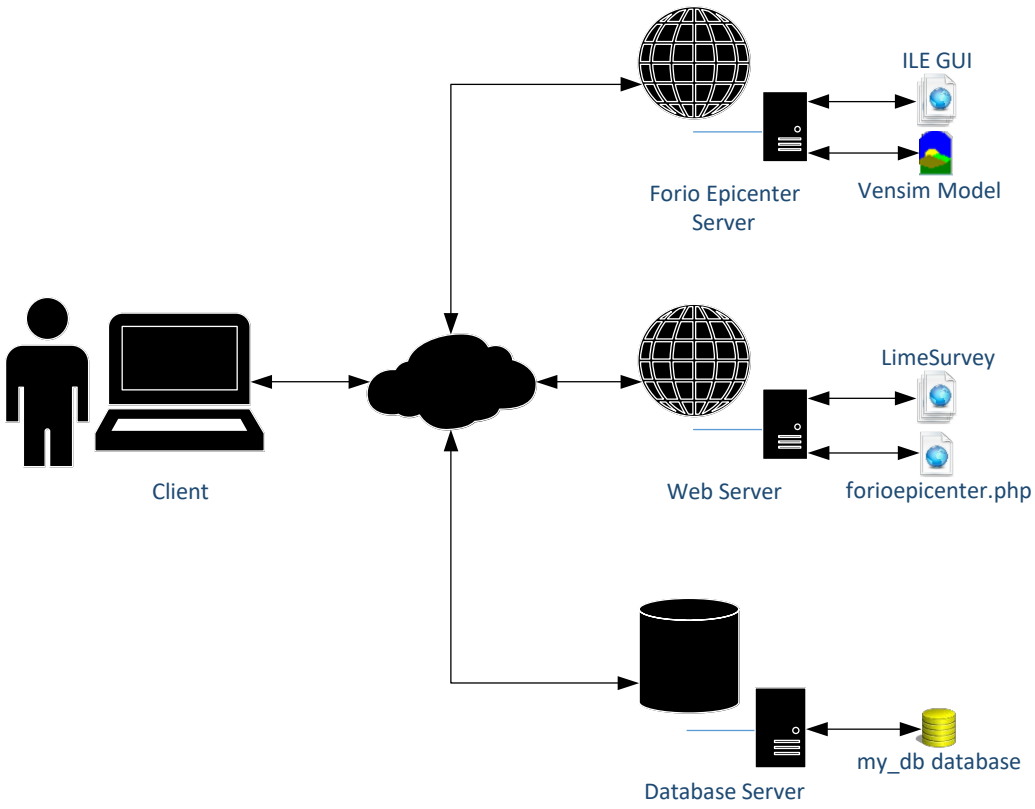


Figure B-2: System's environment

B.3 Data Flow

Figure B-3 shows the context diagram, or level zero Data Flow Diagram of our system. The main external entities of the system in addition to the User are the Vensim model

[84] Available at: forio.com/app/ahmedg/simplified-population-model-example/elements/contour-chart.js

[85] We have authorised Cross-Origin HTTP Request (CORS) using ".htaccess" on our web server.

file and the Database at which simulation decisions and results are stored. User's decision and the simulation results are generated by the User and the Vensim model respectively, and comprise the data to be archived in the Simulations Database. Accordingly, communication between the main process of browsing the ILE web-page and other entities is two ways, except for the Simulations Database, where the communication direction is only towards archiving data. The point behind archiving this data is to use it for further analysis of the Users' behaviour while using the ILE.

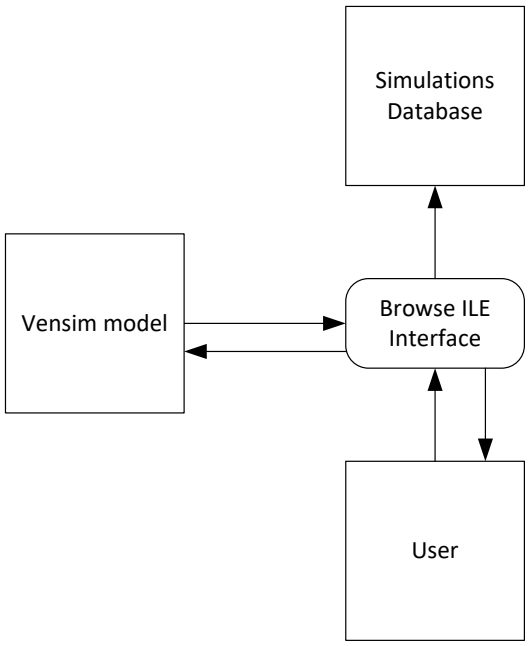


Figure B-3: System's context level Data Flow Diagram

Figure B-4 presents level one Data Flow Diagram of the system. Data Flow Diagrams are not meant to show the execution order, yet we find using this order easier to be read. The first process invoked by the system is retrieving the time parameters from the Vensim model to the time parameters data store. This process is invoked without user interaction, and followed the process of showing and graphing simulation results—in the very first encounter; the showing process is more about initialising the GUI of the ILE in anticipation for the next decision by the User. In the normal case, the first process invoked by the User is select and send decisions to the model, which is followed – normally– by invoking the simulate model process, which simulate the model forward for certain time steps.

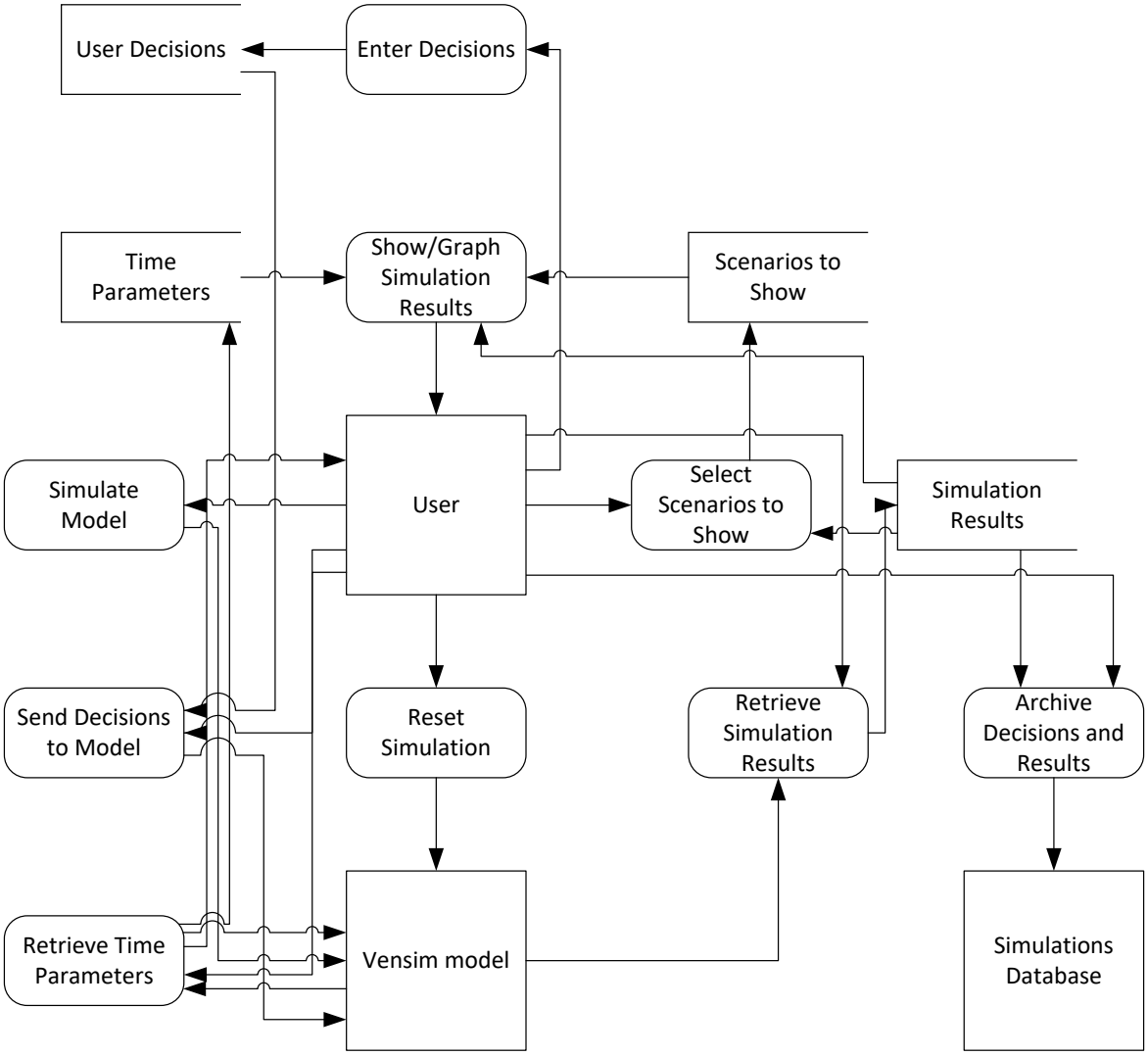


Figure B-4: System's level one Data Flow Diagram

A process of retrieval of simulation results from the model, stores these results to simulation results data store. When one simulation reaches its end, the User can invoke a new one via reset simulation process. Select scenario to show process is invoked by the User to select which scenarios in addition to the possibility of changing these scenarios names or display colours.

All the above-mentioned processes are executed purely between the client-side SDBILE's GUI, and the Forio Epicenter and the Vensim model behind it. To this extent, our System Dynamics based ILE (SDBILE) is fully functioning. However, we also wanted to log the User's interactions with the SDBILE, i.e. archive the decisions he /she takes, and their simulation results to a database. To achieve this, our web-service is called via the process: archive decisions and results, which retrieves the data from the simulation results data store, and archives the decisions and the simulation results to the Database.

B.4 Used Packages

Figure B-5 shows the packages our system depends on including ours. The dependency of one package on another goes against the direction of the arrow, and from perimeter of the figure towards our SDBILE framework in the middle, for example contour.js depends on d3.js, while our contour-chart.js depends on contour.js.

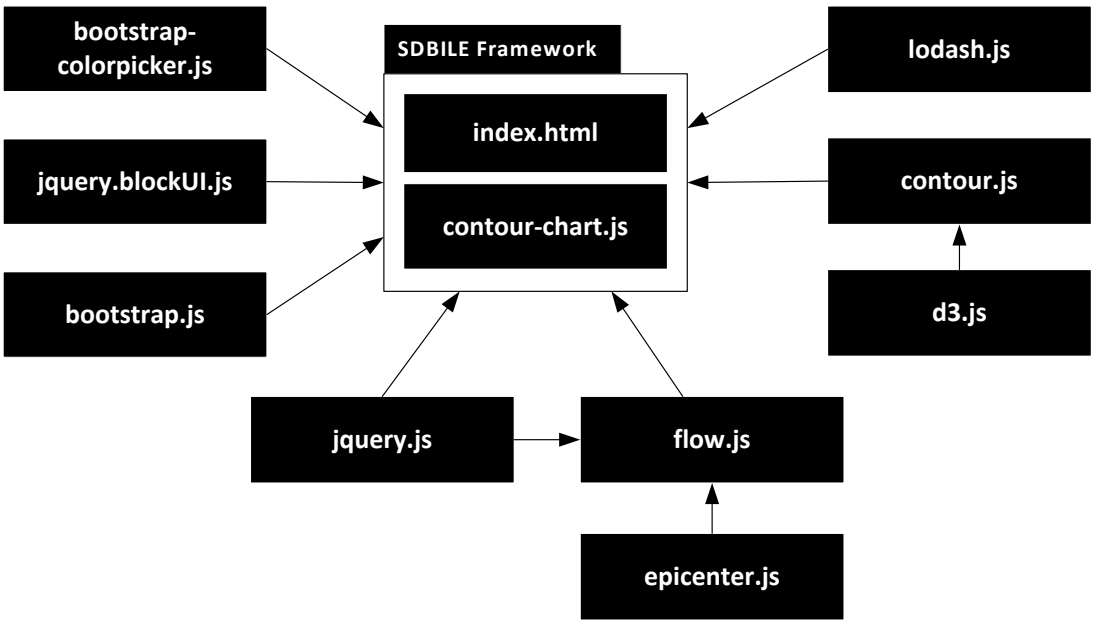


Figure B-5: Packages dependencies

The following table lists these packages, their descriptions, which packages/files exactly are using them, and what they are used for inside the system.

Package name	Description	Used by	Used for
bootstrap.js	"HTML, CSS, and [JavaScript] framework for developing responsive, mobile first projects on the web" [265]. According to W3Techs, bootstrap.js has the second largest market share (18.7%) amongst their sample of websites in November 2016 [266].	index.html	Run the functionalities of the Bootstrap, for example make the help pop-ups appear when the mouse hover a control.
bootstrap-colorpicker.js	Customisable plugin for Bootstrap to enable users to select colours [267]. We have customised this package to suit the scenario/legend selector functionality of our framework.	index.html	Show the colour picker used to change scenario line/bar colour.
contour.js	"Create[s] data visualizations easily, based on intuitive abstractions commonly used in charts and graphs. Contour provides a core set of common visualizations that you can see in our gallery, and it's easy to extend if you want to add your own customizations" [264].	contour-charts.js	To draw the contour charts.
contour-chart.js	Our contour-chart JavaScript package which contains the following *functions*: • `addTimeControls()`→ adds interface hidden textboxes that carries the latest values of the model variables: `TIME`, `INITIAL TIME`, and `FINAL TIME`. • `advanceModel(steps)`→ sends a command to the Forio to advance the Vensim model a number of time steps equal to: `steps`. • `sendDecisions(steps)`→ uses ajax to store user's	index.html	In addition to adding charts to the interface, it contains all JavaScript function that are required by the index.html, example advanceModel(…), sendDecisions(...) … etc.

Package name	Description	Used by	Used for
	decisions to the database, and calls `advanceModel(steps)`. • `getQueryVariables(variable)`→ extracts the database parameters and URL sent to ILE though its URL. • `sendRecentResults()`→ uses ajax to store simulation results to the database. • `resetSimulation(setTime)` → prepares the interface for a new simulation scenario, and calls `resetModel(setTime)`. • `resetModel(setTime)` → sends command to Forio to reset the Vensim model, and advance it to the value of `setTime`. • `addContouChart(chartID, ...)` → adds a new chart to the interface, by instantiating a new object from class `ContourChartClass`. In addition to functions that generate random colours and shades for the charts, and functions that controls the GUI functionalities. Moreover, contour-chart packages contains one *Class*: `ContourChartClass(chartID, ...)` → has all the variables and functions needed draw a chart on the GUI.		
d3.js	"D3.js is a JavaScript library for manipulating documents	contour.js	To draw elements of the contour

Package name	Description	Used by	Used for
	based on data. D3 helps you bring data to life using HTML, SVG, and CSS. D3's emphasis on web standards gives you the full capabilities of modern browsers without tying yourself to a proprietary framework, combining powerful visualization components and a data-driven approach to DOM manipulation" [268].		charts.
epicenter.js	"The Epicenter API Adapters are part of the epicenter.js library. This library abstracts the underlying Epicenter RESTful APIs into a set of services and utilities" [269].	flow.js	This package invokes the Forio API adapters, for example simulate the model.
flow.js	"Flow.js provides two-way data bindings between variables and operations in your project's model and HTML elements in your project's user interface. In this way, Flow.js decouples the model from its interface. This is beneficial as a general design principle, and can be especially helpful for larger development teams where the UI developers and the modellers are different people. If you are comfortable writing HTML and basic JavaScript, using Flow.js can save you significant development time" [270].	index.html	This how index.html connects to the Vensim model. On the other side, flow.js uses epicenter.js to achieve that.
jquery.blockUI .js	"The jQuery BlockUI Plugin lets you simulate synchronous behavior when using AJAX, without locking the browser. When activated, it will prevent user activity with the page (or part of the page) until it is deactivated. BlockUI adds elements	index.html	Block the interface during model processes, so that the user is not able to invoke a new command until the last one finishes.

Package name	Description	Used by	Used for
	to the DOM to give it both the appearance and behavior of blocking user interaction" [271].		
jquery.js	"A very popular library of routines for writing JavaScript applications and automating Web pages. jQuery includes numerous functions for handling HTML and style sheets (CSS) as well as AJAX programming" [272]. According to W3Techs, jquery.js has the largest market share (96.4%) amongst their sample of websites in November 2016 [266].	index.html contour-charts.js flow.js …	index.html/contour-charts.js will use this package as replacement for normal JavaScript syntax. Yet, the most important functionality was the AJAX used to send decisions and results to our PHP web-service.
lodash.js	"Lodash makes JavaScript easier by taking the hassle out of working with arrays, numbers, objects, strings, etc. Lodash's modular methods are great for: Iterating arrays, objects, & strings, Manipulating & testing values, and Creating composite functions" [273].	contour-charts.js	Among other tasks, to do array searching and manipulation.

B.5 Directory Structure

Figure B-6 shows the general directory structure of our ILE framework. In the figure only the basic files/packages are shown, however other files could exist whenever needed either for more functionalities or additional elements on the interface. Furthermore, the packages/files shown in the figure appear in their unminified version—these are the version we provide URLs for in the whole document, as they easier to read, however in the production version we usually use the minified versions —they have same file name with ".min" before the file extension; and as they are smaller in file size, they are easier to download over the network.

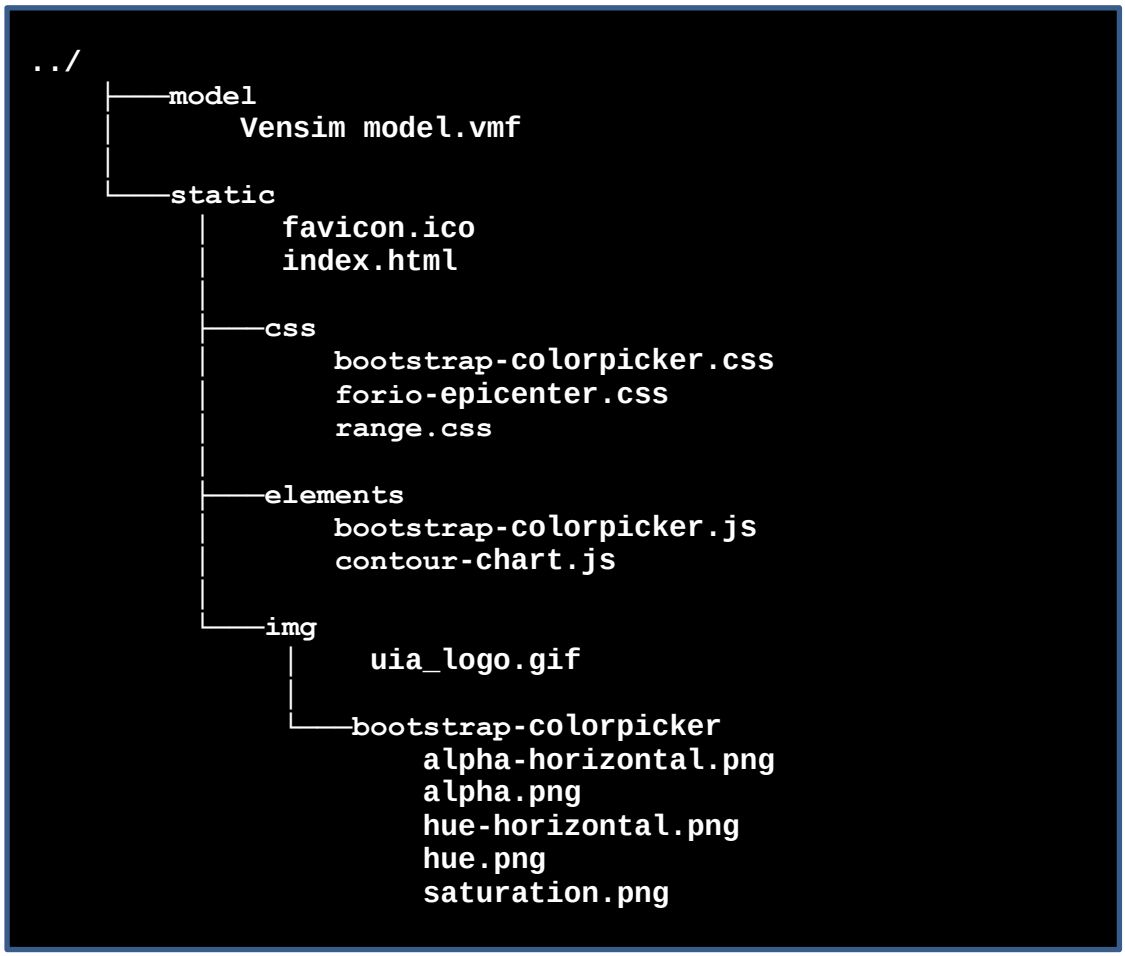


Figure B-6: ILE directory structure

B.6 Database Structure

We have selected MySQL database server for our implementation; however any database server should be suitable, as far as it could be accessed via PHP. The same rationale behind choosing PHP was mentioned in the earlier subsection, the same reason was behind choosing MySQL, according to DB-Engines MySQL is the second popular

database engine after Oracle, which makes it the most popular open source database [152]. Our database itself is very simple, as it contains only two tables, one of them titled "decisions" archives the users' actions, while the other titled "results" archives selected models variables' behaviour. Both tables have the same schema. The following table lists the names and description of the field of both tables, while Figure B-7 shows their schemas:

filedname	Description
SID	A survey ID assigned by Limesurvey during the testing session [274].
SAVEDID	Another ID assigned by Limesurvey during this particular testing session [274].
useridentity	The IP address which is assigned to the user while during this particular testing session.
useragentidentity	Contains information about the web-browser the user is using during particular testing session.
modelurl	Contains the current ILE URL.
modelname	Contains the name of the model (Vensim model file name) which is simulating during particular testing session.
runname	Current scenario name (either the default name assigned by the ILE, or edited by the user).
timestamp	Current timestamp of when this record was stored in the database.
modeltime	The model time step at which the current variable value was taken.
varname	The variable name which the current value was taken for.
varvalue	The current value of the current variable.

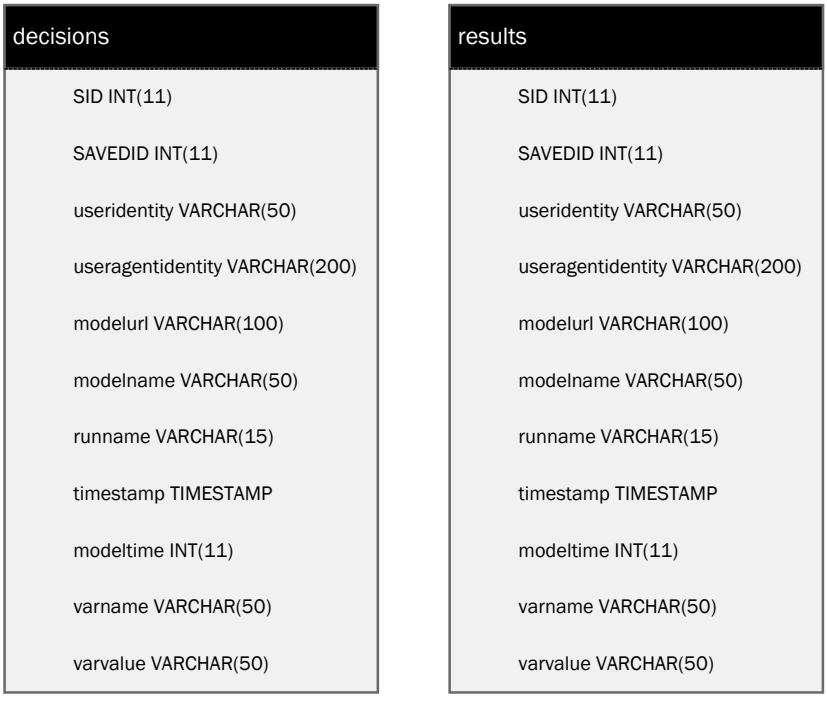


Figure B-7: Database schema

It should be noted that each record in both tables stores data about only one variable and its latest value at certain model's time step (even in the case of the simulation results, where variables are shown as time behaviour, only the latest value will be stored).

B.7 Running SDBILE Example

To be able to practically inspect the network communications among the different components of our ILE framework, we have built a simple SDBILE. We have used the same simplified population example model that we have presented in Chapter 1. Figure B-8 shows the GUI (index.html) of this SDBILE. As shown in the figure, the value of only one decision variable "Carrying Capacity" is to be decided by the user. While for the results, we have chosen to show only the behaviour of "Population".[86]

Like our other SDBILEs presented in Chapters 5 and 9, this SDBILE has 3 simulation control buttons: one to progress the simulation ten month ahead, another to progress the simulation to its end, while the third is to reset the current simulation and start a new one. Similar to our other SDBILEs too, one additional button has been added under the chart to control which scenarios to show in addition to controlling their names and colours. Figure B-9 shows a snapshot of the legend/scenario selector dialogue box.

[86] The ILE is available at: https://forio.com/app/ahmedg/simplified-population-model-example, its model (Vensim file format) in addition to other supporting files are available at: https://forio.com/app/ahmedg/simplified-population-model-example/helper

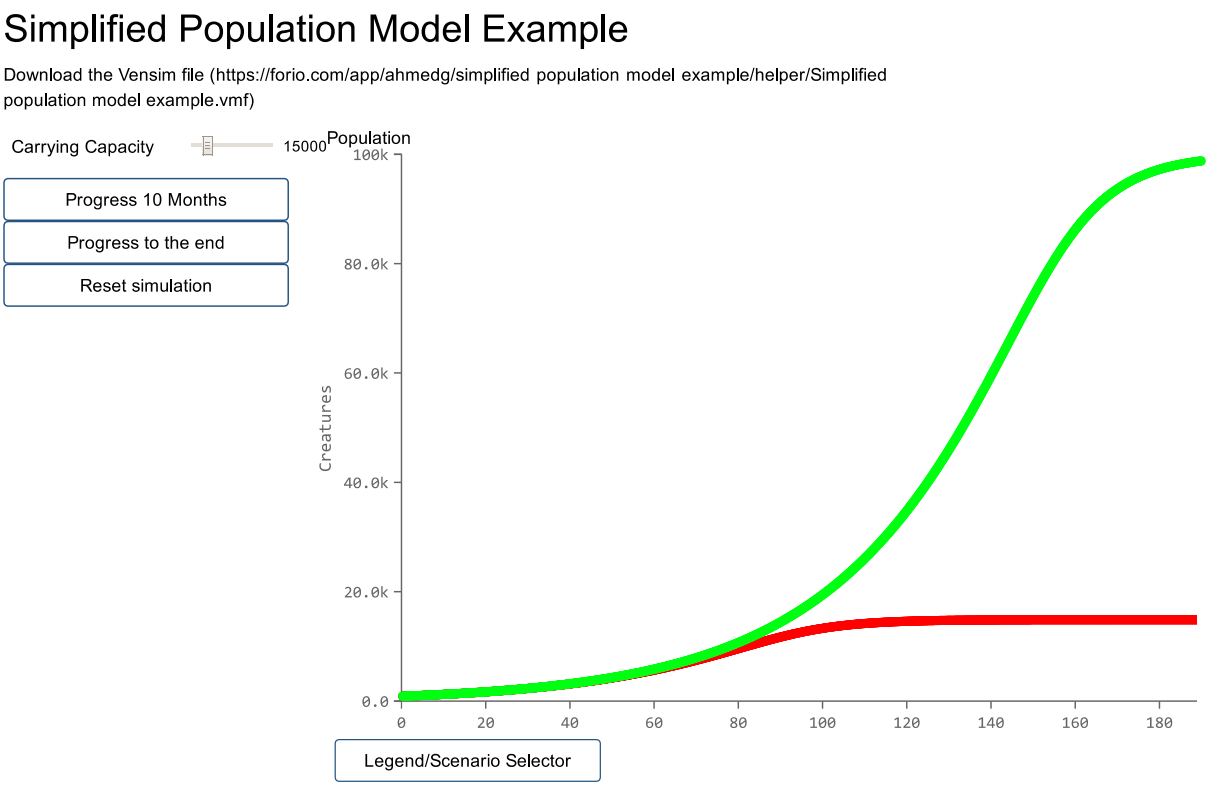


Figure B-8: Simplified Population Model Example SDBILE

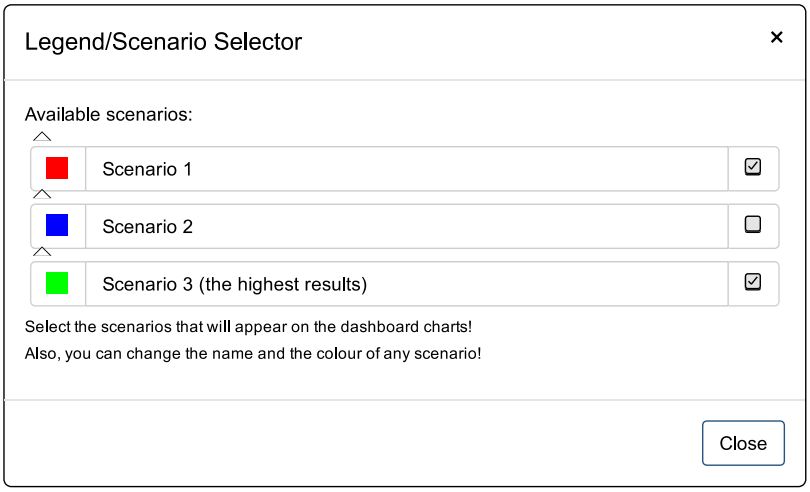


Figure B-9: Legend/Scenario selector of the SDBILE

In the following three subsections, we present the results of inspecting the network communications sequence among the components of our running SDBILE example in two cases: the case of using only the ILE without our PHP web-service, and case of the whole system including the web-service working all together.

B.7.1 Execution and Network Communications Sequence (ILE Only Case)

To inspect and show the execution sequence of packages and network communications between them in the case of the ILE without the PHP web-service, we have used the following URL to load the "index.html" page without invoking the web-service: https://forio.com/app/ahmedg/simplified-population-model-example/index.html

The testing sequence we have used to generate these network communications sequence is as follows:

A. Load index.html

B. Press "Progress 10 months" button

C. Change "Carrying Capacity" slider

D. Press "Progress to the end" button

E. Press "Reset simulation" button

Letters denoting the items of this testing sequence are used in the first column of the following table with the header "**S**" to refer to the respective action in our testing sequence. The network communications were caught using Mozilla Firefox Developers Edition version 52.0.a2. The dumped data was analysed using Telerik Fiddler Web Debugger [275]. The following table shows the compiled results. Figure B-10 shows the timeline of this network communications sequence, the figure was generated using HttpWatch (Basic Edition) [276].

S	ID	Request Method	Host	URL	Content Type
A	1	GET	forio.com	/app/.../index.html	html
A	2	GET	maxcdn.bootstrapcdn.com	/bootstrap/3.3.2/css/bootstrap.min.css	css
A	3	GET	maxcdn.bootstrapcdn.com	/bootstrap/3.3.2/css/bootstrap-theme.min.css	css
A	4	GET	forio.com	/tools/contour/0.9.114/contour.min.css	css
A	5	GET	ajax.googleapis.com	/ajax/libs/jquery/2.1.1/jquery.min.js	js
A	6	GET	maxcdn.bootstrapcdn.com	/bootstrap/3.3.2/js/bootstrap.min.js	js
A	7	GET	cdnjs.cloudflare.com	/ajax/libs/lodash.js/2.4.1/lodash.min.js	js
A	8	GET	cdnjs.cloudflare.com	/ajax/libs/d3/3.5.17/d3.min.js	js
A	9	GET	cdnjs.cloudflare.com	/ajax/libs/jquery.blockUI/2.70/jquery.blockUI.min.js	js
A	10	GET	forio.com	/tools/contour/0.9.114/contour.min.js	js
A	11	GET	forio.com	/tools/js-libs/1.1.2/epicenter.min.js	js
A	12	GET	forio.com	/tools/js-libs/flow/0.8.2/flow.min.js	js
A	13	GET	forio.com	/app/.../css/bootstrap-colorpicker.min.css	css
A	14	GET	forio.com	/app/.../css/forio-epicenter.min.css	css
A	15	GET	forio.com	/app/.../css/range.min.css	css
A	16	GET	forio.com	/app/.../elements/bootstrap-colorpicker.min.js	js
A	17	GET	forio.com	/app/.../elements/contour-chart.min.js	js
A	18	OPTIONS	api.forio.com	/run/.../e0e120a6-7084-4e6d-8a64-95ce49dddb48/	json
A	19	GET	api.forio.com	/run/.../e0e120a6-7084-4e6d-8a64-95ce49dddb48/	json
A	20	OPTIONS	api.forio.com	/run/.../	json
A	21	POST	api.forio.com	/run/.../	json
A	22	OPTIONS	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c/operations/startGame/	json
A	23	POST	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c/operations/startGame/	json
A	24	OPTIONS	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c/operations/stepTo/	json
A	25	POST	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c/operations/stepTo/	json
A	26	OPTIONS	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c/variables/?include=Carrying%20Capacity,Time,Population,FINAL%20TIME,INITIAL%20TIME	json

S	ID	Request Method	Host	URL	Content Type
A	27	GET	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c /variables /?include=Carrying%20Capacity,Time,Population,FINAL %20TIME,INITIAL%20TIME	json
B	28	OP-TIONS	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c /operations/step/	json
B	29	POST	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c /operations/step/	json
B	30	GET	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c /variables /?include=Carrying%20Capacity,Time,Population,FINAL %20TIME,INITIAL%20TIME	json
C	31	OP-TIONS	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c /variables/	json
C	32	PATCH	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c /variables/	json
D	33	POST	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c /operations/step/	json
D	34	GET	api.forio.com	/run/.../2707553d-1add-4b0b-be09-4aedc737e85c /variables /?include=Carrying%20Capacity,Time,Population,FINAL %20TIME,INITIAL%20TIME	json
E	35	POST	api.forio.com	/run/.../	json
E	36	OP-TIONS	api.forio.com	/run/.../26c05031-65cd-4f31-b985-e66ffcec6d42 /operations/startGame/	json
E	37	OP-TIONS	api.forio.com	/run/.../26c05031-65cd-4f31-b985-e66ffcec6d42/variables /?include=Carrying%20Capacity,Time,Population,FINAL %20TIME,INITIAL%20TIME	json
E	38	POST	api.forio.com	/run/.../26c05031-65cd-4f31-b985-e66ffcec6d42 /operations/startGame/	json
E	39	GET	api.forio.com	/run/.../26c05031-65cd-4f31-b985-e66ffcec6d42/variables /?include=Carrying%20Capacity,Time,Population,FINAL %20TIME,INITIAL%20TIME	json
E	40	GET	api.forio.com	/run/.../26c05031-65cd-4f31-b985-e66ffcec6d42/variables /?include=Carrying%20Capacity,Time,Population,FINAL %20TIME,INITIAL%20TIME	json

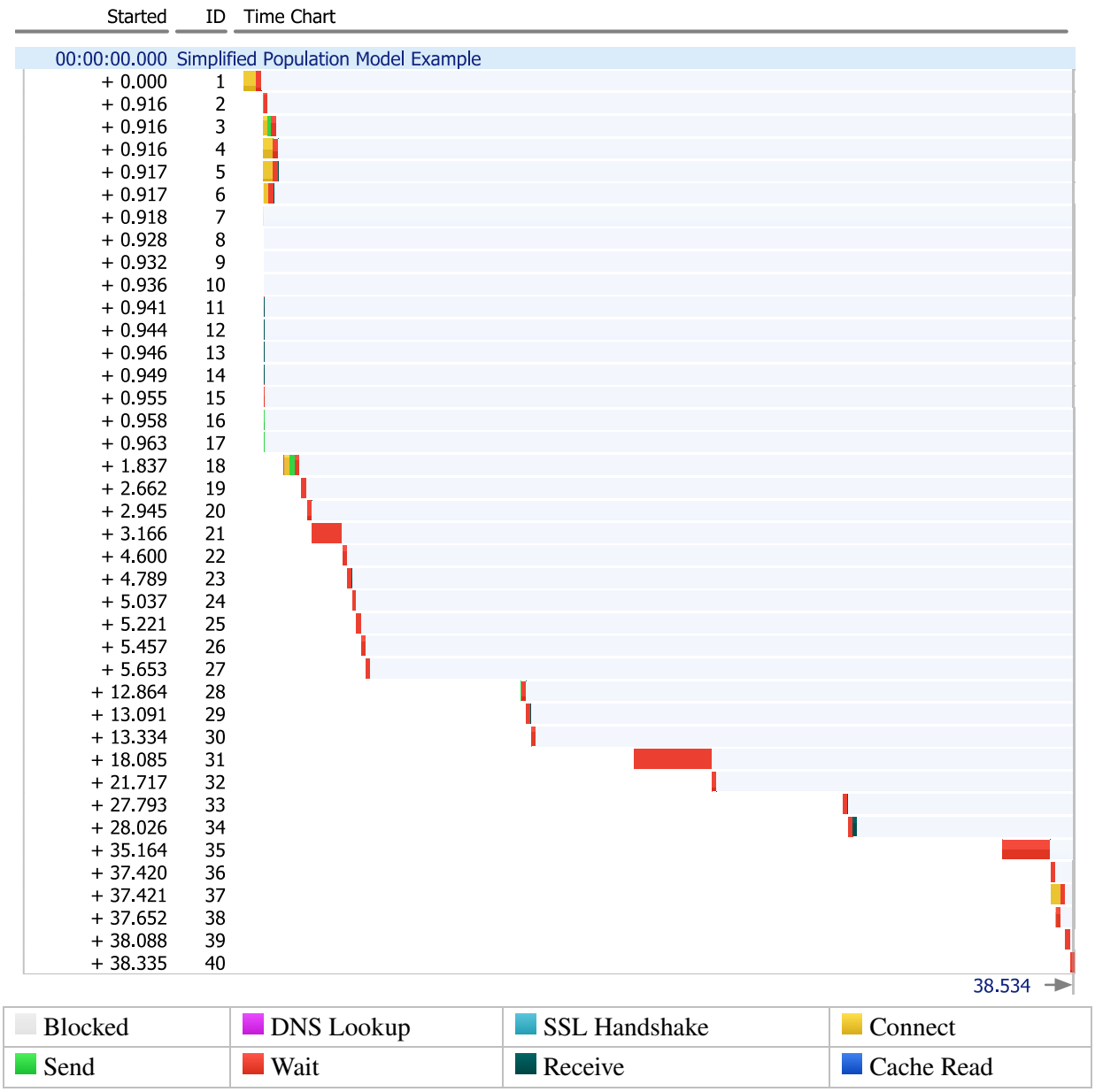


Figure B-10: ILE only case network communications timeline

B.7.2 Execution and Network Communications Sequence (ILE plus the Web-service Case)

In this case, we have invoked the PHP web-service by sending SID, SAVEDID, DBSRVURL to "index.html". As mentioned earlier, SID and SAVEDID are the survey ID and the other ID assigned during this particular testing session respectively by Limesurvey [274]. For testing purpose, we have used the value of "1" for both parameters. The DBSRVURL is the URL of running version of "forioepicenter.php". In this case we have used https://home.uia.no/ahmedg/forioepicenter/forioepicenter.php. The full URL we have used to run this case is: https://forio.com/app/ahmedg/simplified-population-model-example/index.html?SID=1&SAVEDID=1&DBSRVURL=https://home.uia.no/ahmedg/forioepicenter/forioepicenter.php

We have used the same testing sequence we have used in the last subsection to generate the network communications sequence in this case too:

A. Load index.html

B. Press "Progress 10 months" button

C. Change "Carrying Capacity" slider

D. Press "Progress to the end" button

E. Press "Reset simulation" button

Letters denoting the items of this testing sequence are used in the first column of the following table with the header "**S**" to refer to the respective action in our testing sequence. The network communications were caught using Mozilla Firefox Developers Edition version 52.0.a2. The dumped data was analysed using Telerik Fiddler Web Debugger [275]. The following table shows the compiled results. Figure B-11 shows the timeline of this network communications sequence, the figure was generated using HttpWatch (Basic Edition) [276].

S	#	Request Method	Host	URL	Content Type
A	1	GET	forio.com	/app/... /index.html?SID=1&SAVEDID=1&DBSRVURL=https:/ /home.uia.no/ahmedg/forioepicenter/forioepicenter.php	html
A	2	GET	maxcdn.bootstrapcdn.com	/bootstrap/3.3.2/css/bootstrap.min.css	css
A	3	GET	maxcdn.bootstrapcdn.com	/bootstrap/3.3.2/css/bootstrap-theme.min.css	css
A	4	GET	forio.com	/tools/contour/0.9.114/contour.min.css	css
A	5	GET	ajax.googleapis.com	/ajax/libs/jquery/2.1.1/jquery.min.js	js
A	6	GET	maxcdn.bootstrapcdn.com	/bootstrap/3.3.2/js/bootstrap.min.js	js
A	7	GET	cdnjs.cloudflare.com	/ajax/libs/lodash.js/2.4.1/lodash.min.js	js
A	8	GET	cdnjs.cloudflare.com	/ajax/libs/d3/3.5.17/d3.min.js	js
A	9	GET	cdnjs.cloudflare.com	/ajax/libs/jquery.blockUI/2.70/jquery.blockUI.min.js	js
A	10	GET	forio.com	/tools/contour/0.9.114/contour.min.js	js
A	11	GET	forio.com	/tools/js-libs/1.1.2/epicenter.min.js	js
A	12	GET	forio.com	/tools/js-libs/flow/0.8.2/flow.min.js	js
A	13	GET	forio.com	/app/.../css/bootstrap-colorpicker.min.css	css
A	14	GET	forio.com	/app/.../css/forio-epicenter.min.css	css
A	15	GET	forio.com	/app/.../css/range.min.css	css
A	16	GET	forio.com	/app/.../elements/bootstrap-colorpicker.min.js	js
A	17	GET	forio.com	/app/.../elements/contour-chart.min.js	js
A	18	OPTIONS	api.forio.com	/run/.../61fe1c8f-ccee-453a-a705-29d06e6b4bcd/	json
A	19	GET	api.forio.com	/run/.../61fe1c8f-ccee-453a-a705-29d06e6b4bcd/	json
A	20	POST	api.forio.com	/run/.../	json
A	21	OPTIONS	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/operations /startGame/	json
A	22	POST	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/operations /startGame/	json
A	23	OPTIONS	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/operations /stepTo/	json
A	24	POST	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/operations /stepTo/	json
A	25	OPTIONS	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/variables /?include=Carrying%20Capacity,Time,Population,FINAL%20TIME,INITIAL%20TIME	json

S	#	Request Method	Host	URL	Content Type
A	26	GET	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/variables/?include=Carrying%20Capacity,Time,Population,FINAL%20TIME,INITIAL%20TIME	json
A	27	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
B	28	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
B	29	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
B	30	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
B	31	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
B	32	OPTIONS	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/operations/step/	json
B	33	POST	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/operations/step/	json
B	34	GET	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/variables/?include=Carrying%20Capacity,Time,Population,FINAL%20TIME,INITIAL%20TIME	json
B	35	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
C	36	OPTIONS	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/variables/	json
C	37	PATCH	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/variables/	json
D	38	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
D	39	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
D	40	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
D	41	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
D	42	POST	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/operations/step/	json
D	43	GET	api.forio.com	/run/.../6777e3b1-387f-49ff-88d1-700c9d2ee327/variables/?include=Carrying%20Capacity,Time,Population,FINAL%20TIME,INITIAL%20TIME	json
D	44	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html
E	45	POST	api.forio.com	/run/.../	json
E	46	OPTIONS	api.forio.com	/run/.../a3d218ec-1941-497e-9088-fe4c8fdd4d17/operations/startGame/	json
E	47	OPTIONS	api.forio.com	/run/.../a3d218ec-1941-497e-9088-fe4c8fdd4d17/variables/?include=Carrying%20Capacity,Time,Population,FINAL%20TIME,INITIAL%20TIME	json
E	48	POST	api.forio.com	/run/.../a3d218ec-1941-497e-9088-fe4c8fdd4d17/operations/startGame/	json
E	49	GET	api.forio.com	/run/.../a3d218ec-1941-497e-9088-fe4c8fdd4d17/variables/?include=Carrying%20Capacity,Time,Population,FINAL%20TIME,INITIAL%20TIME	json
E	50	GET	api.forio.com	/run/.../a3d218ec-1941-497e-9088-fe4c8fdd4d17/variables/?include=Carrying%20Capacity,Time,Population,FINAL%	json

S	#	Request Method	Host	URL	Content Type
				20TIME,INITIAL%20TIME	
E	51	POST	home.uia.no	/ahmedg/forioepicenter/forioepicenter.php	html

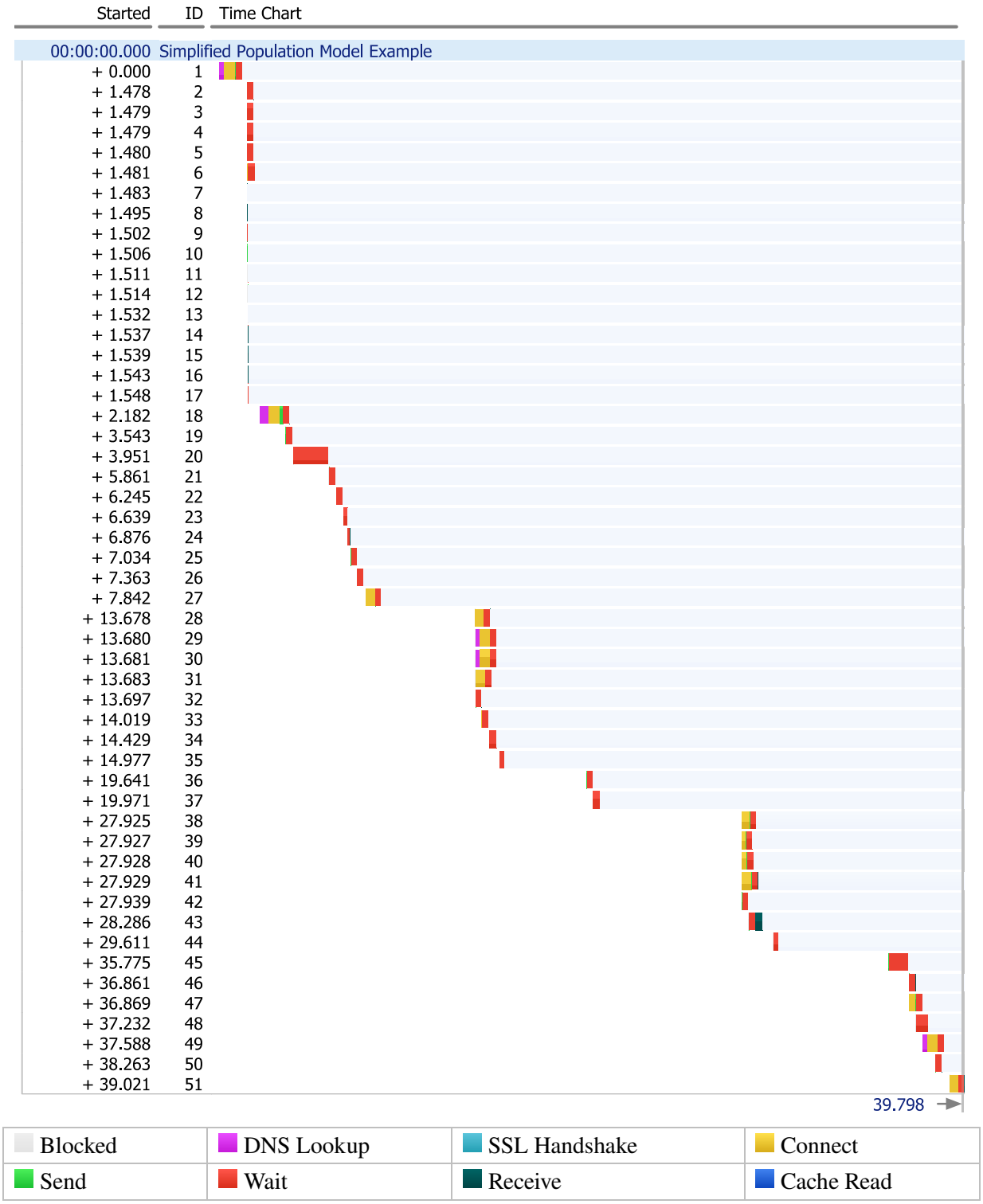


Figure B-11: ILE plus the web-service case network communications timeline

B.7.3 Archived Data (ILE plus the Web-service Case)

In this section, we present the data archived in the database as a result of network communications sequence (ILE plus the Web-service) that we have invoked in Subsection 0.

B.7.3.1 Database `decisions` Table

The following table shows the data resulted from the following **SQL query:** "`SELECT * FROM `decisions`;`", and it is **generated by:** phpMyAdmin 3.3.7 / MySQL 5.0.95

SID	SAVEDID	useridentity	useragentidentity	modelurl	modelname	runname	timestamp	modeltime	varname	varvalue
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	https://forio.com/app/ahmedg /simplified-population-model-example /index.html?SID=1&SAVEDID=1&DBSRVURL	Simplified population model example.vmf	Scenario-1	2016-11-24 03:39:10	0	Time	0
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	https://forio.com/app/ahmedg /simplified-population-model-example /index.html?SID=1&SAVEDID=1&DBSRVURL	Simplified population model example.vmf	Scenario-1	2016-11-24 03:39:10	0	FINAL TIME	200
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	https://forio.com/app/ahmedg /simplified-population-model-example /index.html?SID=1&SAVEDID=1&DBSRVURL	Simplified population model example.vmf	Scenario-1	2016-11-24 03:39:10	0	INITIAL TIME	0
1	1	90.149.34.2	Mozilla/5.0 (Windows NT 6.1;	https://forio.com/app/ahmedg	Simplified	Scenar-	2016-11-	0	Carry-	15000

SID	SAVEDID	useridenti-ty	useragentidentity	modelurl	mod-elname	run-name	timesta mp	model-time	var-name	varvalue
		48	WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	/simplified-population-model-example /index.html?SID=1&SAVEDID=1&DBSRVURL	population model ex-ample.vmf	io-1	24 03:39:10		ing Capaci-ty	
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	https://forio.com/app/ahmedg /simplified-population-model-example /index.html?SID=1&SAVEDID=1&DBSRVURL	Simplified population model ex-ample.vmf	Scenar-io-1	2016-11-24 03:39:14	10	Time	10
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	https://forio.com/app/ahmedg /simplified-population-model-example /index.html?SID=1&SAVEDID=1&DBSRVURL	Simplified population model ex-ample.vmf	Scenar-io-1	2016-11-24 03:39:14	10	FINAL TIME	200
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	https://forio.com/app/ahmedg /simplified-population-model-example /index.html?SID=1&SAVEDID=1&DBSRVURL	Simplified population model ex-ample.vmf	Scenar-io-1	2016-11-24 03:39:14	10	INI-TIAL TIME	0
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	https://forio.com/app/ahmedg /simplified-population-model-example /index.html?SID=1&SAVEDID=1&DBSRVURL	Simplified population model ex-ample.vmf	Scenar-io-1	2016-11-24 03:39:14	10	Carry-ing Capaci-ty	100000

B.7.3.2 Database `result` Table

The following table shows the data resulted from the following **SQL query:** "`SELECT * FROM `results`;`", and it is **generated by:** phpMyAdmin 3.3.7 / MySQL 5.0.95

SID	SAVEDID	useridenti-ty	useragentidentity	modelurl	mod-elname	run-name	timesta mp	model-time	var-name	varvalue
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	https://forio.com/app/ahmedg /simplified-population-model-example /index.html?SID=1&SAVEDID=1 &DBSRVURL	Simpli-fied pop-ulation model exam-ple.vmf	Scenar-io-1	2016-11-24 03:39:09	0	Popula-tion	1000
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	https://forio.com/app/ahmedg /simplified-population-model-example /index.html?SID=1&SAVEDID=1 &DBSRVURL	Simpli-fied pop-ulation model exam-ple.vmf	Scenar-io-1	2016-11-24 03:39:11	10	Popula-tion	1347.446044 9219
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome /54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	https://forio.com/app/ahmedg /simplified-population-model-example /index.html?SID=1&SAVEDID=1 &DBSRVURL	Simpli-fied pop-ulation model exam-ple.vmf	Scenar-io-1	2016-11-24 03:39:14	200	Popula-tion	99565.7421875
1	1	90.149.34.248	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome	https://forio.com/app/ahmedg /simplified-population-model-example	Simpli-fied pop-ulation	Scenar-io-2	2016-11-24 03:39:1	0	Popula-tion	1000

SID	SAVEDID	useridenti-ty	useragentidentity	modelurl	mod-elname	run-name	timestamp	model-time	var-name	varvalue
			/54.0.2840.87 Safari/537.36 OPR /41.0.2353.56	/index.html?SID=1&SAVEDID=1 &DBSRVURL	model exam-ple.vmf		9			

B.8 Accessibility

All our SDBILEs' interfaces are developed using Bootstrap [265]. "Bootstrap follows common web standards and –with minimal extra effort– can be used to create sites that are accessible to those using [Assistive Technology]" [277]. We made sure that our SDBILEs' GUIs are in conformance with WCAG 2.0 guidelines –including our Simplified Population Model Example ILE, by testing them using the European Internet Inclusion Initiative page-checker (EIII Page Checker) [278].[87] Any non-conformance discovered was fixed according to WCAG 2.0 guidelines. Figure B-12, Figure B-13, and Figure B-14 shows the accessibility check results for all our SDBILEs.

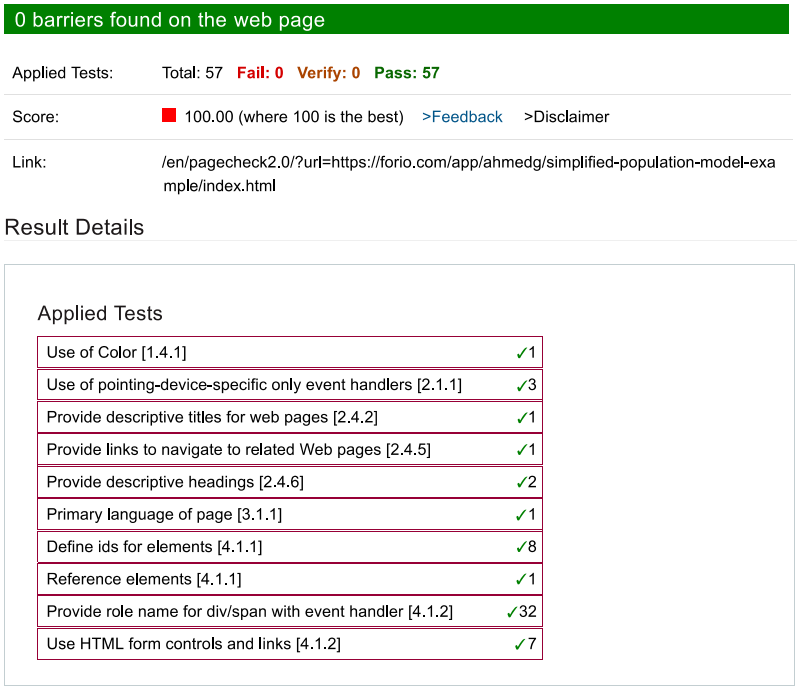
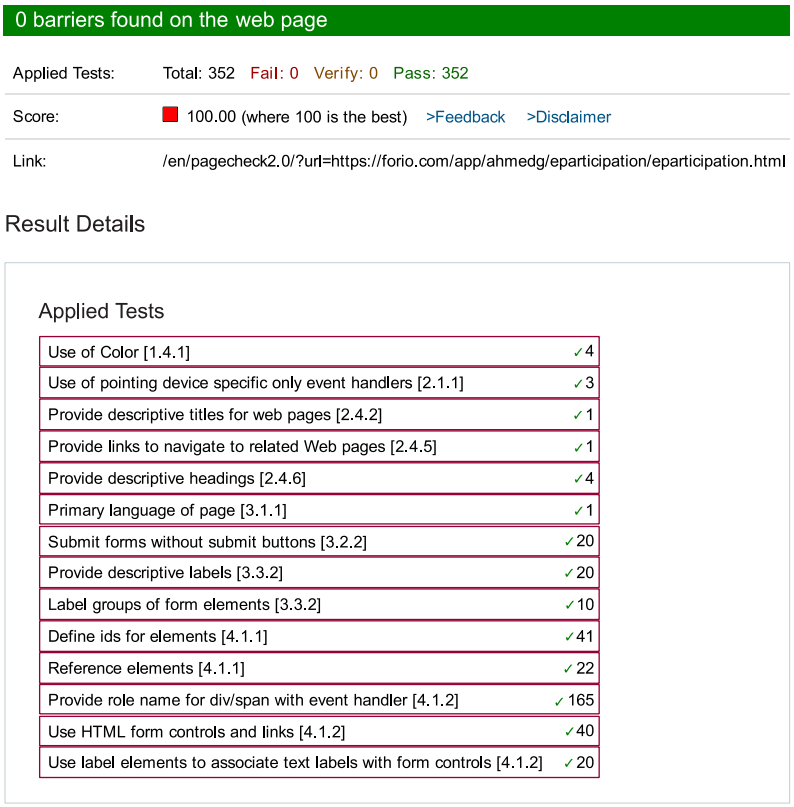


Figure B-12: Simplified population model example SDBILE accessibility check results

[87] This accessibility page-checker is the successor of the eGovMon project's accessibility page-checker.



0 barriers found on the web page

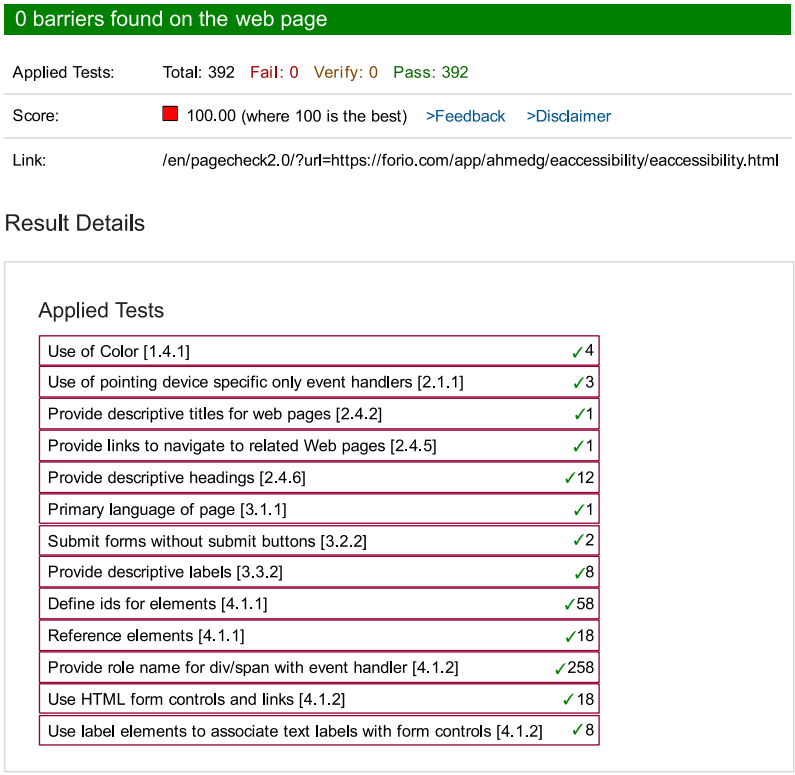
Applied Tests:	Total: 352 Fail: 0 Verify: 0 Pass: 352
Score:	100.00 (where 100 is the best) >Feedback >Disclaimer
Link:	/en/pagecheck2.0/?url=https://forio.com/app/ahmedg/eparticipation/eparticipation.html

Result Details

Applied Tests

Use of Color [1.4.1]	✓4
Use of pointing device specific only event handlers [2.1.1]	✓3
Provide descriptive titles for web pages [2.4.2]	✓1
Provide links to navigate to related Web pages [2.4.5]	✓1
Provide descriptive headings [2.4.6]	✓4
Primary language of page [3.1.1]	✓1
Submit forms without submit buttons [3.2.2]	✓20
Provide descriptive labels [3.3.2]	✓20
Label groups of form elements [3.3.2]	✓10
Define ids for elements [4.1.1]	✓41
Reference elements [4.1.1]	✓22
Provide role name for div/span with event handler [4.1.2]	✓165
Use HTML form controls and links [4.1.2]	✓40
Use label elements to associate text labels with form controls [4.1.2]	✓20

Figure B-13: eParticipation SDBILE accessibility check results



0 barriers found on the web page

Applied Tests:	Total: 392 Fail: 0 Verify: 0 Pass: 392
Score:	100.00 (where 100 is the best) >Feedback >Disclaimer
Link:	/en/pagecheck2.0/?url=https://forio.com/app/ahmedg/eaccessibility/eaccessibility.html

Result Details

Applied Tests

Use of Color [1.4.1]	✓4
Use of pointing device specific only event handlers [2.1.1]	✓3
Provide descriptive titles for web pages [2.4.2]	✓1
Provide links to navigate to related Web pages [2.4.5]	✓1
Provide descriptive headings [2.4.6]	✓12
Primary language of page [3.1.1]	✓1
Submit forms without submit buttons [3.2.2]	✓2
Provide descriptive labels [3.3.2]	✓8
Define ids for elements [4.1.1]	✓58
Reference elements [4.1.1]	✓18
Provide role name for div/span with event handler [4.1.2]	✓258
Use HTML form controls and links [4.1.2]	✓18
Use label elements to associate text labels with form controls [4.1.2]	✓8

Figure B-14: eAccessibility SDBILE accessibility check results

B.9 Abbreviations and Definitions

AJAX	Asynchronous JavaScript and XML: “Using an enhancement in JavaScript that allows Web pages to be more interactive and behave like local applications, which are also known as "rich client" applications. AJAX enables the Web page to retrieve small amounts of data from the server without reloading the entire page” [279].
API	Application Programming Interface: “A language and message format used by an application program to communicate with the operating system or some other control program such as a database management system (DBMS) or communications protocol. APIs are implemented by writing function calls in the program, which provide the linkage to the required subroutine for execution. Thus, an API implies that a driver or program module is available in the computer to perform the operation or that software must be linked into the existing program to perform the tasks” [280].
API Adapter	“A windows service and related applications that runs on an agent computer. The Adapter create a virtual web server (on a defined port), that when requested via something like a web browser, will respond with HTML, xml or json code.” [281]
CSS	Cascading Style Sheets: “A style sheet format for HTML documents endorsed by the World Wide Web Consortium. CSS1 (Version 1.0) provided hundreds of layout settings that can be applied to all the subsequent HTML pages that are downloaded. CSS2 (Version 2.0) added support for XML, oral presentations for the visually impaired, downloadable fonts and other enhancements” [282].
GUI	Graphical User Interface: “The common method of interacting with a computer that allows any graphics image to be displayed on screen. Except for entering text on the keyboard, the primary way the computer is operated is with a mouse or touchpad pointing device. The mouse/touchpad is used to select icons and menu options as well as move and resize windows that frame the application and elements within it. The major GUIs

	are Windows and Mac along with GNOME and KDE for Linux" [283]
HTML	HyperText Markup Language: "The standard document format for Web pages, defined by the Internet Engineering Task Force (IETF). Every Web page contains HTML tags (codes) embedded in the text that define the page layout, fonts and hypertext links. The link contains the URL (address) of another Web page on that same server or any server worldwide, hence "World Wide" Web. The HTML tags also define the graphic elements on the page, each of which is a separate file on a local or remote server" [284].
JavaScript	"A widely used programming language that is embedded in most Web pages. Supported by all Web browsers, it enables interactive functions to be added to Web pages, which are otherwise static. JavaScript evolved from Netscape's LiveScript language" [285]
MySQL	"A very popular SQL-based relational DBMS for both Web and embedded applications. Pronounced "my S-Q-L," MySQL runs under all popular operating systems. The free, open source versions are available under the GNU license, and hundreds of millions of copies have been downloaded worldwide" [286].
PHP	PHP Hypertext Preprocessor: "A scripting language that is widely used to create dynamic Web pages. Combining syntax from the C, Java and Perl languages, PHP code is embedded within HTML pages for server side execution. It is commonly used to extract data out of a database on the Web server and present it on the Web page" [287].
SQL	Structured Query Language: "[A] language used to interrogate and process data in a relational database. Originally developed by IBM for its mainframes, SQL commands can be used to interactively work with a database or can be embedded within a script or programming language to interface to a database. Programming extensions to SQL have turned it into a full-blown database programming language, and all major database management systems (DBMSs) support it." [288].

WCAG 2.0	Web Content Accessibility Guidelines 2.0: A set of web accessibility guidelines “developed through the W3C process in cooperation with individuals and organizations around the world, with a goal of proving a single shared standard for web content accessibility that meets the needs of individuals, organizations, and governments internationally” [289].

C Literature Review Concept Matrix

Paper title	Publishing year /Publication type	Short description	Information source(s)	Used tool(s)/Used method(s)	Scope/ Usage
Modeling intergovernmental collaboration: a system dynamics approach [172]	2002/Conference paper	Developing an SD model depicting the dynamics controlling intergovernmental information system project stakeholders' collaboration, trust building, and knowledge sharing	• Group model building • Interviews	• Stock and Flow diagram • Simulation results	New York state, Homeless Information Management System (HIMS), USA
A Dynamic Theory of Collaboration: A Structural Approach to Facilitating Intergovernmental Use of Information Technology [173]	2003/Conference paper	Exploring the dynamics of trust, collaboration and knowledge sharing among different governmental agencies in implementing the Homeless Information Management System (HIMS) in New York state, USA	• Case study • Group model building	• CLD • Stock and Flow diagram • Simulation results	New York state, Homeless Information Management System (HIMS), USA
Knowledge and The Development of Interpersonal Trust: A Dynamic Model [174]	2004/Conference paper	Knowledge sharing and interpersonal trust development, based on [173]	• Case study • Literature review • Interviews	• CLD • Simulation results	New York state, Homeless Information Management System (HIMS), USA
Modelling Methods for	2005/Book section	Presenting 2 models to	• Case study	• Stock and Flow dia-	New York state, Home-

Paper title	Publishing year /Publication type	Short description	Information source(s)	Used tool(s)/Used method(s)	Scope/ Usage
Information Integration: Comparative Cases in e-Government [175]		comparing between applying Discrete Event and SD modelling methods to the eGovernment field –We only reviewed the SD model (HIMS) [173]. Compared to the original model, this model focused only on trust dynamics	• Group model building	gram • Simulation results	less Information Management System (HIMS), USA
Exploring the dynamics of collaboration in interorganizational settings [176]	2006/Book section	Interorganizational collaboration	• Case study • Group model building • Interviews	• CLD • Stock and Flow diagram	New York state, Homeless Information Management System (HIMS), USA
Knowledge sharing and trust in collaborative requirements analysis [177]	2008/Journal article*	The paper is an extended version of [173]			
Toward a Theory of e-Government Interorganizational Collaboration: Generic Structures for Cross-Boundary Requirements Analysis	2013/Book section	Presenting a generic theory of inter-organisational cross-boundaries eGovernment projects	Case study	CLD	General eGovernment projects based on the New York state's Homeless Information Management System (HIMS) [173]

Paper title	Publishing year /Publication type	Short description	Information source(s)	Used tool(s)/Used method(s)	Scope/ Usage
[178]					
Trust and Collaboration in Interorganizational Information Technology Projects in the Public Sector [179]	2013/Journal article	Presenting a model that explains the role of collaboration in a public sector project in building trust among stakeholders	Case study	• CLD • Stock and Flow diagram • Simulation results	General eGovernment projects based on the New York state's Homeless Information Management System (HIMS) [173]
Rules, Norms, and Individual Preferences for Action: An Institutional Framework to Understand the Dynamics of e-Government [31]	2004/Conference paper	Presenting a theoretical and analytical framework to explain eGovernment development aiming at finding leverage points of intervention.	Literature review	CLD	General eGovernment projects
Information systems development as emergent socio-technical change: a practice approach [183]	2005/Journal article	Investigates the social and organizational factors causing success and failure of information systems development	• Case study • Literature review • Interviews	Stock and Flow diagram	General eGovernment projects based on the New York state's Multipurpose Access for Customer Relations and Operational Support (MACROS) project
Using System Dynamics for Theory Building in Digital Government Research: Exploring the	2006/Conference paper	Exploring the main eGovernment organisational and technological sophistication via a pre-	Literature review	CLD	General eGovernment projects

Paper title	Publishing year /Publication type	Short description	Information source(s)	Used tool(s)/Used method(s)	Scope/ Usage
Dynamics of Digital Government Evolution [184]		liminary CLD to be used later in group model building sessions			
E-Government Risks Research Based on System Dynamics [93]	2007/Conference paper	Presents a model to estimate the risks to eGovernment service, and how to sustain their security	Literature review	Stock and Flow diagram (open system [290] /open-loop system [11])	General eGovernment projects
Emergence of the Governance Structure for Information Integration across Governmental Agencies: A System Dynamics Approach [181]	2007/Conference paper	Presents a dynamical theory and a model that describes the process of information integration in the context of collaboration in an intergovernmental agencies settings	Group model building	• Stock and Flow diagram • Simulation results	General theory and its application to New York State's criminal justice users' "one-stop shopping" access to needed information project, USA
Assessing municipal wireless network projects: the case of Wi-Fi Philadelphia [92]	2008/Journal article	Introduces a model that helps in deciding if the city of Philadelphia should compete with private sector providers in the local Wi-Fi market	Case study	• CLD • Stock and Flow diagram • Simulation results	City of Philadelphia, USA
Using institutional theory and dynamic simula-	2009/Conference paper*	Combining the institutional theory [291],	• Interviews • Survey	• Stock and Flow diagram	"eMexico program", Mexico

Paper title	Publishing year /Publication type	Short description	Information source(s)	Used tool(s)/Used method(s)	Scope/ Usage
tion to understand complex e-Government phenomena [185]		[292] and SD to build a preliminary model to understand the interactions between institutional, organisational, and technological components in the eGovernment context in Mexico "eMexico program" – a government initiative that includes different internet service portals	• Case studies	• Simulation results	
Using institutional theory and dynamic simulation to understand complex e-Government phenomena [30]	2011/Journal article	The paper is an extended version of [185]			
Transparency and Openness in Government: A System Dynamics Perspective [182]	2011/Conference paper	Introducing an SD model that envisage the relationships among different government stakeholders (the congress, the president, the people, and the press)	Literature review	• Stock and Flow diagram • Simulation results	General eGovernment projects, USA

Paper title	Publishing year /Publication type	Short description	Information source(s)	Used tool(s)/Used method(s)	Scope/ Usage
		as controlled by the US constitution, focusing on the effect of transparency and open government in promoting a less secretive government			
Understanding the Context of Large-Scale IT Failures [193]	2012/Journal article	Addressing the problem of requirement shifting in large government IT projects using SD modelling	Case studies	• CLD • Stock and Flow diagram • Simulation results	General eGovernment projects, USA
A Resource-Based View of Local Digital Government: Core Capabilities for Success from the Case of Mexico [189]	2011/Conference paper*	Modelling resource-based view [293], [294] of the organisation using System Dynamics modelling	• Workshops • Case studies	Stock and Flow diagram (conceptual level)	General municipal local government, Mexico
Identifying Core Capabilities for Transformational Local Digital Government: A Preliminary Conceptual Model [190]	2012/Book section	Introduce a preliminary conceptual System Dynamics model that renders the fundamental capabilities and resources required to achieve a successful	• Workshops • Case studies	Stock and Flow diagram (conceptual level)	General municipal local government, Mexico

Paper title	Publishing year /Publication type	Short description	Information source(s)	Used tool(s)/Used method(s)	Scope/ Usage
		transformation to eGovernment on the local level. The paper is an extended version of [189]			
A Dynamic-Capabilities View of Local Electronic Government: Lessons from Two Successful Cases [192]	2012/Conference paper	Using System Dynamics Modelling and dynamic-capabilities view of an organisation [191] to identify the core capabilities and resources necessary to **develop** a successful eGovernment strategy. The paper is a continuation and extended version of [190] and [189]	• Workshops • Case studies	Simulation results	General municipal local government, Mexico
Territorial Governance, E-Government and Sustainable Development Policy: A System Dynamics Approach [188]	2013/Book section	Showing how can System Dynamics be used as a tool of eGovernment to support sustainable development	• Case study	• CLD • Stock and Flow diagram (conceptual level)	Territorial eGovernment level, Sweden
Understanding the Coevolution of Institutions, Technology, and	2013/Conference paper	Introducing a theory of the co-evolution of technology, organiza-	• Case study • Interviews	Stock and Flow diagram	Puebla state portal, Mexico

Paper title	Publishing year /Publication type	Short description	Information source(s)	Used tool(s)/Used method(s)	Scope/ Usage
Organizations: The Enactment of the State Government Portal of Puebla [194]		tional networks, and institutional arrangements in government transformation via IT			
Digital government transformation and Internet portals: The coevolution of technology, organizations, and institutions [195]	2014/Journal article	The paper is an extended version of [194]			

Appendix II. Documentation of the Models

A Documentation of PWD from Welfare to Jobs SD Model[88]

A.1 Model Assessment Results

Model Information	Number
Total Number of Variables	160
Total Number of State Variables (Level+Smooth+Delay Variables)	10 (6.3%)
Total Number of Stocks (Stocks in Level+Smooth+Delay Variables) †	10 (6.3%)
Total Number of Macros	0
Variables with Source Information	0
Variables with Dimensionless Units	71 (44.4%)
Variables without Predefined Min or Max Values	113 (70.6%)
Function Sensitivity Parameters	0
Data Lookup Tables	0
Time Unit	Year
Initial Time	2001
Final Time	2047
Reported Time Interval	TIME STEP
Time Step	0.125
Model Is Fully Formulated	Yes
Modeler-Defined Groups	Yes
VPM File Available	Yes
Equations with Embedded Data (0 and 1 constants ignored)	16 (10%)
Equations With Unit Errors or Warnings	0
Variables Not in Any View	0
Incompletely Defined Subscripted Variables	0
Nonmonotonic Lookup Functions	3 (1.9%)
Cascading (Chained) Lookup Functions	0
Non-Zero End Sloped Lookup Functions	6 (3.8%)
Equations with "IF THEN ELSE" Functions	22 (13.8%)
Equations with "MIN" or "MAX" Functions	0
Equations with "STEP", "PULSE", or Related Functions	1 (0.6%)
Unused Variables	0
Supplementary Variables	26
Supplementary Variables Being Used	0
Complex Variable Formulations (Richardson's Rule = 3)	29
Complex Stock Formulations	0

Symbols, Types, Group and abbreviations used in the model documentation

Types:	**C** : Constant (41)	"A variable whose value does not change over time." [229]
	L : Level	"Levels (also called accumulations, stocks and states). These change only over time and the values they take on at any time depend on the value they (and other

[88] The model (Vensim file format) is available at: https://forio.com/app/ahmedg/eparticipation/helper/

(10 / **10**) *	variables) took on at previous times. … The Level variables ultimately determine the dynamic behavior of a system." [229]
LI : Level Initial (8)	These are constants used as the initial values for the Levels. Sometimes we chose to initialise the Level directly within its equation, without the need to have an independent constant to inilaise it.
F : Flow (23)	Also called Rate. "These are the variables that directly change the Levels. Rates are essentially the same as Auxiliaries and differ only in the way they are used in a model." [229]
A : Auxiliary (91)	"Any dynamic variable that is computed from other variables at a given time. Auxiliaries are typically the most numerous variable type. An auxiliary variable has an expression involving other variables in its equation." [229]
G : Game (12)	A constant value, except when the model is set to run in the gaming mode. In the gaming mode, the user input is used instead of the constant value.
T : Lookup (6 / **6**) **	"Nonlinear functions with numerical parameters (where the parameters are the x- and y-axis values). They are defined in equations beginning with a left parenthesis (and ending with a right parenthesis)." [229]

* (state variables / **total stocks**).

** (lookup variables / **lookup tables**).

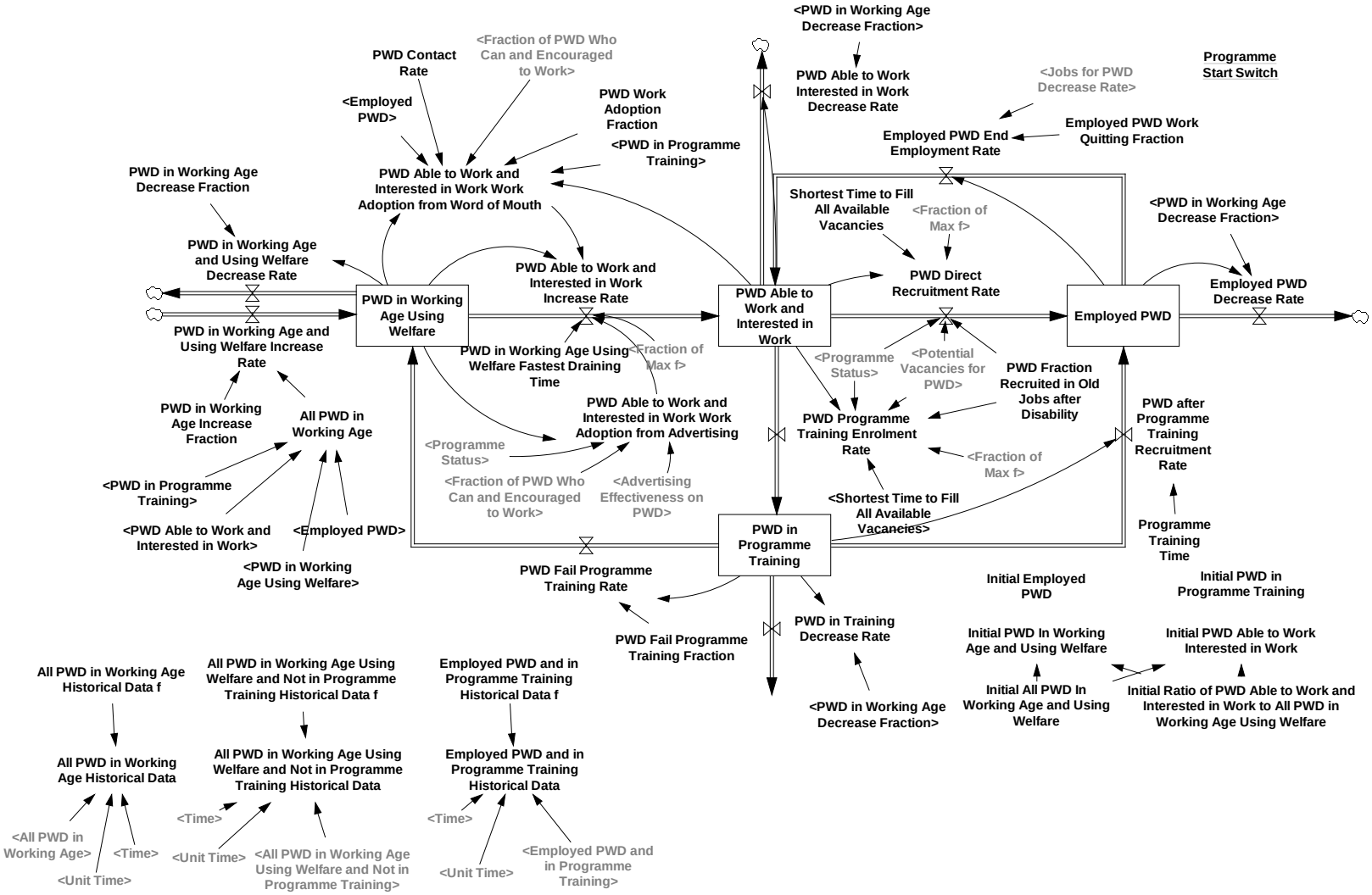
Groups*:	**Advertising Effectiveness** (13)	**Control** (4) Simulation Control Parameters	**Employers Side** (38)	**Employers Side Decisions** (17)	**Programme Costs** (13)
	PWD Side (50)	**PWD Side Decisions**(25)			

* "Groups are not really variables, but a way to group different variables together. They have no values, but can be used to access collections of other variable types." [229]

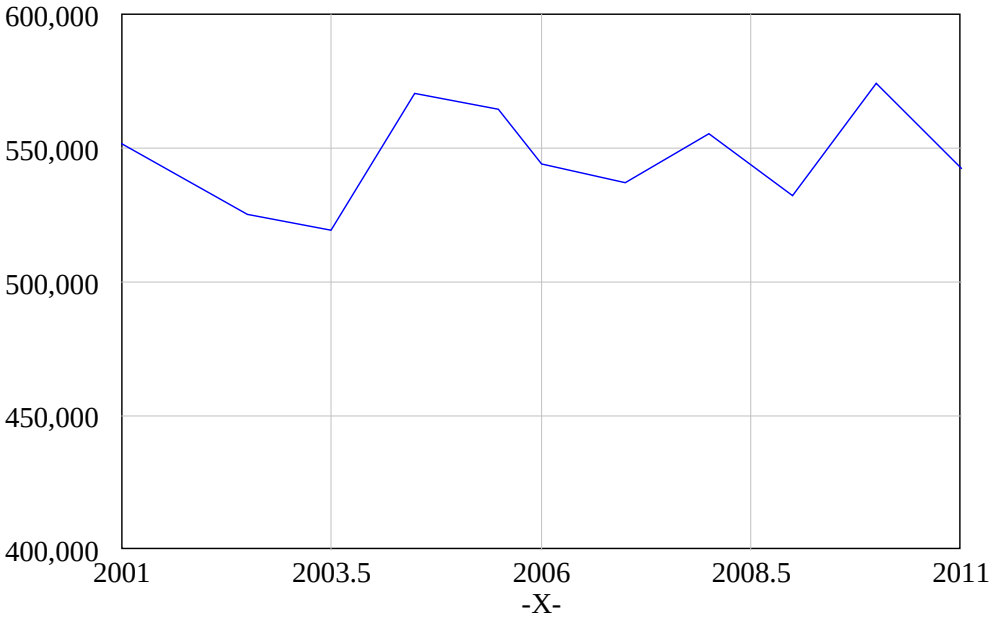
Views*:	**PWD Side** (67)	**Employers Side** (59)	**Advertising Effectiveness** (23)	**PWD Side Decisions** (35)	**Employers Side Decisions** (29)
	Programme Costs (38)				

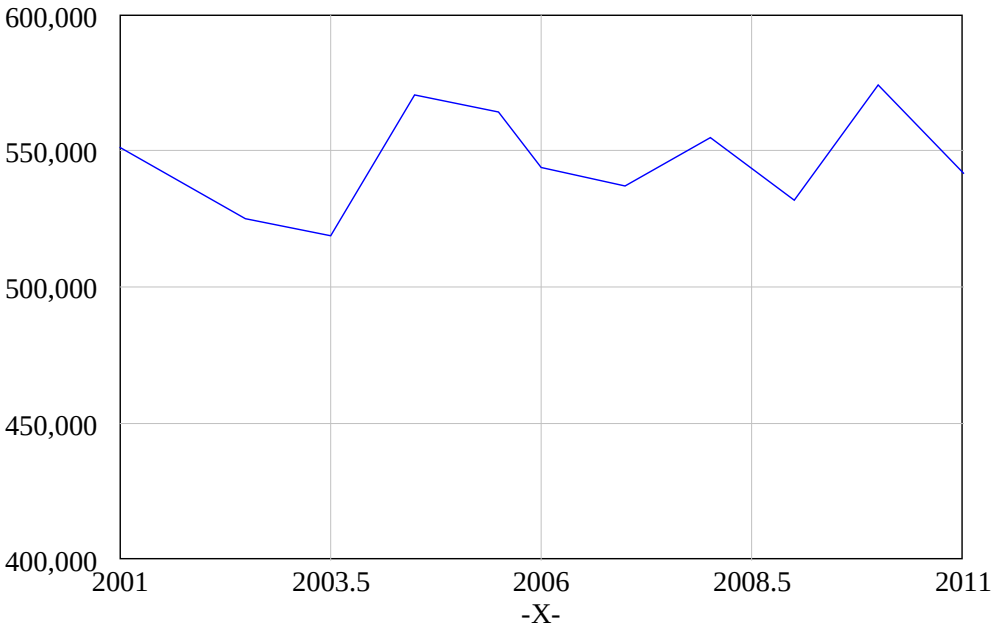
* "A model is a set of causal dependencies and equations defining the mathematical relationship among variables. A view is a visual representation of some subset of those relationships." [229]

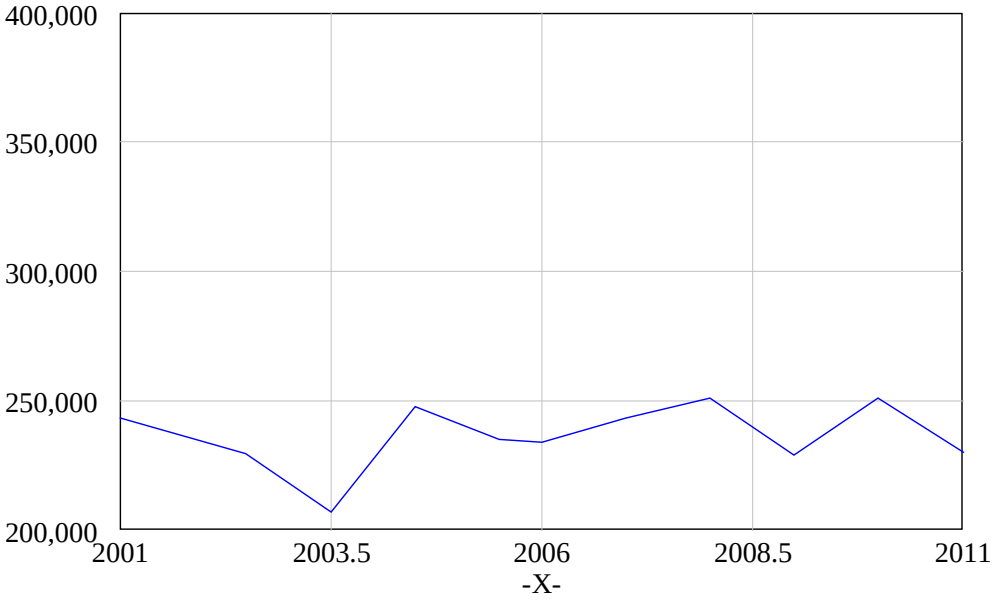
A.2 PWD Side Subsystem (67 variables)

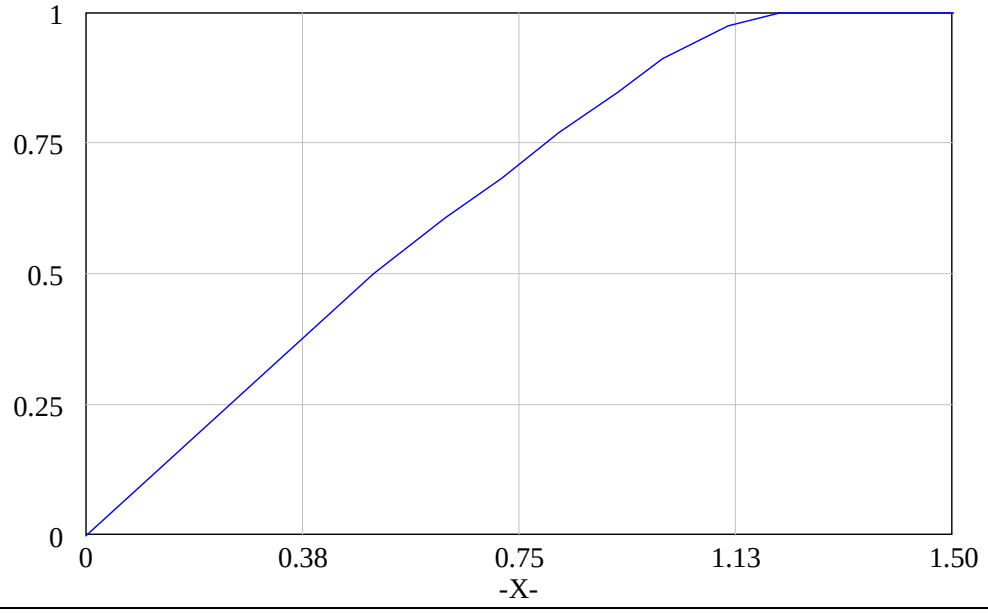


Group	Type	Variable Name and Description
PWD Side	#7 A 	**Advertising Effectiveness on PWD** (Dimensionless/Year) = Advertising Effectiveness* Programme Advertising on PWD Annual Spending* Programme Advertising on PWD Spending over Time* ZIDZ (1,PWD in Working Age Using Welfare* Advertising Spending Needed per Disabled Person per Year) **Description:** *Advertising results in adoption according the effectiveness of the advertising (=0.011). The fraction of the population adopting each year as the result of advertising (= 0.0021). The fraction of households adopting the innovation each year as a result of advertising (=0.0008). The value (0.0008) is the best fit parameter to match the cable TV subscriber data.* **Present in 2 views:** • PWD Side • Advertising Effectiveness **Used by:** • PWD Able to Work and Interested in Work Work Adoption from Advertising **Feedback loops:** 28 (8.9 %)
PWD Side	#13 A 	**All PWD in Working Age** (Persons) = PWD in Working Age Using Welfare+ PWD Able to Work and Interested in Work+ PWD in Programme Training+ Employed PWD **Present in 2 views:** • PWD Side • Programme Costs **Used by:** • All PWD in Working Age Historical Data • PWD in Working Age and Using Welfare Increase Rate • Ratio of All PWD in Working Age Using Welfare and Not in Training to All PWD in Working Age • Ratio of Employed PWD and in Programme Training to All PWD in Working Age **Feedback loops:** 127 (40.2 %)
PWD Side	#14 A 	**All PWD in Working Age Historical Data** (Persons) = IF THEN ELSE (Time< 2012,All PWD in Working Age Historical Data f (Time/ Unit Time) ,All PWD in Working Age) **Present in 1 view:** • PWD Side **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
PWD Side	#15 T 	**All PWD in Working Age Historical Data f** (Persons) = [(2001,400000)-(2011,600000)],(2001,551189),(2002.5,524828),(2003.5,518837),(2004.5,570361),(2005.5,564370),(2006,544000),(2007,537000),(2008,555000),(2009,532000),(2010,574000),(2011,542000) **Present in 1 view:** • PWD Side **Used by:** • All PWD in Working Age Historical Data **Feedback loops:** 0

Group	Type	Variable Name and Description
		All PWD in Working Age Historical Data f 
PWD Side	#16 A	**All PWD in Working Age Using Welfare and Not in Programme Training** (Persons) = PWD Able to Work and Interested in Work+ PWD in Working Age Using Welfare **Present in 2 views:** • PWD Side • Programme Costs **Used by:** • All PWD in Working Age Using Welfare and Not in Programme Training Historical Data • Government Spending on PWD • Ratio of All PWD in Working Age Using Welfare and Not in Training to All PWD in Working Age • Ratio of PWD Able to Work and Interested in Working to All PWD in Working Age Using Welfare and Not in Programme Training **Feedback loops:** 0
PWD Side	#17 A	**All PWD in Working Age Using Welfare and Not in Programme Training Historical Data** (Persons) = IF THEN ELSE (Time< 2012,All PWD in Working Age Using Welfare and Not in Programme Training Historical Data f(Time/ Unit Time) ,All PWD in Working Age Using Welfare and Not in Programme Training) **Present in 1 view:** • PWD Side **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
PWD Side	#18 T	**All PWD in Working Age Using Welfare and Not in Programme Training Historical Data f** (Persons) = [(2001,200000)-(2011,400000)],(2001,308189),(2002.5,295328),(2003.5,311837),(2004.5,322861),(2005.5,329245),(2006,310000),(2007,294000),(2008,304000),(2009,303000),(2010,323000),(2011,312000) **Present in 1 view:**

Group	Type	Variable Name and Description
		• PWD Side **Used by:** • All PWD in Working Age Using Welfare and Not in Programme Training Historical Data **Feedback loops:** 0 All PWD in Working Age Historical Data f 
PWD Side	#34 L	**Employed PWD** (Persons) = $\int$ (PWD Direct Recruitment Rate+ PWD after Programme Training Recruitment Rate- Employed PWD End Employment Rate- Employed PWD Decrease Rate) $\cdot dt$ + [Initial Employed PWD] **Description:** *The number of working People with Disabilities in the system. Increased by adoption and decreased when adopters discard the idea.* **Present in 3 views:** • PWD Side • Employers Side • Programme Costs **Used by:** • All PWD in Working Age • Employed PWD and in Programme Training • Employed PWD Decrease Rate • Employed PWD End Employment Rate • Government Spending on PWD • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth • PWD Jobs Quitting Rate • Total Working PWD Taxes **Feedback loops:** 212 (67.1 %)
PWD Side	#35 A	**Employed PWD and in Programme Training** (Persons) = PWD in Programme Training+ Employed PWD **Present in 2 views:** • PWD Side • Programme Costs

Group	Type	Variable Name and Description
		Used by: • Employed PWD and in Programme Training Historical Data • Ratio of Employed PWD and in Programme Training to All PWD in Working Age **Feedback loops:** 0
PWD Side	#36 A	**Employed PWD and in Programme Training Historical Data** (Persons) = IF THEN ELSE (Time< 2012,Employed PWD and in Programme Training Historical Data f (Time/ Unit Time) ,Employed PWD and in Programme Training) **Present in 1 view:** • PWD Side **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
PWD Side	#37 T	**Employed PWD and in Programme Training Historical Data f** (Persons) = [(2001,200000)-(2011,400000)],(2001,243000),(2002.5,229500),(2003.5,207000),(2004.5,247500),(2005.5,235125),(2006,234000),(2007,243000),(2008,251000),(2009,229000),(2010,251000),(2011,230000) **Present in 1 view:** • PWD Side **Used by:** • Employed PWD and in Programme Training Historical Data **Feedback loops:** 0 Employed PWD and in Programme Training Historical Data f 
PWD Side	#38 F,A	**Employed PWD Decrease Rate** (Persons/Year) = Employed PWD* PWD in Working Age Decrease Fraction **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employed PWD • PWD Jobs Quitting Rate **Feedback loops:** 54 (17.1 %)
PWD	#39	**Employed PWD End Employment Rate** (Persons/Year)

Group	Type	Variable Name and Description
Side	F,A	= Employed PWD* Employed PWD Work Quitting Fraction+ Jobs for PWD Decrease Rate **Present in 1 view:** • PWD Side **Used by:** • Employed PWD • PWD Able to Work and Interested in Work **Feedback loops:** 131 (41.5 %)
PWD Side	#40 C	**Employed PWD Work Quitting Fraction** (Dimensionless/Year) = 0.033 **Description:** *Probability of quitting Leontaridi, Rannia M. and Melanie E. Ward. 2002. Work-Related Stress, Quitting Intentions and Absenteeism. Bonn, Germany: The Institute for the Study of Labor (IZA). http://ftp.iza.org/dp493.pdf (Accessed: 7. March 2012).* **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employed PWD End Employment Rate • PWD Jobs Quitting Rate **Feedback loops:** 0
PWD Side	#64 T	**Fraction of Max f** (Dimensionless) = [(0,0)-(1.5,2),(0,0),(2,2)],(0,0),(0.5,0.5),(0.621176,0.604982),(0.72,0.683274),(0.818824,0.768683),(0.921176,0.846975),(1,0.911032),(1.11176,0.975089),(1.2,1),(1.5,1) **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employers Willing to Recruit PWD Increase Rate • PWD Able to Work and Interested in Work Increase Rate • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate **Feedback loops:** 0 Fraction of Max f 

Group	Type	Variable Name and Description
PWD Side	#65 A 	**Fraction of PWD Who Can and Encouraged to Work** (Dimensionless) = IF THEN ELSE (PWD Side Decisions Decoder= 0:OR: PWD Side Decisions Decoder= 4:OR: PWD Side Decisions Decoder= 8:OR: PWD Side Decisions Decoder= 12:OR: PWD Side Decisions Decoder= 16:OR: PWD Side Decisions Decoder= 20:OR: PWD Side Decisions Decoder= 24:OR: PWD Side Decisions Decoder= 28:OR: PWD Side Decisions Decoder= 32:OR: PWD Side Decisions Decoder= 64:OR:PWD Side Decisions Decoder= 68:OR: PWD Side Decisions Decoder= 72:OR: PWD Side Decisions Decoder= 76:OR: PWD Side Decisions Decoder= 80:OR: PWD Side Decisions Decoder= 84:OR: PWD Side Decisions Decoder= 88:OR: PWD Side Decisions Decoder= 92:OR:PWD Side Decisions Decoder= 128:OR: PWD Side Decisions Decoder= 132:OR: PWD Side Decisions Decoder= 136:OR: PWD Side Decisions Decoder= 140:OR: PWD Side Decisions Decoder= 144:OR: PWD Side Decisions Decoder= 148:OR: PWD Side Decisions Decoder= 152:OR: PWD Side Decisions Decoder= 156:OR: PWD Side Decisions Decoder= 160:OR: PWD Side Decisions Decoder= 192:OR: PWD Side Decisions Decoder= 196:OR: PWD Side Decisions Decoder= 200:OR: PWD Side Decisions Decoder= 204:OR: PWD Side Decisions Decoder= 208:OR: PWD Side Decisions Decoder= 212:OR: PWD Side Decisions Decoder= 216:OR: PWD Side Decisions Decoder= 220,0,IF THEN ELSE (PWD Side Decisions Decoder= 130:OR: PWD Side Decisions Decoder= 162:OR: PWD Side Decisions Decoder= 164,0.019868,IF THEN ELSE (PWD Side Decisions Decoder= 2:OR: PWD Side Decisions Decoder= 34:OR: PWD Side Decisions Decoder= 129:OR: PWD Side Decisions Decoder= 168,0.023179,IF THEN ELSE (PWD Side Decisions Decoder= 40,0.02649,IF THEN ELSE (PWD Side Decisions Decoder= 161:OR: PWD Side Decisions Decoder= 224:OR: PWD Side Decisions Decoder= 232,0.029801,IF THEN ELSE (PWD Side Decisions Decoder= 172,0.033113,IF THEN ELSE (PWD Side Decisions Decoder= 36:OR: PWD Side Decisions Decoder= 96:OR: PWD Side Decisions Decoder= 104:OR: PWD Side Decisions Decoder= 134:OR: PWD Side Decisions Decoder= 166:OR:PWD Side Decisions Decoder= 176,0.036424,IF THEN ELSE (PWD Side Decisions Decoder= 184:OR: PWD Side Decisions Decoder= 228:OR: PWD Side Decisions Decoder= 236:OR: PWD Side Decisions Decoder= 240:OR: PWD Side Decisions Decoder= 248,0.039735,IF THEN ELSE (PWD Side Decisions Decoder= 1,0.043046,IF THEN ELSE (PWD Side Decisions Decoder= 133,0.046358,IF THEN ELSE (PWD Side Decisions Decoder= 48,0.049669,IF THEN ELSE (PWD Side Decisions Decoder= 33:OR: PWD Side Decisions Decoder= 44:OR:PWD Side Decisions Decoder= 56:OR: PWD Side Decisions Decoder= 131:OR: PWD Side Decisions Decoder= 137:OR: PWD Side Decisions Decoder= 163:OR: PWD Side Decisions Decoder= 165,0.05298,IF THEN ELSE (PWD Side Decisions Decoder= 6:OR: PWD Side Decisions Decoder= 38:OR: PWD Side Decisions Decoder= 112:OR: PWD Side Decisions Decoder= 120,0.056291,IF THEN ELSE(PWD Side Decisions Decoder= 138:OR:PWD Side Decisions Decoder= 169:OR:PWD Side Decisions Decoder= 170,0.059603,IF THEN ELSE(PWD Side Decisions Decoder= 10:OR: PWD Side Decisions Decoder= 42:OR: PWD Side Decisions Decoder= 100:OR: PWD Side Decisions Decoder= 108,0.062914,IF THEN ELSE(PWD Side Decisions Decoder= 145,0.066225,IF THEN ELSE (PWD Side Decisions Decoder= 193:OR: PWD Side Decisions Decoder= 201,0.069536,IF THEN ELSE (PWD Side Decisions Decoder= 9:OR: PWD Side Decisions Decoder= 225:OR: PWD Side Decisions Decoder= 233,0.076159,IF THEN ELSE (PWD Side Decisions Decoder= 3:OR: PWD Side Decisions Decoder= 35:OR: PWD Side Decisions Decoder= 135:OR: PWD Side Decisions Decoder= 139:OR: PWD Side Decisions Decoder= 141:OR: PWD Side Decisions Decoder= 142:OR: PWD Side Decisions Decoder= 153:OR: PWD Side Decisions Decoder= 167:OR: PWD Side Decisions Decoder= 171:OR: PWD Side Decisions Decoder= 174,0.07947,IF THEN ELSE (PWD Side Decisions Decoder= 177,0.082781,IF THEN ELSE

Group	Type	Variable Name and Description
		(PWD Side Decisions Decoder= 41:OR: PWD Side Decisions Decoder= 146:OR: PWD Side Decisions Decoder= 173:OR: PWD Side Decisions Decoder= 178:OR: PWD Side Decisions Decoder= 194:OR: PWD Side Decisions Decoder= 202:OR: PWD Side Decisions Decoder= 209:OR: PWD Side Decisions Decoder= 217:OR: PWD Side Decisions Decoder= 226:OR: PWD Side Decisions Decoder= 234,0.086093,IF THEN ELSE (PWD Side Decisions Decoder= 66:OR: PWD Side Decisions Decoder= 74:OR: PWD Side Decisions Decoder= 98:OR: PWD Side Decisions Decoder= 106,0.092715,IF THEN ELSE (PWD Side Decisions Decoder= 180:OR: PWD Side Decisions Decoder= 185:OR: PWD Side Decisions Decoder= 188:OR: PWD Side Decisions Decoder= 244:OR: PWD Side Decisions Decoder= 252,0.096026,IF THEN ELSE (PWD Side Decisions Decoder= 5:OR: PWD Side Decisions Decoder= 65:OR: PWD Side Decisions Decoder= 73:OR: PWD Side Decisions Decoder= 154:OR: PWD Side Decisions Decoder= 186:OR: PWD Side Decisions Decoder= 197:OR: PWD Side Decisions Decoder= 205,0.099338,IF THEN ELSE (PWD Side Decisions Decoder= 14:OR: PWD Side Decisions Decoder= 46:OR: PWD Side Decisions Decoder= 241:OR: PWD Side Decisions Decoder= 249,0.10265,IF THEN ELSE (PWD Side Decisions Decoder= 11:OR: PWD Side Decisions Decoder= 18:OR: PWD Side Decisions Decoder= 43:OR: PWD Side Decisions Decoder= 50:OR: PWD Side Decisions Decoder= 229:OR: PWD Side Decisions Decoder= 237,0.10596,IF THEN ELSE (PWD Side Decisions Decoder= 97:OR: PWD Side Decisions Decoder= 105:OR: PWD Side Decisions Decoder= 143:OR: PWD Side Decisions Decoder= 175:OR: PWD Side Decisions Decoder= 195:OR: PWD Side Decisions Decoder= 203:OR: PWD Side Decisions Decoder= 210:OR: PWD Side Decisions Decoder= 218:OR: PWD Side Decisions Decoder= 227:OR: PWD Side Decisions Decoder= 235:OR: PWD Side Decisions Decoder= 242:OR: PWD Side Decisions Decoder= 250,0.10927,IF THEN ELSE (PWD Side Decisions Decoder= 37:OR: PWD Side Decisions Decoder= 198:OR: PWD Side Decisions Decoder= 206:OR: PWD Side Decisions Decoder= 230:OR:PWD Side Decisions Decoder= 238,0.11258,IF THEN ELSE (PWD Side Decisions Decoder= 26:OR: PWD Side Decisions Decoder= 58:OR:PWD Side Decisions Decoder= 147,0.11921,IF THEN ELSE (PWD Side Decisions Decoder= 179,0.12252,IF THEN ELSE (PWD Side Decisions Decoder= 82:OR: PWD Side Decisions Decoder= 90:OR: PWD Side Decisions Decoder= 114:OR: PWD Side Decisions Decoder= 122,0.13245,IF THEN ELSE (PWD Side Decisions Decoder= 155,0.13576,IF THEN ELSE (PWD Side Decisions Decoder= 52:OR: PWD Side Decisions Decoder= 60:OR: PWD Side Decisions Decoder= 187,0.13907,IF THEN ELSE (PWD Side Decisions Decoder= 7:OR: PWD Side Decisions Decoder= 39:OR: PWD Side Decisions Decoder= 67:OR: PWD Side Decisions Decoder= 70:OR: PWD Side Decisions Decoder= 75:OR: PWD Side Decisions Decoder= 78:OR: PWD Side Decisions Decoder= 99:OR: PWD Side Decisions Decoder= 102:OR:PWD Side Decisions Decoder= 107:OR: PWD Side Decisions Decoder= 110:OR: PWD Side Decisions Decoder= 116:OR: PWD Side Decisions Decoder= 124,0.14238,IF THEN ELSE (PWD Side Decisions Decoder= 13:OR: PWD Side Decisions Decoder= 17:OR: PWD Side Decisions Decoder= 199:OR: PWD Side Decisions Decoder= 207:OR: PWD Side Decisions Decoder= 231:OR: PWD Side Decisions Decoder= 239,0.1457,IF THEN ELSE (PWD Side Decisions Decoder= 211:OR: PWD Side Decisions Decoder= 219,0.15232,IF THEN ELSE (PWD Side Decisions Decoder= 243:OR: PWD Side Decisions Decoder= 251,0.15563,IF THEN ELSE (PWD Side Decisions Decoder= 25,0.15894,IF THEN ELSE (PWD Side Decisions Decoder= 45,0.16225,IF THEN ELSE (PWD Side Decisions Decoder= 49:OR: PWD Side Decisions Decoder= 81:OR: PWD Side Decisions Decoder= 89,0.16556,IF THEN ELSE (PWD Side Decisions Decoder= 69:OR: PWD Side Decisions Decoder= 77,0.1755,IF THEN ELSE (PWD Side Decisions Decoder= 57,0.17881,IF THEN ELSE (PWD Side Decisions Decoder= 113:OR: PWD Side Decisions Decoder= 121,0.18543,IF THEN ELSE (PWD Side Deci-

Group	Type	Variable Name and Description
		sions Decoder= 15:OR: PWD Side Decisions Decoder= 47:OR: PWD Side Decisions Decoder= 101:OR: PWD Side Decisions Decoder= 109,0.19205,IF THEN ELSE (PWD Side Decisions Decoder= 149,0.19536,IF THEN ELSE (PWD Side Decisions Decoder= 19:OR: PWD Side Decisions Decoder= 150,0.20199,IF THEN ELSE (PWD Side Decisions Decoder= 51:OR: PWD Side Decisions Decoder= 182,0.2053,IF THEN ELSE (PWD Side Decisions Decoder= 157,0.21192,IF THEN ELSE (PWD Side Decisions Decoder= 27:OR: PWD Side Decisions Decoder= 213,0.21854,IF THEN ELSE (PWD Side Decisions Decoder= 59:OR: PWD Side Decisions Decoder= 158:OR: PWD Side Decisions Decoder= 221,0.22185,IF THEN ELSE (PWD Side Decisions Decoder= 190,0.22517,IF THEN ELSE (PWD Side Decisions Decoder= 181,0.22848,IF THEN ELSE (PWD Side Decisions Decoder= 83:OR: PWD Side Decisions Decoder= 91,0.2351,IF THEN ELSE (PWD Side Decisions Decoder= 71:OR: PWD Side Decisions Decoder= 79:OR: PWD Side Decisions Decoder= 103:OR: PWD Side Decisions Decoder= 111:OR: PWD Side Decisions Decoder= 115:OR: PWD Side Decisions Decoder= 123,0.23841,IF THEN ELSE (PWD Side Decisions Decoder= 214:OR: PWD Side Decisions Decoder= 222,0.24172,IF THEN ELSE (PWD Side Decisions Decoder= 189:OR: PWD Side Decisions Decoder= 246:OR: PWD Side Decisions Decoder= 254,0.24503,IF THEN ELSE (PWD Side Decisions Decoder= 245,0.25497,IF THEN ELSE (PWD Side Decisions Decoder= 253,0.25828,IF THEN ELSE (PWD Side Decisions Decoder= 22,0.28146,IF THEN ELSE (PWD Side Decisions Decoder= 54,0.28477,IF THEN ELSE (PWD Side Decisions Decoder= 151,0.2947,IF THEN ELSE (PWD Side Decisions Decoder= 30:OR: PWD Side Decisions Decoder= 183,0.30132,IF THEN ELSE (PWD Side Decisions Decoder= 62,0.30464,IF THEN ELSE (PWD Side Decisions Decoder= 159,0.32119,IF THEN ELSE (PWD Side Decisions Decoder= 86:OR: PWD Side Decisions Decoder= 94,0.3245,IF THEN ELSE (PWD Side Decisions Decoder= 118:OR: PWD Side Decisions Decoder= 126:OR: PWD Side Decisions Decoder= 191,0.32781,IF THEN ELSE (PWD Side Decisions Decoder= 215,0.34768,IF THEN ELSE (PWD Side Decisions Decoder= 223,0.35099,IF THEN ELSE (PWD Side Decisions Decoder= 247,0.3543,IF THEN ELSE (PWD Side Decisions Decoder= 255,0.35762,IF THEN ELSE (PWD Side Decisions Decoder= 21,0.53974,IF THEN ELSE (PWD Side Decisions Decoder= 29,0.56623,IF THEN ELSE (PWD Side Decisions Decoder= 85,0.58278,IF THEN ELSE (PWD Side Decisions Decoder= 93,0.58609,IF THEN ELSE (PWD Side Decisions Decoder= 53,0.59272,IF THEN ELSE (PWD Side Decisions Decoder= 61,0.61921,IF THEN ELSE (PWD Side Decisions Decoder= 117,0.63907,IF THEN ELSE (PWD Side Decisions Decoder= 125,0.64238,IF THEN ELSE (PWD Side Decisions Decoder= 23,0.68874,IF THEN ELSE (PWD Side Decisions Decoder= 55,0.69536,IF THEN ELSE (PWD Side Decisions Decoder= 31,0.72517,IF THEN ELSE (PWD Side Decisions Decoder= 63,0.73179,IF THEN ELSE (PWD Side Decisions Decoder= 87,0.76159,IF THEN ELSE (PWD Side Decisions Decoder= 95,0.7649,IF THEN ELSE (PWD Side Decisions Decoder= 119,0.76821,0.77152) **Present in 2 views:** • PWD Side • PWD Side Decisions **Used by:** • PWD Able to Work and Interested in Work Work Adoption from Advertising • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth **Feedback loops**: 92 (29.1 %)
PWD Side	#78 C	**Initial All PWD In Working Age and Using Welfare** (Persons) = 308300 **Description:** *Source SSB*

Group	Type	Variable Name and Description
		Present in 1 view: • PWD Side **Used by:** • Initial PWD Able to Work Interested in Work • Initial PWD In Working Age and Using Welfare **Feedback loops:** 0
PWD Side	#79 LI,C 	**Initial Employed PWD** (Persons) = 231800 **Description:** *Source SSB* **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employed PWD • Jobs for PWD **Feedback loops:** 0
PWD Side	#82 LI,A 	**Initial PWD Able to Work Interested in Work** (Persons) = Initial All PWD In Working Age and Using Welfare* Initial Ratio of PWD Able to Work and Interested in Work to All PWD in Working Age Using Welfare **Present in 1 view:** • PWD Side **Used by:** • PWD Able to Work and Interested in Work **Feedback loops:** 0
PWD Side	#83 LI,C 	**Initial PWD in Programme Training** (Persons) = 0 **Present in 1 view:** • PWD Side **Used by:** • PWD in Programme Training **Feedback loops:** 0
PWD Side	#84 LI,A 	**Initial PWD In Working Age and Using Welfare** (Persons) = Initial All PWD In Working Age and Using Welfare* (1- Initial Ratio of PWD Able to Work and Interested in Work to All PWD in Working Age Using Welfare) **Present in 1 view:** • PWD Side **Used by:** • PWD in Working Age Using Welfare **Feedback loops:** 0
PWD Side	#85 C 	**Initial Ratio of PWD Able to Work and Interested in Work to All PWD in Working Age Using Welfare** (Dimensionless [0,1,1]) = 0.25 **Present in 1 view:** • PWD Side **Used by:** • Initial PWD Able to Work Interested in Work • Initial PWD In Working Age and Using Welfare **Feedback loops:** 0
PWD	#91	**Jobs for PWD Decrease Rate** (Persons/Year)

Group	Type	Variable Name and Description
Side	F,A	= Employers Recruiting PWD Decrease Rate* Average Jobs for PWD per Employers Recruiting PWD **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employed PWD End Employment Rate • Jobs for PWD **Feedback loops:** 125 (39.6 %)
PWD Side	#100 L	**Potential Vacancies for PWD** (Persons) = $\int$ (PWD Jobs Quitting Rate+ Potential Vacancies for PWD Increase Rate- PWD Vacancies Occupying Rate- Potential Vacancies for PWD Decrease Rate) $\cdot dt$ + [Initial Vacancies for PWD] **Present in 4 views:** • PWD Side • Employers Side • PWD Side Decisions • Programme Costs **Used by:** • Average Potential Vacancies for PWD per Employers Recruiting PWD • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate • Ratio of Job Vacancies for PWD to All Posts for PWD • Suitable Jobs Availability **Feedback loops:** 196 (62.0 %)
PWD Side	#112 G	**Programme Start Switch** (Dimensionless [0,1,1]) = GAME(0) **Present in 6 views:** • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions • Programme Costs **Used by:** • Programme Status **Feedback loops:** 0
PWD Side	#114 A	**Programme Status** (Dimensionless) = STEP (Programme Start Switch ,Programme Start Year) **Present in 5 views:** • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions **Used by:** • Employers Recruiting PWD Adoption from Advertising • Programme Advertising on Employers Annual Spending • Programme Advertising on PWD Annual Spending

Group	Type	Variable Name and Description
		• PWD Able to Work and Interested in Work Work Adoption from Advertising • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate **Feedback loops:** 0
PWD Side	#115 A	**Programme Training Time** (Year) = 2/ 0.875 **Description:** *The existence of a successful example like "Telenor Open Mind" programme, which is operated by a private communication company called Telenor , and although it is on a small scale – they only take in 6 person a year, at least 75 % of them get a fixed job later. (Skøien, Hem and Tyrmi 2006; Telenor Group 2008), puts more emphasis on efforts targeting employers to cultivating more jobs (Tøssebro 2009). We assume that half of the 25% who cannot get jobs will eventually get jobs too. So 75% + 12.5% = 85% (fraction of trainees who get fixed jobs), and 2 years is the programme period.* **Present in 1 view:** • PWD Side **Used by:** • PWD after Programme Training Recruitment Rate **Feedback loops:** 0
PWD Side	#116 L	**PWD Able to Work and Interested in Work** (Persons) = $\int$ (PWD Able to Work and Interested in Work Increase Rate+ Employed PWD End Employment Rate- PWD Direct Recruitment Rate- PWD Programme Training Enrolment Rate- PWD Able to Work Interested in Work Decrease Rate) $\cdot dt$ + [Initial PWD Able to Work Interested in Work] **Description:** *18% of inactive Persons permanently disabled who say they want to work* **Present in 2 views:** • PWD Side • Programme Costs **Used by:** • All PWD in Working Age • All PWD in Working Age Using Welfare and Not in Programme Training • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth • PWD Able to Work Interested in Work Decrease Rate • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate • Ratio of PWD Able to Work and Interested in Working to All PWD in Working Age Using Welfare and Not in Programme Training **Feedback loops:** 260 (82.3 %)
PWD Side	#117 F,A	**PWD Able to Work and Interested in Work Increase Rate** (Persons/Year) = (PWD in Working Age Using Welfare/ PWD in Working Age Using Welfare Fastest Draining Time)* Fraction of Max f (XIDZ ((PWD Able to Work and Interested in Work Work Adoption from Advertising+ PWD Able to Work and Interested in Work Work Adoption from Word of Mouth) ,PWD in Working Age Using Welfare/ PWD in Working Age Using Welfare Fastest Draining Time ,10)) **Description:** *(PWD Able to Work and Interested in Work Work Adoption from Advertising + PWD Able to Work and Interested in Work Work Adoption from Word of Mouth)* **Present in 1 view:** • PWD Side **Used by:** • PWD Able to Work and Interested in Work

Group	Type	Variable Name and Description
		• PWD in Working Age Using Welfare **Feedback loops:** 225 (71.2 %)
PWD Side	#118 A 	**PWD Able to Work and Interested in Work Work Adoption from Advertising** (Persons /Year) = Advertising Effectiveness on PWD* PWD in Working Age Using Welfare* Fraction of PWD Who Can and Encouraged to Work* Programme Status **Description:** *Adoption can result from advertising according to the effectiveness of the advertising effort with the pool of potential adopters.* **Present in 1 view:** • PWD Side **Used by:** • PWD Able to Work and Interested in Work Increase Rate **Feedback loops:** 102 (32.3 %)
PWD Side	#119 A 	**PWD Able to Work and Interested in Work Work Adoption from Word of Mouth** (Persons/Year) = PWD Contact Rate* PWD Work Adoption Fraction* PWD in Working Age Using Welfare* Fraction of PWD Who Can and Encouraged to Work* (PWD Able to Work and Interested in Work+ Employed PWD+ PWD in Programme Training)* ZIDZ (1,PWD in Working Age Using Welfare+ PWD Able to Work and Interested in Work+ Employed PWD+ PWD in Programme Training) **Description:** *Adoption by word of mouth is driven by the contact rate between potential adopters and active adopters and the fraction of times these interactions will result in adoption. The word of mouth effect is small if the number of active adopters relative to the total population size is small. Contact Rate c*Adoption Fraction i*Potential Adopters P*Adopters A/Total Population N* **Present in 1 view:** • PWD Side **Used by:** • PWD Able to Work and Interested in Work Increase Rate **Feedback loops:** 95 (30.1 %)
PWD Side	#120 F,A 	**PWD Able to Work Interested in Work Decrease Rate** (Persons/Year) = PWD Able to Work and Interested in Work* PWD in Working Age Decrease Fraction **Present in 1 view:** • PWD Side **Used by:** • PWD Able to Work and Interested in Work **Feedback loops:** 1 (0.3 %)
PWD Side	#121 F,A 	**PWD after Programme Training Recruitment Rate** (Persons/Year) = PWD in Programme Training/ Programme Training Time **Present in 1 view:** • PWD Side **Used by:** • Employed PWD • PWD in Programme Training **Feedback loops:** 31 (9.8 %)
PWD Side	#122 C 	**PWD Contact Rate** (Dimensionless/Year) = 45.7142 **Description:** *The rate at which active adopters come into contact with potential adopters.* **Present in 1 view:** • PWD Side

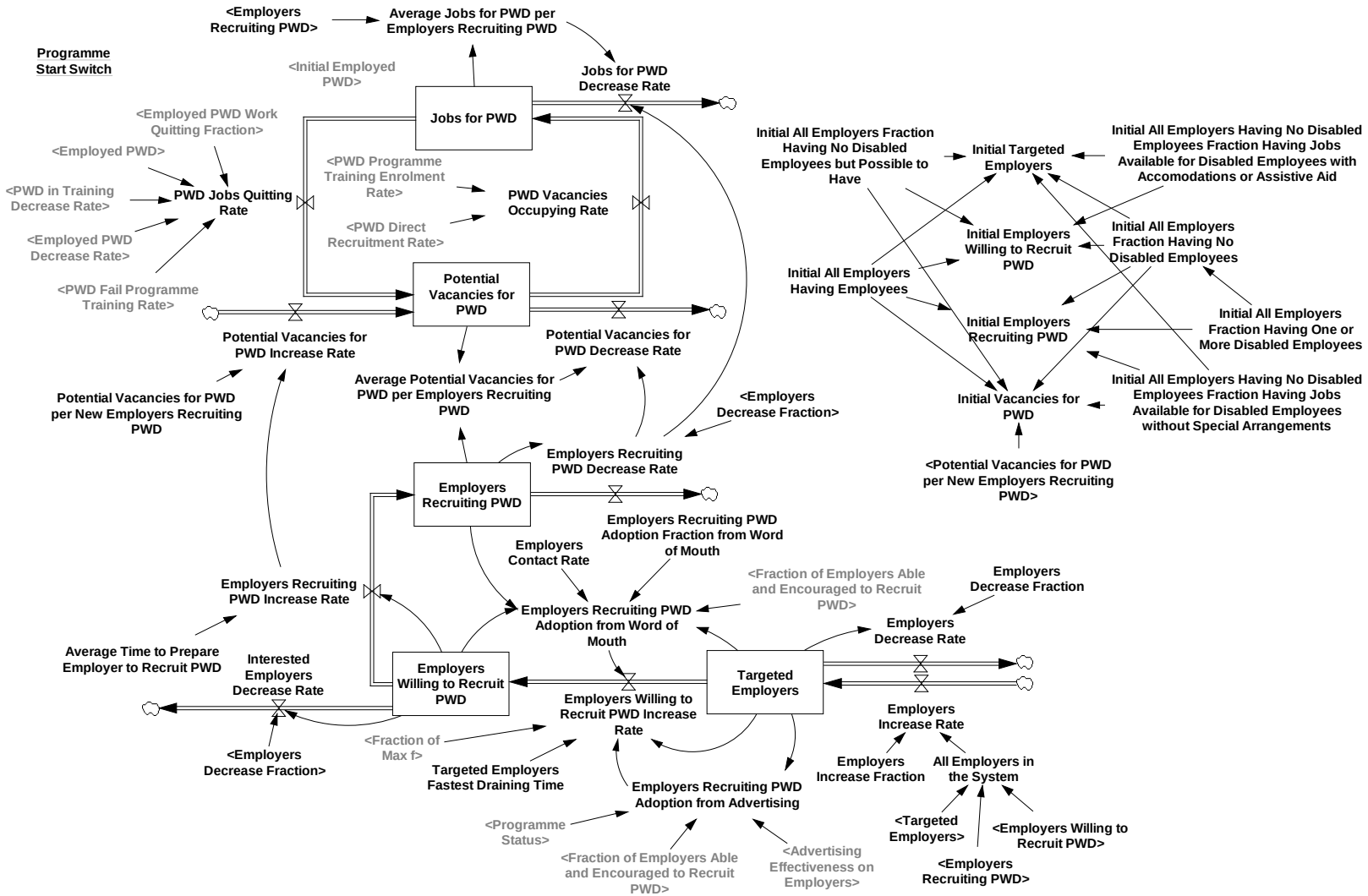
Group	Type	Variable Name and Description
		Used by: • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth **Feedback loops:** 0
PWD Side	#123 F,A	**PWD Direct Recruitment Rate** (Persons/Year) = IF THEN ELSE (Programme Status= 1,(PWD Able to Work and Interested in Work / Shortest Time to Fill All Available Vacancies)* Fraction of Max f (XIDZ (Potential Vacancies for PWD/ Shortest Time to Fill All Available Vacancies ,PWD Able to Work and Interested in Work/Shortest Time to Fill All Available Vacancies ,10))* PWD Fraction Recruited in Old Jobs after Disability ,(PWD Able to Work and Interested in Work/ Shortest Time to Fill All Available Vacancies)* Fraction of Max f (xidz (Potential Vacancies for PWD/ Shortest Time to Fill All Available Vacancies ,PWD Able to Work and Interested in Work/ Shortest Time to Fill All Available Vacancies ,10))) **Description:** *(Maximum outflow*Fraction of Max f(xidz(Desired draining , Maximum outflow,10)))* **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employed PWD • PWD Able to Work and Interested in Work • PWD Vacancies Occupying Rate **Feedback loops:** 193 (61.1 %)
PWD Side	#124 C	**PWD Fail Programme Training Fraction** (Dimensionless/Year) = 0.125 **Description:** *In Telenors HCP, at least 75 % of the trainees get a fixed job later. (Skøien, Hem and Tyrmi 2006; Telenor Group 2008). We are not sure about where the other 25% go, so we assumed that half of will fail and go back welfare while the other half will find a job eventually* **Present in 1 view:** • PWD Side **Used by:** • PWD Fail Programme Training Rate **Feedback loops:** 0
PWD Side	#125 F,A	**PWD Fail Programme Training Rate** (Persons/Year) = PWD in Programme Training* PWD Fail Programme Training Fraction **Present in 2 views:** • PWD Side • Employers Side **Used by:** • PWD in Programme Training • PWD in Working Age Using Welfare • PWD Jobs Quitting Rate **Feedback loops:** 73 (23.1 %)
PWD Side	#126 C	**PWD Fraction Recruited in Old Jobs after Disability** (Dimensionless [0,1,1]) = 0.42 **Description:** *Tøssebro, Jan. 2009. Report on the employment of PWD in European countries - Norway. Academic Network of European Disability experts (ANED). http://www.disability-europe.net/content/pdf/NO - ANED 2009 Employment Report Final.pdf (Accessed: 2. February 2010).* **Present in 1 view:**

Group	Type	Variable Name and Description
		• PWD Side **Used by:** • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate **Feedback loops:** 0
PWD Side	#127 L	**PWD in Programme Training** (Persons) = $\int$ (PWD Programme Training Enrolment Rate- PWD after Programme Training Recruitment Rate- PWD Fail Programme Training Rate- PWD in Training Decrease Rate) $\cdot dt$ + [Initial PWD in Programme Training] **Present in 2 views:** • PWD Side • Programme Costs **Used by:** • All PWD in Working Age • Employed PWD and in Programme Training • Government Spending on PWD • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth • PWD after Programme Training Recruitment Rate • PWD Fail Programme Training Rate • PWD in Training Decrease Rate **Feedback loops:** 183 (57.9 %)
PWD Side	#128 F,A	**PWD in Training Decrease Rate** (Persons/Year) = PWD in Programme Training* PWD in Working Age Decrease Fraction **Present in 2 views:** • PWD Side • Employers Side **Used by:** • PWD in Programme Training • PWD Jobs Quitting Rate **Feedback loops:** 37 (11.7 %)
PWD Side	#129 F,A	**PWD in Working Age and Using Welfare Decrease Rate** (Persons/Year) = PWD in Working Age Using Welfare* PWD in Working Age Decrease Fraction **Present in 1 view:** • PWD Side **Used by:** • PWD in Working Age Using Welfare **Feedback loops:** 1 (0.3 %)
PWD Side	#130 F,A	**PWD in Working Age and Using Welfare Increase Rate** (Persons/Year) = All PWD in Working Age* PWD in Working Age Increase Fraction **Present in 1 view:** • PWD Side **Used by:** • PWD in Working Age Using Welfare **Feedback loops:** 127 (40.2 %)
PWD Side	#131 C	**PWD in Working Age Decrease Fraction** (Dimensionless/Year) = 0.0455473 **Description:** *0.00314 of people move to full pension (age: over 67), and 0.0084 deaths* **Present in 1 view:**

Group	Type	Variable Name and Description
		• PWD Side **Used by:** • Employed PWD Decrease Rate • PWD Able to Work Interested in Work Decrease Rate • PWD in Training Decrease Rate • PWD in Working Age and Using Welfare Decrease Rate **Feedback loops:** 0
PWD Side	#132 C	**PWD in Working Age Increase Fraction** (Dimensionless/Year) = 0.0478414 **Description:** *0.0125 live births - 0.00179 deaths (0-14) 0.0125 -0.00179 however computed to match stock* **Present in 1 view:** • PWD Side **Used by:** • PWD in Working Age and Using Welfare Increase Rate **Feedback loops:** 0
PWD Side	#133 L	**PWD in Working Age Using Welfare** (Persons) = $\int$ (PWD in Working Age and Using Welfare Increase Rate+ PWD Fail Programme Training Rate- PWD Able to Work and Interested in Work Increase Rate- PWD in Working Age and Using Welfare Decrease Rate) $\cdot dt$ + [Initial PWD In Working Age and Using Welfare] **Description:** *The initial number of People with Disabilities using welfare is determined by the total population size and the current number of active adopters. It is reduced by adoption and increased when working disabled come back and natural total population increase.* **Present in 3 views:** • PWD Side • Advertising Effectiveness • PWD Side Decisions **Used by:** • Advertising Effectiveness on PWD • All PWD in Working Age • All PWD in Working Age Using Welfare and Not in Programme Training • Flexible Working Hours • Programme Advertising on PWD Optimal Annual Spending • PWD Able to Work and Interested in Work Increase Rate • PWD Able to Work and Interested in Work Work Adoption from Advertising • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth • PWD in Working Age and Using Welfare Decrease Rate **Feedback loops:** 170 (53.8 %)
PWD Side	#134 C	**PWD in Working Age Using Welfare Fastest Draining Time** (Year) = 1.11143 **Present in 1 view:** • PWD Side **Used by:** • PWD Able to Work and Interested in Work Increase Rate **Feedback loops:** 0
PWD Side	#136 F,A	**PWD Programme Training Enrolment Rate** (Persons/Year) = IF THEN ELSE (Programme Status= 1,(PWD Able to Work and Interested in Work / Shortest Time to Fill All Available Vacancies)* Fraction of Max f (XIDZ (Potential Vacancies for PWD/ Shortest Time to Fill All Available Vacancies ,PWD Able to Work and

Group	Type	Variable Name and Description
		Interested in Work/Shortest Time to Fill All Available Vacancies ,10))* (1- PWD Fraction Recruited in Old Jobs after Disability) ,0) **Description:** *(Level to drain / Fastest draining time) * Fraction of Max f (xidz (Desired draining , Level to drain / Fastest draining time , 10))* **Present in 4 views:** • PWD Side • Employers Side • PWD Side Decisions • Programme Costs **Used by:** • Employment Training • Government Spending on PWD • PWD Able to Work and Interested in Work • PWD in Programme Training • PWD Vacancies Occupying Rate **Feedback loops:** 230 (72.8 %)
PWD Side	#140 C	**PWD Work Adoption Fraction** (Dimensionless) = 0.0176 **Description:** *The fraction of times a contact between an active adopter and a potential adopter results in adoption.* **Present in 1 view:** • PWD Side **Used by:** • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth **Feedback loops:** 0
PWD Side	#149 C	**Shortest Time to Fill All Available Vacancies** (Year) = 1.24708 **Present in 1 view:** • PWD Side **Used by:** • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate **Feedback loops:** 0
PWD Side	#160 C	**Unit Time** (Year) = 1 **Present in 2 views:** • PWD Side • Advertising Effectiveness **Used by:** • All PWD in Working Age Historical Data • All PWD in Working Age Using Welfare and Not in Programme Training Historical Data • Employed PWD and in Programme Training Historical Data • Programme Advertising on Employers Spending over Time • Programme Advertising on PWD Spending over Time **Feedback loops:** 0

A.3 Employers Side Subsystem (59 variables)



Group	Type	Variable Name and Description
Employers Side	#6 A	**Advertising Effectiveness on Employers** (Dimensionless/Year) = Advertising Effectiveness* Programme Advertising on Employers Annual Spending* Programme Advertising on Employers Spending over Time* ZIDZ (1,Targeted Employers* Advertising Spending Needed per Employer per Year) **Description:** *Advertising results in adoption according the effectiveness of the advertising.* **Present in 2 views:** • Employers Side • Advertising Effectiveness **Used by:** • Employers Recruiting PWD Adoption from Advertising **Feedback loops:** 3 (0.9 %)
Employers Side	#12 A	**All Employers in the System** (Employers) = Targeted Employers+ Employers Recruiting PWD+ Employers Willing to Recruit PWD **Present in 2 views:** • Employers Side • Programme Costs **Used by:** • Employers Increase Rate • Ratio of Employers Recruiting PWD to All Employers in the System **Feedback loops:** 13 (4.1 %)
Employers Side	#22 A	**Average Jobs for PWD per Employers Recruiting PWD** (Persons/Employer) = ZIDZ (Jobs for PWD ,Employers Recruiting PWD) **Present in 1 view:** • Employers Side **Used by:** • Jobs for PWD Decrease Rate **Feedback loops:** 125 (39.6 %)
Employers Side	#24 A	**Average Potential Vacancies for PWD per Employers Recruiting PWD** (Persons /Employer) = ZIDZ (Potential Vacancies for PWD ,Employers Recruiting PWD) **Present in 1 view:** • Employers Side **Used by:** • Potential Vacancies for PWD Decrease Rate **Feedback loops:** 1 (0.3 %)
Employers Side	#27 C	**Average Time to Prepare Employer to Recruit PWD** (Year) = 1.01 **Present in 1 view:** • Employers Side **Used by:** • Employers Recruiting PWD Increase Rate **Feedback loops:** 0
PWD Side	#34 L	**Employed PWD** (Persons) = $\int$ (PWD Direct Recruitment Rate+ PWD after Programme Training Recruitment Rate- Employed PWD End Employment Rate- Employed PWD Decrease Rate) $\cdot dt$ + [Initial Employed PWD] **Description:** *The number of working People with Disabilities in the system. Increased by adoption and decreased when adopters discard the idea.* **Present in 3 views:**

Group	Type	Variable Name and Description
		• PWD Side • Employers Side • Programme Costs **Used by:** • All PWD in Working Age • Employed PWD and in Programme Training • Employed PWD Decrease Rate • Employed PWD End Employment Rate • Government Spending on PWD • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth • PWD Jobs Quitting Rate • Total Working PWD Taxes **Feedback loops:** 212 (67.1 %)
PWD Side	#38 F,A	**Employed PWD Decrease Rate** (Persons/Year) = Employed PWD* PWD in Working Age Decrease Fraction **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employed PWD • PWD Jobs Quitting Rate **Feedback loops:** 54 (17.1 %)
PWD Side	#40 C	**Employed PWD Work Quitting Fraction** (Dimensionless/Year) = 0.033 **Description:** *Probability of quitting Leontaridi, Rannia M. and Melanie E. Ward. 2002. Work-Related Stress, Quitting Intentions and Absenteeism. Bonn, Germany: The Institute for the Study of Labor (IZA). http://ftp.iza.org/dp493.pdf (Accessed: 7. March 2012).* **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employed PWD End Employment Rate • PWD Jobs Quitting Rate **Feedback loops:** 0
Em-ployers Side	#41 C	**Employers Contact Rate** (Dimensionless/Year) = 26.3432 **Present in 1 view:** • Employers Side **Used by:** • Employers Recruiting PWD Adoption from Word of Mouth **Feedback loops:** 0
Em-ployers Side	#42 C	**Employers Decrease Fraction** (Dimensionless/Year) = 0.0119006 **Description:** *0.0580313 http://arsmelding.brreg.no/en/downloads http://arsmelding.brreg.no/resources/files/diagrammer /FR_Nyregistrerte_foretak_2009_og_2010_og_bestand_pr_31.12.2010_DIAGRAM.xlsx* **Present in 1 view:** • Employers Side **Used by:** • Employers Decrease Rate

Group	Type	Variable Name and Description
		• Employers Recruiting PWD Decrease Rate • Interested Employers Decrease Rate **Feedback loops:** 0
Em-ployers Side	#43 F,A	**Employers Decrease Rate** (Employers/Year) = Targeted Employers* Employers Decrease Fraction **Present in 1 view:** • Employers Side **Used by:** • Targeted Employers **Feedback loops:** 1 (0.3 %)
Em-ployers Side	#44 C	**Employers Increase Fraction** (Dimensionless/Year) = 0.0142106 **Description:** *0.0661462 http://arsmelding.brreg.no/en/downloads http://arsmelding.brreg.no /resources/files/diagrammer /FR_Nyregistrerte_foretak_2009_og_2010_og_bestand_pr_31.12.2010_DIAGRAM.xlsx* **Present in 1 view:** • Employers Side **Used by:** • Employers Increase Rate **Feedback loops:** 0
Em-ployers Side	#45 F,A	**Employers Increase Rate** (Employers/Year) = All Employers in the System* Employers Increase Fraction **Present in 1 view:** • Employers Side **Used by:** • Targeted Employers **Feedback loops:** 13 (4.1 %)
Em-ployers Side	#46 L	**Employers Recruiting PWD** (Employers) = $\int$ (Employers Recruiting PWD Increase Rate- Employers Recruiting PWD Decrease Rate) $\cdot dt$ + [Initial Employers Recruiting PWD] **Description:** *Employers Recruiting or Having Vacancies for PWD* **Present in 3 views:** • Employers Side • Employers Side Decisions • Programme Costs **Used by:** • All Employers in the System • Average Jobs for PWD per Employers Recruiting PWD • Average Potential Vacancies for PWD per Employers Recruiting PWD • Competitors Recruiting PWD • Employers Recruiting PWD Adoption from Word of Mouth • Employers Recruiting PWD Decrease Rate • Ratio of Employers Recruiting PWD to All Employers in the System **Feedback loops:** 10 (3.2 %)
Em-ployers Side	#47 C	**Employers Recruiting PWD Adoption Fraction from Word of Mouth** (Dimensionless) = 0.0176 **Present in 1 view:** • Employers Side **Used by:**

Group	Type	Variable Name and Description
		• Employers Recruiting PWD Adoption from Word of Mouth **Feedback loops:** 0
Em-ployers Side	#48 A	**Employers Recruiting PWD Adoption from Advertising** (Employers/Year) = Advertising Effectiveness on Employers* Targeted Employers* Fraction of Employers Able and Encouraged to Recruit PWD* Programme Status **Description:** *Adoption can result from advertising according to the effectiveness of the advertising effort with the pool of potential adopters.* **Present in 1 view:** • Employers Side **Used by:** • Employers Willing to Recruit PWD Increase Rate **Feedback loops:** 10 (3.2 %)
Em-ployers Side	#49 A	**Employers Recruiting PWD Adoption from Word of Mouth** (Employers/Year) = Employers Contact Rate* Employers Recruiting PWD Adoption Fraction from Word of Mouth* Targeted Employers* Fraction of Employers Able and Encouraged to Recruit PWD* (Employers Recruiting PWD+ Employers Willing to Recruit PWD)* ZIDZ (1,Targeted Employers + Employers Willing to Recruit PWD+ Employers Recruiting PWD) **Description:** *Fraction of Employers recruiting PWD* **Present in 1 view:** • Employers Side **Used by:** • Employers Willing to Recruit PWD Increase Rate **Feedback loops:** 9 (2.8 %)
Em-ployers Side	#50 F,A	**Employers Recruiting PWD Decrease Rate** (Employer/Year) = Employers Recruiting PWD* Employers Decrease Fraction **Present in 1 view:** • Employers Side **Used by:** • Employers Recruiting PWD • Jobs for PWD Decrease Rate • Potential Vacancies for PWD Decrease Rate **Feedback loops:** 1 (0.3 %)
Em-ployers Side	#51 F,A	**Employers Recruiting PWD Increase Rate** (Employers/Year) = Employers Willing to Recruit PWD/ Average Time to Prepare Employer to Recruit PWD **Present in 2 views:** • Employers Side • Programme Costs **Used by:** • Employers Recruiting PWD • Employers Willing to Recruit PWD • Government Spending on PWD • Potential Vacancies for PWD Increase Rate **Feedback loops:** 10 (3.2 %)
Em-ployers Side	#53 L	**Employers Willing to Recruit PWD** (Employers) = $\int$ (Employers Willing to Recruit PWD Increase Rate- Employers Recruiting PWD Increase Rate- Interested Employers Decrease Rate) $\cdot dt$ + [Initial Employers Willing to Recruit PWD] **Present in 1 view:** • Employers Side

Group	Type	Variable Name and Description
		Used by: • All Employers in the System • Employers Recruiting PWD Adoption from Word of Mouth • Employers Recruiting PWD Increase Rate • Interested Employers Decrease Rate **Feedback loops:** 18 (5.7 %)
Em-ployers Side	#54 F,A 	**Employers Willing to Recruit PWD Increase Rate** (Employers/Year) = (Targeted Employers/ Targeted Employers Fastest Draining Time)* Fraction of Max f (XIDZ ((Employers Recruiting PWD Adoption from Advertising+ Employers Recruiting PWD Adoption from Word of Mouth) ,Targeted Employers/ Targeted Employers Fastest Draining Time,10)) **Present in 1 view:** • Employers Side **Used by:** • Employers Willing to Recruit PWD • Targeted Employers **Feedback loops:** 22 (7.0 %)
Em-ployers Side	#63 A 	**Fraction of Employers Able and Encouraged to Recruit PWD** (Dimensionless) = IF THEN ELSE (Employers Side Decisions Decoder= 0:OR: Employers Side Decisions Decoder= 64:OR: Employers Side Decisions Decoder= 128:OR: Employers Side Decisions Decoder= 129:OR: Employers Side Decisions Decoder= 192:OR: Employers Side Decisions Decoder= 193:OR: Employers Side Decisions Decoder= 256:OR: Employers Side Decisions Decoder= 257:OR: Employers Side Decisions Decoder= 320:OR: Employers Side Decisions Decoder= 321:OR: Employers Side Decisions Decoder= 384:OR: Employers Side Decisions Decoder= 385:OR: Employers Side Decisions Decoder= 448:OR: Employers Side Decisions Decoder= 449,0,IF THEN ELSE (Employers Side Decisions Decoder= 1:OR: Employers Side Decisions Decoder= 65:OR: Employers Side Decisions Decoder= 352:OR: Employers Side Decisions Decoder= 353:OR: Employers Side Decisions Decoder= 416:OR: Employers Side Decisions Decoder= 417:OR: Employers Side Decisions Decoder= 480:OR: Employers Side Decisions Decoder= 481,0.0097087,IF THEN ELSE (Employers Side Decisions Decoder= 264:OR: Employers Side Decisions Decoder= 265:OR: Employers Side Decisions Decoder= 288:OR: Employers Side Decisions Decoder= 289:OR: Employers Side Decisions Decoder= 328:OR: Employers Side Decisions Decoder= 329:OR: Employers Side Decisions Decoder= 360:OR: Employers Side Decisions Decoder= 361:OR: Employers Side Decisions Decoder= 392:OR: Employers Side Decisions Decoder= 393:OR: Employers Side Decisions Decoder= 424:OR: Employers Side Decisions Decoder= 425:OR: Employers Side Decisions Decoder= 456:OR: Employers Side Decisions Decoder= 457:OR: Employers Side Decisions Decoder= 488:OR: Employers Side Decisions Decoder= 489,0.019417,IF THEN ELSE (Employers Side Decisions Decoder= 260:OR: Employers Side Decisions Decoder= 261:OR: Employers Side Decisions Decoder= 268:OR: Employers Side Decisions Decoder= 269:OR: Employers Side Decisions Decoder= 296:OR: Employers Side Decisions Decoder= 297:OR: Employers Side Decisions Decoder= 324:OR: Employers Side Decisions Decoder= 325:OR: Employers Side Decisions Decoder= 332:OR: Employers Side Decisions Decoder= 333:OR: Employers Side Decisions Decoder= 388:OR: Employers Side Decisions Decoder= 389:OR: Employers Side Decisions Decoder= 396:OR: Employers Side Decisions Decoder= 397:OR: Employers Side Decisions Decoder= 452:OR: Employers Side Decisions Decoder= 453:OR: Employers Side Decisions Decoder= 460:OR: Employers Side Decisions Decoder= 461,0.029126,IF THEN ELSE (Employers Side Decisions Decoder= 224:OR: Employers Side Decisions Decoder= 225:OR: Employers Side Decisions Decoder= 356:OR: Employers Side Decisions Decoder= 357:OR: Employers Side Decisions Decoder= 364:OR: Employers Side Decisions Decoder=

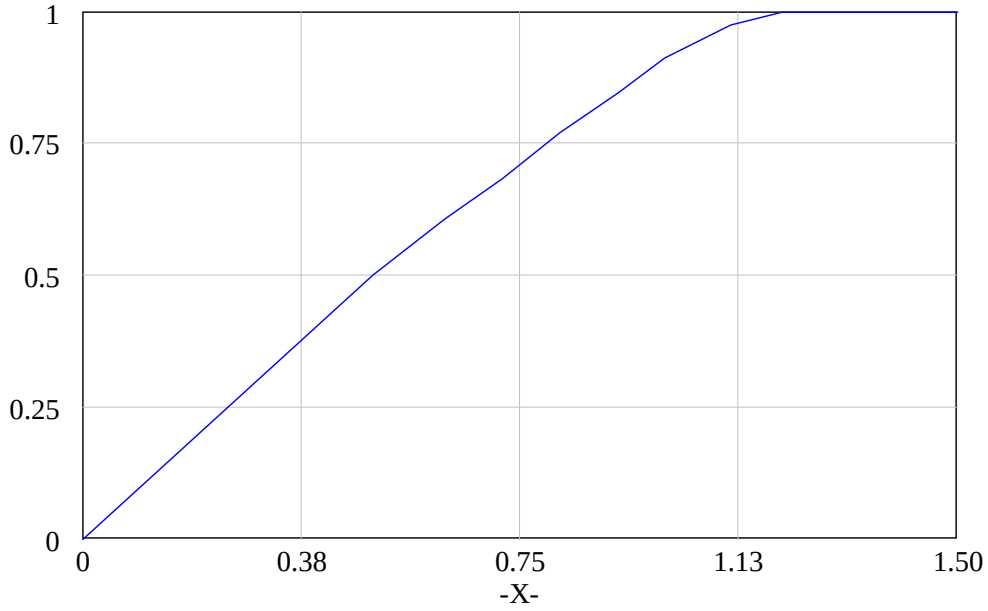
Group	Type	Variable Name and Description
		365:OR: Employers Side Decisions Decoder= 420:OR: Employers Side Decisions Decoder= 421:OR: Employers Side Decisions Decoder= 428:OR: Employers Side Decisions Decoder= 429:OR: Employers Side Decisions Decoder= 484:OR: Employers Side Decisions Decoder= 485:OR: Employers Side Decisions Decoder= 492:OR: Employers Side Decisions Decoder= 493,0.038835,IF THEN ELSE (Employers Side Decisions Decoder= 132:OR: Employers Side Decisions Decoder= 133:OR: Employers Side Decisions Decoder= 136:OR: Employers Side Decisions Decoder= 137:OR: Employers Side Decisions Decoder= 196:OR: Employers Side Decisions Decoder= 197:OR: Employers Side Decisions Decoder= 200:OR: Employers Side Decisions Decoder= 201:OR: Employers Side Decisions Decoder= 258:OR: Employers Side Decisions Decoder= 259:OR: Employers Side Decisions Decoder= 292:OR: Employers Side Decisions Decoder= 293:OR: Employers Side Decisions Decoder= 300:OR: Employers Side Decisions Decoder= 301:OR: Employers Side Decisions Decoder= 322:OR: Employers Side Decisions Decoder= 323:OR: Employers Side Decisions Decoder= 386:OR: Employers Side Decisions Decoder= 387:OR: Employers Side Decisions Decoder= 450:OR: Employers Side Decisions Decoder= 451,0.048544,IF THEN ELSE (Employers Side Decisions Decoder= 96:OR: Employers Side Decisions Decoder= 97:OR: Employers Side Decisions Decoder= 140:OR: Employers Side Decisions Decoder= 141:OR: Employers Side Decisions Decoder= 204:OR: Employers Side Decisions Decoder= 205:OR: Employers Side Decisions Decoder= 262:OR: Employers Side Decisions Decoder= 263:OR: Employers Side Decisions Decoder= 266:OR: Employers Side Decisions Decoder= 267:OR: Employers Side Decisions Decoder= 270:OR: Employers Side Decisions Decoder= 271:OR: Employers Side Decisions Decoder= 326:OR: Employers Side Decisions Decoder= 327:OR: Employers Side Decisions Decoder= 330:OR: Employers Side Decisions Decoder= 331:OR: Employers Side Decisions Decoder= 334:OR: Employers Side Decisions Decoder= 335:OR: Employers Side Decisions Decoder= 390:OR: Employers Side Decisions Decoder= 391:OR: Employers Side Decisions Decoder= 394:OR: Employers Side Decisions Decoder= 395:OR: Employers Side Decisions Decoder= 398:OR: Employers Side Decisions Decoder= 399:OR: Employers Side Decisions Decoder= 454:OR: Employers Side Decisions Decoder= 455:OR: Employers Side Decisions Decoder= 458:OR: Employers Side Decisions Decoder= 459:OR: Employers Side Decisions Decoder= 462:OR: Employers Side Decisions Decoder= 463,0.058252,IF THEN ELSE (Employers Side Decisions Decoder= 4:OR: Employers Side Decisions Decoder= 5:OR: Employers Side Decisions Decoder= 8:OR: Employers Side Decisions Decoder= 9:OR: Employers Side Decisions Decoder= 68:OR: Employers Side Decisions Decoder= 69:OR: Employers Side Decisions Decoder= 72:OR: Employers Side Decisions Decoder= 73:OR: Employers Side Decisions Decoder= 232:OR: Employers Side Decisions Decoder= 233:OR: Employers Side Decisions Decoder= 354:OR: Employers Side Decisions Decoder= 355:OR: Employers Side Decisions Decoder= 358:OR: Employers Side Decisions Decoder= 359:OR: Employers Side Decisions Decoder= 362:OR: Employers Side Decisions Decoder= 363:OR: Employers Side Decisions Decoder= 366:OR: Employers Side Decisions Decoder= 367:OR: Employers Side Decisions Decoder= 418:OR: Employers Side Decisions Decoder= 419:OR: Employers Side Decisions Decoder= 422:OR: Employers Side Decisions Decoder= 423:OR: Employers Side Decisions Decoder= 426:OR: Employers Side Decisions Decoder= 427:OR: Employers Side Decisions Decoder= 430:OR: Employers Side Decisions Decoder= 431:OR: Employers Side Decisions Decoder= 482:OR: Employers Side Decisions Decoder= 483:OR: Employers Side Decisions Decoder= 486:OR: Employers Side Decisions Decoder= 487:OR: Employers Side Decisions Decoder= 490:OR: Employers Side Decisions Decoder= 491:OR: Employers Side Decisions Decoder= 494:OR: Employers Side Decisions Decoder= 495,0.067961,IF THEN ELSE (Employers Side Decisions Decoder= 12:OR: Employers Side Decisions Decoder= 13:OR: Employers Side Decisions Decoder= 76:OR: Employers Side Decisions Decoder= 77:OR: Employers Side Decisions Decoder= 228:OR: Employers Side Decisions Decoder=

Group	Type	Variable Name and Description
		229:OR: Employers Side Decisions Decoder= 290:OR: Employers Side Decisions Decoder= 291:OR: Employers Side Decisions Decoder= 294:OR: Employers Side Decisions Decoder= 295:OR: Employers Side Decisions Decoder= 298:OR: Employers Side Decisions Decoder= 299:OR: Employers Side Decisions Decoder= 302:OR: Employers Side Decisions Decoder= 303,0.07767,IF THEN ELSE (Employers Side Decisions Decoder= 104:OR: Employers Side Decisions Decoder= 105:OR: Employers Side Decisions Decoder= 130:OR: Employers Side Decisions Decoder= 131:OR: Employers Side Decisions Decoder= 160:OR: Employers Side Decisions Decoder= 161:OR: Employers Side Decisions Decoder= 194:OR: Employers Side Decisions Decoder= 195:OR: Employers Side Decisions Decoder= 236:OR: Employers Side Decisions Decoder= 237,0.087379,IF THEN ELSE (Employers Side Decisions Decoder= 2:OR: Employers Side Decisions Decoder= 66:OR: Employers Side Decisions Decoder= 100:OR: Employers Side Decisions Decoder= 101:OR: Employers Side Decisions Decoder= 134:OR: Employers Side Decisions Decoder= 135:OR: Employers Side Decisions Decoder= 198:OR: Employers Side Decisions Decoder= 199,0.097087,IF THEN ELSE (Employers Side Decisions Decoder= 3:OR: Employers Side Decisions Decoder= 67:OR: Employers Side Decisions Decoder= 108:OR: Employers Side Decisions Decoder= 109:OR: Employers Side Decisions Decoder= 138:OR: Employers Side Decisions Decoder= 139:OR: Employers Side Decisions Decoder= 142:OR: Employers Side Decisions Decoder= 143:OR: Employers Side Decisions Decoder= 202:OR: Employers Side Decisions Decoder= 203:OR: Employers Side Decisions Decoder= 206:OR: Employers Side Decisions Decoder= 207,0.1068,IF THEN ELSE (Employers Side Decisions Decoder= 6:OR: Employers Side Decisions Decoder= 7:OR: Employers Side Decisions Decoder= 70:OR:Employers Side Decisions Decoder= 71:OR: Employers Side Decisions Decoder= 168:OR: Employers Side Decisions Decoder= 169,0.1165,IF THEN ELSE(Employers Side Decisions Decoder= 10:OR:Employers Side Decisions Decoder= 11:OR:Employers Side Decisions Decoder= 14:OR:Employers Side Decisions Decoder= 15:OR:Employers Side Decisions Decoder= 74:OR:Employers Side Decisions Decoder= 75:OR:Employers Side Decisions Decoder= 78:OR:Employers Side Decisions Decoder= 79:OR:Employers Side Decisions Decoder= 164:OR:Employers Side Decisions Decoder= 165:OR:Employers Side Decisions Decoder= 226:OR:Employers Side Decisions Decoder= 227:OR:Employers Side Decisions Decoder= 230:OR:Employers Side Decisions Decoder= 231:OR:Employers Side Decisions Decoder= 400:OR:Employers Side Decisions Decoder= 401:OR:Employers Side Decisions Decoder= 408:OR:Employers Side Decisions Decoder= 409:OR:Employers Side Decisions Decoder= 464:OR:Employers Side Decisions Decoder= 465:OR:Employers Side Decisions Decoder= 472:OR:Employers Side Decisions Decoder= 473,0.12621,IF THEN ELSE(Employers Side Decisions Decoder= 172:OR: Employers Side Decisions Decoder= 173:OR: Employers Side Decisions Decoder= 234:OR: Employers Side Decisions Decoder= 235:OR: Employers Side Decisions Decoder= 238:OR: Employers Side Decisions Decoder= 239:OR: Employers Side Decisions Decoder= 404:OR: Employers Side Decisions Decoder= 405:OR: Employers Side Decisions Decoder= 412:OR: Employers Side Decisions Decoder= 413:OR: Employers Side Decisions Decoder= 468:OR: Employers Side Decisions Decoder= 469:OR: Employers Side Decisions Decoder= 476:OR: Employers Side Decisions Decoder= 477,0.13592,IF THEN ELSE(Employers Side Decisions Decoder= 98:OR: Employers Side Decisions Decoder= 99:OR: Employers Side Decisions Decoder= 102:OR: Employers Side Decisions Decoder= 103:OR: Employers Side Decisions Decoder= 272:OR: Employers Side Decisions Decoder= 273:OR: Employers Side Decisions Decoder= 280:OR: Employers Side Decisions Decoder= 281:OR: Employers Side Decisions Decoder= 336:OR: Employers Side Decisions Decoder= 337:OR: Employers Side Decisions Decoder= 344:OR: Employers Side Decisions Decoder= 345:OR: Employers Side Decisions Decoder= 402:OR: Employers Side Decisions Decoder= 403:OR: Employers Side Decisions Decoder= 406:OR: Employers Side Decisions Decoder= 407:OR: Employers Side De-

Group	Type	Variable Name and Description
		cisions Decoder= 410:OR: Employers Side Decisions Decoder= 411:OR: Employers Side Decisions Decoder= 414:OR: Employers Side Decisions Decoder= 415:OR: Employers Side Decisions Decoder= 466:OR: Employers Side Decisions Decoder= 467:OR: Employers Side Decisions Decoder= 470:OR: Employers Side Decisions Decoder= 471:OR: Employers Side Decisions Decoder= 474:OR: Employers Side Decisions Decoder= 475:OR: Employers Side Decisions Decoder= 478:OR: Employers Side Decisions Decoder= 479:OR: Employers Side Decisions Decoder= 496:OR: Employers Side Decisions Decoder= 497:OR: Employers Side Decisions Decoder= 504:OR: Employers Side Decisions Decoder= 505,0.14563,IF THEN ELSE (Employers Side Decisions Decoder= 106:OR: Employers Side Decisions Decoder= 107:OR: Employers Side Decisions Decoder= 110:OR: Employers Side Decisions Decoder= 111:OR: Employers Side Decisions Decoder= 276:OR: Employers Side Decisions Decoder= 277:OR: Employers Side Decisions Decoder= 284:OR: Employers Side Decisions Decoder= 285:OR: Employers Side Decisions Decoder= 340:OR: Employers Side Decisions Decoder= 341:OR: Employers Side Decisions Decoder= 348:OR: Employers Side Decisions Decoder= 349:OR: Employers Side Decisions Decoder= 432:OR: Employers Side Decisions Decoder= 433:OR: Employers Side Decisions Decoder= 440:OR: Employers Side Decisions Decoder= 441,0.15534,IF THEN ELSE (Employers Side Decisions Decoder= 274:OR: Employers Side Decisions Decoder= 275:OR: Employers Side Decisions Decoder= 278:OR: Employers Side Decisions Decoder= 279:OR: Employers Side Decisions Decoder= 282:OR: Employers Side Decisions Decoder= 283:OR: Employers Side Decisions Decoder= 286:OR: Employers Side Decisions Decoder= 287:OR: Employers Side Decisions Decoder= 338:OR: Employers Side Decisions Decoder= 339:OR: Employers Side Decisions Decoder= 342:OR: Employers Side Decisions Decoder= 343:OR: Employers Side Decisions Decoder= 346:OR: Employers Side Decisions Decoder= 347:OR: Employers Side Decisions Decoder= 350:OR: Employers Side Decisions Decoder= 351:OR: Employers Side Decisions Decoder= 500:OR: Employers Side Decisions Decoder= 501:OR: Employers Side Decisions Decoder= 508:OR: Employers Side Decisions Decoder= 509,0.16505,IF THEN ELSE (Employers Side Decisions Decoder= 162:OR: Employers Side Decisions Decoder= 163:OR: Employers Side Decisions Decoder= 166:OR: Employers Side Decisions Decoder= 167:OR: Employers Side Decisions Decoder= 368:OR: Employers Side Decisions Decoder= 369:OR: Employers Side Decisions Decoder= 376:OR: Employers Side Decisions Decoder= 377:OR: Employers Side Decisions Decoder= 436:OR: Employers Side Decisions Decoder= 437:OR: Employers Side Decisions Decoder= 444:OR: Employers Side Decisions Decoder= 445:OR: Employers Side Decisions Decoder= 498:OR: Employers Side Decisions Decoder= 499:OR: Employers Side Decisions Decoder= 502:OR: Employers Side Decisions Decoder= 503:OR: Employers Side Decisions Decoder= 506:OR: Employers Side Decisions Decoder= 507:OR: Employers Side Decisions Decoder= 510:OR: Employers Side Decisions Decoder= 511,0.17476,IF THEN ELSE (Employers Side Decisions Decoder= 170:OR: Employers Side Decisions Decoder= 171:OR: Employers Side Decisions Decoder= 174:OR: Employers Side Decisions Decoder= 175:OR: Employers Side Decisions Decoder= 434:OR: Employers Side Decisions Decoder= 435:OR: Employers Side Decisions Decoder= 438:OR: Employers Side Decisions Decoder= 439:OR: Employers Side Decisions Decoder= 442:OR: Employers Side Decisions Decoder= 443:OR: Employers Side Decisions Decoder= 446:OR: Employers Side Decisions Decoder= 447,0.18447,IF THEN ELSE (Employers Side Decisions Decoder= 32:OR: Employers Side Decisions Decoder= 33:OR: Employers Side Decisions Decoder= 372:OR: Employers Side Decisions Decoder= 373:OR: Employers Side Decisions Decoder= 380:OR: Employers Side Decisions Decoder= 381,0.19417,IF THEN ELSE (Employers Side Decisions Decoder= 208:OR: Employers Side Decisions Decoder= 209:OR: Employers Side Decisions Decoder= 216:OR: Employers Side Decisions Decoder= 217:OR: Employers Side Decisions Decoder= 370:OR: Employers Side Decisions Decoder= 371:OR: Employers Side Decisions Decoder= 374:OR: Employers Side

Group	Type	Variable Name and Description
		Decisions Decoder= 375:OR: Employers Side Decisions Decoder= 378:OR: Employers Side Decisions Decoder= 379:OR: Employers Side Decisions Decoder= 382:OR: Employers Side Decisions Decoder= 383,0.20388,IF THEN ELSE (Employers Side Decisions Decoder= 144:OR: Employers Side Decisions Decoder= 145:OR: Employers Side Decisions Decoder= 152:OR: Employers Side Decisions Decoder= 153:OR: Employers Side Decisions Decoder= 212:OR: Employers Side Decisions Decoder= 213:OR: Employers Side Decisions Decoder= 220:OR: Employers Side Decisions Decoder= 221,0.21359,IF THEN ELSE (Employers Side Decisions Decoder= 40:OR: Employers Side Decisions Decoder= 41:OR: Employers Side Decisions Decoder= 148:OR: Employers Side Decisions Decoder= 149:OR: Employers Side Decisions Decoder= 156:OR: Employers Side Decisions Decoder= 157:OR: Employers Side Decisions Decoder= 210:OR: Employers Side Decisions Decoder= 211:OR: Employers Side Decisions Decoder= 214:OR: Employers Side Decisions Decoder= 215:OR: Employers Side Decisions Decoder= 218:OR: Employers Side Decisions Decoder= 219:OR: Employers Side Decisions Decoder= 222:OR: Employers Side Decisions Decoder= 223:OR: Employers Side Decisions Decoder= 304:OR: Employers Side Decisions Decoder= 305:OR: Employers Side Decisions Decoder= 312:OR: Employers Side Decisions Decoder= 313,0.2233,IF THEN ELSE (Employers Side Decisions Decoder= 36:OR: Employers Side Decisions Decoder= 37:OR: Employers Side Decisions Decoder= 146:OR:Employers Side Decisions Decoder= 147:OR: Employers Side Decisions Decoder= 150:OR: Employers Side Decisions Decoder= 151:OR:Employers Side Decisions Decoder= 154:OR: Employers Side Decisions Decoder= 155:OR: Employers Side Decisions Decoder= 158:OR:Employers Side Decisions Decoder= 159,0.23301,IF THEN ELSE (Employers Side Decisions Decoder= 44:OR: Employers Side Decisions Decoder= 45:OR: Employers Side Decisions Decoder= 308:OR: Employers Side Decisions Decoder= 309:OR: Employers Side Decisions Decoder= 316:OR: Employers Side Decisions Decoder= 317,0.24272,IF THEN ELSE (Employers Side Decisions Decoder= 306:OR:Employers Side Decisions Decoder= 307:OR: Employers Side Decisions Decoder= 310:OR: Employers Side Decisions Decoder= 311:OR:Employers Side Decisions Decoder= 314:OR: Employers Side Decisions Decoder= 315:OR: Employers Side Decisions Decoder= 318:OR:Employers Side Decisions Decoder= 319,0.25243,IF THEN ELSE (Employers Side Decisions Decoder= 34:OR: Employers Side Decisions Decoder= 35:OR: Employers Side Decisions Decoder= 38:OR: Employers Side Decisions Decoder= 39:OR: Employers Side Decisions Decoder= 80:OR: Employers Side Decisions Decoder= 81:OR: Employers Side Decisions Decoder= 88:OR: Employers Side Decisions Decoder= 89,0.28155,IF THEN ELSE (Employers Side Decisions Decoder= 42:OR: Employers Side Decisions Decoder= 43:OR: Employers Side Decisions Decoder= 46:OR: Employers Side Decisions Decoder= 47:OR: Employers Side Decisions Decoder= 84:OR: Employers Side Decisions Decoder= 85:OR: Employers Side Decisions Decoder= 92:OR: Employers Side Decisions Decoder= 93,0.29126,IF THEN ELSE (Employers Side Decisions Decoder= 240:OR: Employers Side Decisions Decoder= 241:OR: Employers Side Decisions Decoder= 248:OR:Employers Side Decisions Decoder= 249,0.30097,IF THEN ELSE (Employers Side Decisions Decoder= 16:OR: Employers Side Decisions Decoder= 17:OR: Employers Side Decisions Decoder= 24:OR: Employers Side Decisions Decoder= 25:OR: Employers Side Decisions Decoder= 82:OR: Employers Side Decisions Decoder= 83:OR: Employers Side Decisions Decoder= 86:OR: Employers Side Decisions Decoder= 87:OR: Employers Side Decisions Decoder= 90:OR: Employers Side Decisions Decoder= 91:OR: Employers Side Decisions Decoder= 94:OR: Employers Side Decisions Decoder= 95,0.31068,IF THEN ELSE (Employers Side Decisions Decoder= 20:OR: Employers Side Decisions Decoder= 21:OR: Employers Side Decisions Decoder= 28:OR: Employers Side Decisions Decoder= 29:OR: Employers Side Decisions Decoder= 244:OR: Employers Side Decisions Decoder= 245:OR: Employers Side Decisions Decoder= 252:OR: Employers Side Decisions Decoder= 253,0.32039,IF THEN ELSE

Group	Type	Variable Name and Description
		(Employers Side Decisions Decoder= 242:OR: Employers Side Decisions Decoder= 243:OR: Employers Side Decisions Decoder= 246:OR: Employers Side Decisions Decoder= 247:OR: Employers Side Decisions Decoder= 250:OR: Employers Side Decisions Decoder= 251:OR: Employers Side Decisions Decoder= 254:OR: Employers Side Decisions Decoder= 255,0.3301,IF THEN ELSE (Employers Side Decisions Decoder= 18:OR: Employers Side Decisions Decoder= 19:OR: Employers Side Decisions Decoder= 22:OR: Employers Side Decisions Decoder= 23:OR: Employers Side Decisions Decoder= 26:OR: Employers Side Decisions Decoder= 27:OR: Employers Side Decisions Decoder= 30:OR: Employers Side Decisions Decoder= 31,0.33981,IF THEN ELSE (Employers Side Decisions Decoder= 112:OR: Employers Side Decisions Decoder= 113:OR: Employers Side Decisions Decoder= 120:OR:Employers Side Decisions Decoder= 121,0.42718,IF THEN ELSE (Employers Side Decisions Decoder= 116:OR: Employers Side Decisions Decoder= 117:OR: Employers Side Decisions Decoder= 124:OR: Employers Side Decisions Decoder= 125,0.4466,IF THEN ELSE (Employers Side Decisions Decoder= 176:OR: Employers Side Decisions Decoder= 177:OR: Employers Side Decisions Decoder= 184:OR:Employers Side Decisions Decoder= 185,0.45631,IF THEN ELSE (Employers Side Decisions Decoder= 114:OR: Employers Side Decisions Decoder= 115:OR: Employers Side Decisions Decoder= 118:OR: Employers Side Decisions Decoder= 119:OR: Employers Side Decisions Decoder= 122:OR: Employers Side Decisions Decoder= 123:OR: Employers Side Decisions Decoder= 126:OR: Employers Side Decisions Decoder= 127,0.46602,IF THEN ELSE (Employers Side Decisions Decoder= 180:OR: Employers Side Decisions Decoder= 181:OR:Employers Side Decisions Decoder= 188:OR: Employers Side Decisions Decoder= 189,0.47573,IF THEN ELSE (Employers Side Decisions Decoder= 178:OR: Employers Side Decisions Decoder= 179:OR: Employers Side Decisions Decoder= 182:OR: Employers Side Decisions Decoder= 183:OR: Employers Side Decisions Decoder= 186:OR: Employers Side Decisions Decoder= 187:OR: Employers Side Decisions Decoder= 190:OR: Employers Side Decisions Decoder= 191,0.48544,IF THEN ELSE (Employers Side Decisions Decoder= 48:OR:Employers Side Decisions Decoder= 49:OR: Employers Side Decisions Decoder= 56:OR: Employers Side Decisions Decoder= 57,0.94175,IF THEN ELSE (Employers Side Decisions Decoder= 52:OR: Employers Side Decisions Decoder= 53:OR: Employers Side Decisions Decoder= 60:OR: Employers Side Decisions Decoder= 61,0.96117,0.98058) **Present in 2 views:** • Employers Side • Employers Side Decisions **Used by:** • Employers Recruiting PWD Adoption from Advertising • Employers Recruiting PWD Adoption from Word of Mouth **Feedback loops:** 8 (2.5 %)
PWD Side	#64 L	**Fraction of Max f** (Dimensionless) = [(0,0)-(1.5,2),(0,0),(2,2)],(0,0),(0.5,0.5),(0.621176,0.604982),(0.72,0.683274),(0.818824,0.768683),(0.921176,0.846975),(1,0.911032),(1.11176,0.975089),(1.2,1),(1.5,1) **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employers Willing to Recruit PWD Increase Rate • PWD Able to Work and Interested in Work Increase Rate • PWD Direct Recruitment Rate

Group	Type	Variable Name and Description
		• PWD Programme Training Enrolment Rate **Feedback loops:** 0 Fraction of Max f 
Em-ployers Side	#72 A	**Initial All Employers Fraction Having No Disabled Employees** (Dimensionless [0,1,1]) = 1- Initial All Employers Fraction Having One or More Disabled Employees **Description:** *Skog Hansen, Inger Lise and Tone Fløtten. 2011. Companies' role as active activation partners. In: 9th Annual ESPAnet Conference. Valencia, Spain, 8. September. http://espanet2011.net/2010/12/13/6-labour-market-policy-activation-and-beyond/ (Accessed: 1. March 2012). Figure 1 Share of companies which have one or more persons with disability employed. 2007.(N=501).* **Present in 1 view:** • Employers Side **Used by:** • Initial Employers Recruiting PWD • Initial Employers Willing to Recruit PWD • Initial Targeted Employers • Initial Vacancies for PWD **Feedback loops:** 0
Em-ployers Side	#73 C	**Initial All Employers Fraction Having No Disabled Employees but Possible to Have** (Dimensionless [0,1,1]) = 1 **Description:** *0.75----Skog Hansen, Inger Lise and Tone Fløtten. 2011. Companies' role as active activation partners. In: 9th Annual ESPAnet Conference. Valencia, Spain, 8. September. http://espanet2011.net/2010/12/13/6-labour-market-policy-activation-and-beyond/ (Accessed: 1. March 2012). --> Table 2 Share of companies after their considerations of possibilities for a person with disabilities to fill an ordinary position within the company, by type of disability. 2007. (N=501)* **Present in 1 view:** • Employers Side **Used by:** • Initial Employers Willing to Recruit PWD • Initial Targeted Employers • Initial Vacancies for PWD

Group	Type	Variable Name and Description
		Feedback loops: 0
Em-ployers Side	#74 C	**Initial All Employers Fraction Having One or More Disabled Employees** (Dimensionless [0,1,1]) = 0.48503 **Description:** *Skog Hansen, Inger Lise and Tone Fløtten. 2011. Companies' role as active activation partners. In: 9th Annual ESPAnet Conference. Valencia, Spain, 8. September. http://espanet2011.net/2010/12/13/6-labour-market-policy-activation-and-beyond/ (Accessed: 1. March 2012). Figure 1 Share of companies which have one or more persons with disability employed. 2007.(N=501).* **Present in 1 view:** • Employers Side **Used by:** • Initial All Employers Fraction Having No Disabled Employees • Initial Employers Recruiting PWD **Feedback loops:** 0
Em-ployers Side	#75 C	**Initial All Employers Having Employees** (Employers) = 175987 **Description:** *Computed for year 2001 employers having 1 employee or more <--> 2011 - http://www.ssb.no/english/yearbook/tab/tab-326.html-----the same way 113487 from http://statbank.ssb.no/statistikkbanken /Default_FR.asp?PXSid=0&nvl=true&PLanguage=1&tilside=selectvarval /define.asp&Tabellid=07196* *PWD overrepresented in small firms-->PWDs' labour market participation in Norway–a sort of literature review by Jan Tøssebro NTNU http://www.nova.no/asset/3941/1/3941_1.pdf* **Present in 1 view:** • Employers Side **Used by:** • Initial Employers Recruiting PWD • Initial Employers Willing to Recruit PWD • Initial Targeted Employers • Initial Vacancies for PWD **Feedback loops:** 0
Em-ployers Side	#76 C	**Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees with Accomodations or Assistive Aid** (Dimensionless [0,1,1]) = 0.0151 **Description:** *0.4612----Skog Hansen, Inger Lise and Tone Fløtten. 2011. Companies' role as active activation partners. In: 9th Annual ESPAnet Conference. Valencia, Spain, 8. September. http://espanet2011.net/2010/12/13/6-labour-market-policy-activation-and-beyond/ (Accessed: 1. March 2012). --> Figure 3 Share of respondents from companies with no disabled employees at present who say that there are jobs suitable for PWD in their company with or without special arrangements. 2007. (N=258). 0.0191161* **Present in 1 view:** • Employers Side **Used by:** • Initial Employers Willing to Recruit PWD • Initial Targeted Employers **Feedback loops:** 0
Em-ployers Side	#77 C	**Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees without Special Arrangements** (Dimensionless [0,1,1]) = 0.108527 **Description:** *(0.1085) Skog Hansen, Inger Lise and Tone Fløtten. 2011. Companies' role as*

Group	Type	Variable Name and Description
		active activation partners. In: 9th Annual ESPAnet Conference. Valencia, Spain, 8. September. http://espanet2011.net/2010/12/13/6-labour-market-policy-activation-and-beyond/ (Accessed: 1. March 2012). --> Figure 3 Share of respondents from companies with no disabled employees at present who say that there are jobs suitable for PWD in their company with or without special arrangements. 2007. (N=258). **Present in 1 view:** • Employers Side **Used by:** • Initial Employers Recruiting PWD • Initial Targeted Employers • Initial Vacancies for PWD **Feedback loops:** 0
PWD Side	#79 LI,C	**Initial Employed PWD** (Persons) = 231800 **Description:** *231000**** 231808* **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employed PWD • Jobs for PWD **Feedback loops:** 0
Employers Side	#80 LI,A	**Initial Employers Recruiting PWD** (Employers) = Initial All Employers Having Employees* (Initial All Employers Fraction Having One or More Disabled Employees+ Initial All Employers Fraction Having No Disabled Employees* Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees without Special Arrangements) **Description:** *Employers Recruiting or Having Vacancies for PWD* **Present in 1 view:** • Employers Side **Used by:** • Employers Recruiting PWD **Feedback loops:** 0
Employers Side	#81 LI,A	**Initial Employers Willing to Recruit PWD** (Employers) = Initial All Employers Fraction Having No Disabled Employees but Possible to Have* Initial All Employers Having Employees* Initial All Employers Fraction Having No Disabled Employees* Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees with Accomodations or Assistive Aid **Present in 1 view:** • Employers Side **Used by:** • Employers Willing to Recruit PWD **Feedback loops:** 0
Employers Side	#86 LI,A	**Initial Targeted Employers** (Employers) = Initial All Employers Fraction Having No Disabled Employees but Possible to Have* Initial All Employers Having Employees* Initial All Employers Fraction Having No Disabled Employees* (1- Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees without Special Arrangements- Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees with Accomodations or Assistive Aid)

Group	Type	Variable Name and Description
		Description: *Employers having 15 Employees and More Enterprises in 2001 = 388269 (all enterprises) * Percentage of Employers having 15 Employees and More of the total (0.0561891) Percentage of Employers having 10 Employees and More of the total (0.0776299) PWD overrepresented in small firms-->PWDs' labour market participation in Norway–a sort of literature review by Jan Tøssebro NTNU http://www.nova.no/asset/3941/1/3941_1.pdf* **Present in 2 views:** • Employers Side • Employers Side Decisions **Used by:** • Competitors Recruiting PWD • Targeted Employers **Feedback loops:** 0
Em-ployers Side	#88 LI,A	**Initial Vacancies for PWD** (Persons) = Initial All Employers Fraction Having No Disabled Employees but Possible to Have* Initial All Employers Having Employees* Initial All Employers Fraction Having No Disabled Em-ployees* Initial All Employers Having No Disabled Employees Fraction Having Jobs Availa-ble for Disabled Employees without Special Arrangements* Potential Vacancies for PWD per New Employers Recruiting PWD **Present in 1 view:** • Employers Side **Used by:** • Potential Vacancies for PWD **Feedback loops:** 0
Em-ployers Side	#89 F,A	**Interested Employers Decrease Rate** (Employers/Year) = Employers Willing to Recruit PWD* Employers Decrease Fraction **Present in 1 view:** • Employers Side **Used by:** • Employers Willing to Recruit PWD **Feedback loops:** 1 (0.3 %)
Em-ployers Side	#90 L	**Jobs for PWD** (Persons) = $\int$ (PWD Vacancies Occupying Rate- PWD Jobs Quitting Rate- Jobs for PWD Decrease Rate) $\cdot dt$ + [Initial Employed PWD] **Present in 2 views:** • Employers Side • Programme Costs **Used by:** • Average Jobs for PWD per Employers Recruiting PWD • Ratio of Job Vacancies for PWD to All Posts for PWD **Feedback loops:** 125 (39.6 %)
PWD Side	#91 F,A	**Jobs for PWD Decrease Rate** (Persons/Year) = Employers Recruiting PWD Decrease Rate* Average Jobs for PWD per Employers Recruit-ing PWD **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employed PWD End Employment Rate • Jobs for PWD

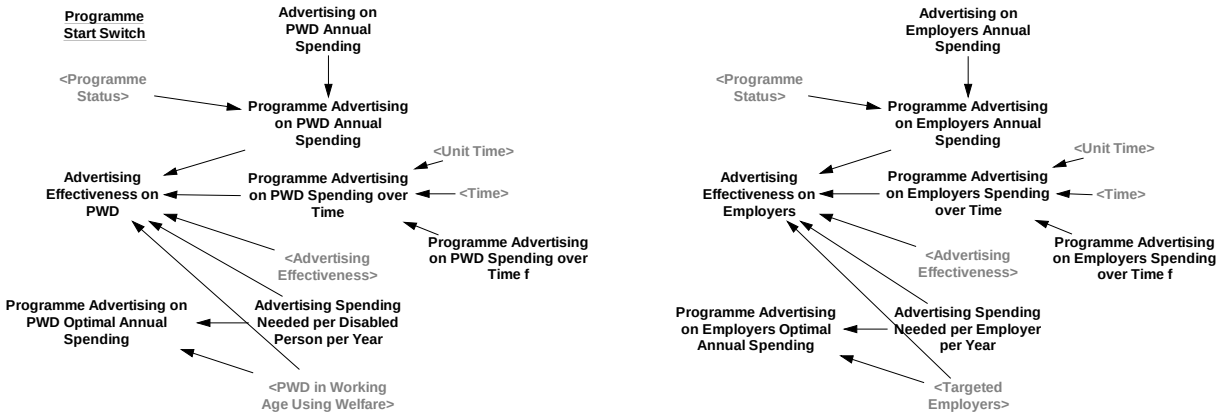
Group	Type	Variable Name and Description
		Feedback loops: 125 (39.6 %)
PWD Side	#100 L	**Potential Vacancies for PWD** (Persons) = $\int$ (PWD Jobs Quitting Rate+ Potential Vacancies for PWD Increase Rate- PWD Vacancies Occupying Rate- Potential Vacancies for PWD Decrease Rate) $\cdot dt$ + [Initial Vacancies for PWD] **Present in 4 views:** • PWD Side • Employers Side • PWD Side Decisions • Programme Costs **Used by:** • Average Potential Vacancies for PWD per Employers Recruiting PWD • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate • Ratio of Job Vacancies for PWD to All Posts for PWD • Suitable Jobs Availability **Feedback loops:** 196 (62.0 %)
Em-ployers Side	#101 F,A	**Potential Vacancies for PWD Decrease Rate** (Persons/Year) = Employers Recruiting PWD Decrease Rate* Average Potential Vacancies for PWD per Em-ployers Recruiting PWD **Present in 1 view:** • Employers Side **Used by:** • Potential Vacancies for PWD **Feedback loops:** 1 (0.3 %)
Em-ployers Side	#102 F,A	**Potential Vacancies for PWD Increase Rate** (Persons/Year) = Potential Vacancies for PWD per New Employers Recruiting PWD* Employers Recruiting PWD Increase Rate **Present in 1 view:** • Employers Side **Used by:** • Potential Vacancies for PWD **Feedback loops:** 0
Em-ployers Side	#103 C	**Potential Vacancies for PWD per New Employers Recruiting PWD** (Persons/Employer) = 2.71891 **Description:** *2.95-3.94898 Computed : employed disabled persons http://www.ssb.no /akutu_en/ and enterprises with 1 or more employees http://statbank.ssb.no/statistikkbanken /Default_FR.asp?PXSid=0&nvl=true&PLanguage=1&tilside=selectvarval /define.asp&Tabellid=07196 1.097* **Present in 2 views:** • Employers Side • Programme Costs **Used by:** • Average Cost to Prepare Employer to Recruit PWD • Initial Vacancies for PWD • Potential Vacancies for PWD Increase Rate **Feedback loops:** 0
PWD Side	#112 G	**Programme Start Switch** (Dimensionless [0,1,1]) = GAME(0)

Group	Type	Variable Name and Description
		Present in 6 views: • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions • Programme Costs **Used by:** • Programme Status **Feedback loops:** 0
PWD Side	#114 A	**Programme Status** (Dimensionless) = STEP (Programme Start Switch ,Programme Start Year) **Present in 5 views:** • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions **Used by:** • Employers Recruiting PWD Adoption from Advertising • Programme Advertising on Employers Annual Spending • Programme Advertising on PWD Annual Spending • PWD Able to Work and Interested in Work Work Adoption from Advertising • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate **Feedback loops:** 0
PWD Side	#123 F,A	**PWD Direct Recruitment Rate** (Persons/Year) = IF THEN ELSE (Programme Status= 1,(PWD Able to Work and Interested in Work / Shortest Time to Fill All Available Vacancies)* Fraction of Max f (XIDZ (Potential Vacancies for PWD/ Shortest Time to Fill All Available Vacancies ,PWD Able to Work and Interested in Work/Shortest Time to Fill All Available Vacancies ,10))* PWD Fraction Recruited in Old Jobs after Disability ,(PWD Able to Work and Interested in Work/ Shortest Time to Fill All Available Vacancies)* Fraction of Max f (xidz (Potential Vacancies for PWD/ Shortest Time to Fill All Available Vacancies ,PWD Able to Work and Interested in Work/ Shortest Time to Fill All Available Vacancies ,10))) **Description:** *Maximum outflow*Fraction of Max f(xidz(Desired draining , Maximum outflow,10))* **Present in 2 views:** • PWD Side • Employers Side **Used by:** • Employed PWD • PWD Able to Work and Interested in Work • PWD Vacancies Occupying Rate **Feedback loops:** 193 (61.1 %)
PWD Side	#125 F,A	**PWD Fail Programme Training Rate** (Persons/Year) = PWD in Programme Training* PWD Fail Programme Training Fraction **Description:** *(Level to drain / Fastest draining time) * Fraction of Max f (xidz (Desired draining , Level to drain / Fastest draining time , 10))* **Present in 2 views:**

Group	Type	Variable Name and Description
		• PWD Side • Employers Side **Used by:** • PWD in Programme Training • PWD in Working Age Using Welfare • PWD Jobs Quitting Rate **Feedback loops:** 73 (23.1 %)
PWD Side	#128 F,A 	**PWD in Training Decrease Rate** (Persons/Year) = PWD in Programme Training* PWD in Working Age Decrease Fraction **Present in 2 views:** • PWD Side • Employers Side **Used by:** • PWD in Programme Training • PWD Jobs Quitting Rate **Feedback loops:** 37 (11.7 %)
Em-ployers Side	#135 F,A 	**PWD Jobs Quitting Rate** (Persons/Year) = Employed PWD* Employed PWD Work Quitting Fraction+ Employed PWD Decrease Rate+ PWD Fail Programme Training Rate+ PWD in Training Decrease Rate **Present in 1 view:** • Employers Side **Used by:** • Jobs for PWD • Potential Vacancies for PWD **Feedback loops:** 178 (56.3 %)
PWD Side	#136 F,A 	**PWD Programme Training Enrolment Rate** (Persons/Year) = IF THEN ELSE (Programme Status= 1,(PWD Able to Work and Interested in Work / Shortest Time to Fill All Available Vacancies)* Fraction of Max f (XIDZ (Potential Vacancies for PWD/ Shortest Time to Fill All Available Vacancies ,PWD Able to Work and Interested in Work/Shortest Time to Fill All Available Vacancies ,10))* (1- PWD Fraction Recruited in Old Jobs after Disability) ,0) **Description:** *(Level to drain / Fastest draining time) * Fraction of Max f (xidz (Desired draining , Level to drain / Fastest draining time , 10))* **Present in 4 views:** • PWD Side • Employers Side • PWD Side Decisions • Programme Costs **Used by:** • Employment Training • Government Spending on PWD • PWD Able to Work and Interested in Work • PWD in Programme Training • PWD Vacancies Occupying Rate **Feedback loops:** 230 (72.8 %)
Em-ployers Side	#138 F,A 	**PWD Vacancies Occupying Rate** (Persons/Year) = PWD Direct Recruitment Rate+ PWD Programme Training Enrolment Rate **Present in 1 view:** • Employers Side **Used by:**

Group	Type	Variable Name and Description
		• Jobs for PWD • Potential Vacancies for PWD **Feedback loops:** 141 (44.6 %)
Employers Side	#155 L	**Targeted Employers** (Employers) $= \int ($ Employers Increase Rate- Employers Willing to Recruit PWD Increase Rate- Employers Decrease Rate $) \cdot dt$ + [Initial Targeted Employers] **Present in 3 views:** • Employers Side • Advertising Effectiveness • Employers Side Decisions **Used by:** • Advertising Effectiveness on Employers • All Employers in the System • Disabled Employees Have Valuable Experiences • Employers Decrease Rate • Employers Recruiting PWD Adoption from Advertising • Employers Recruiting PWD Adoption from Word of Mouth • Employers Willing to Recruit PWD Increase Rate • Programme Advertising on Employers Optimal Annual Spending **Feedback loops:** 20 (6.3 %)
Employers Side	#156 C	**Targeted Employers Fastest Draining Time** (Year) = 1.04823 **Present in 1 view:** • Employers Side **Used by:** • Employers Willing to Recruit PWD Increase Rate **Feedback loops:** 0

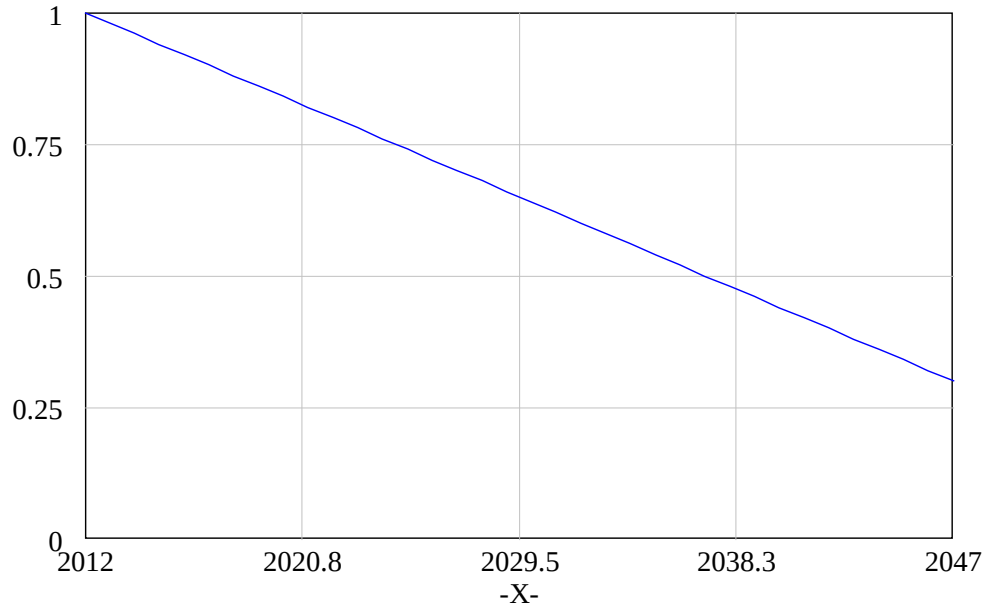
A.4 Advertising Effectiveness Subsystem (23 variables)

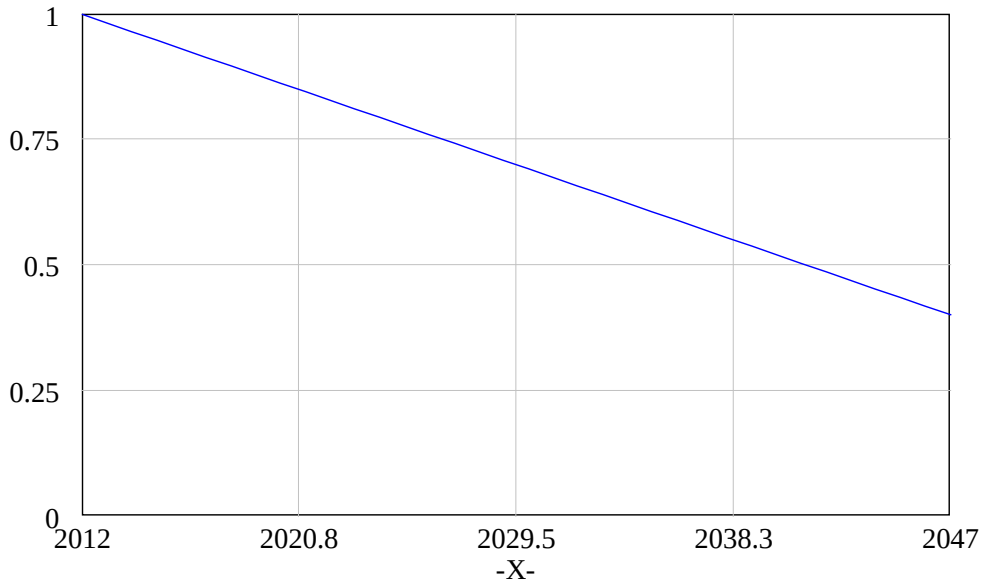


Group	Type	Variable Name and Description
Advertising Effectiveness	#5 C	**Advertising Effectiveness** (Dimensionless/Year) = 0.00244244 **Present in 1 view:** • Advertising Effectiveness **Used by:**

Group	Type	Variable Name and Description
		• Advertising Effectiveness on Employers • Advertising Effectiveness on PWD **Feedback loops:** 0
Em-ploy-ers Side	#6 A 	**Advertising Effectiveness on Employers** (Dimensionless/Year) = Advertising Effectiveness* Programme Advertising on Employers Annual Spend-ing* Programme Advertising on Employers Spending over Time* ZIDZ (1,Targeted Employ-ers* Advertising Spending Needed per Employer per Year) **Description:** *Advertising results in adoption according the effectiveness of the advertising.* **Present in 2 views:** • Employers Side • Advertising Effectiveness **Used by:** • Employers Recruiting PWD Adoption from Advertising **Feedback loops:** 3 (0.9 %)
PWD Side	#7 A 	**Advertising Effectiveness on PWD** (Dimensionless/Year) = Advertising Effectiveness* Programme Advertising on PWD Annual Spending* Programme Advertising on PWD Spending over Time* ZIDZ (1,PWD in Working Age Using Wel-fare* Advertising Spending Needed per Disabled Person per Year) **Description:** *(0.011) Advertising results in adoption according the effectiveness of the adver-tising. (0.0021) The fraction of the population adopting each year as the result of advertising. (0.0008) The fraction of households adopting the innovation each year as a result of advertis-ing. The value 0.0008 is the best fit parameter to match the cable TV subscriber data.* **Present in 2 views:** • PWD Side • Advertising Effectiveness **Used by:** • PWD Able to Work and Interested in Work Work Adoption from Advertising **Feedback loops:** 28 (8.9 %)
Adver-tising Effec-tive-ness	#8 G 	**Advertising on Employers Annual Spending** (NOK/Year [0,?]) = GAME(2.97126e+006) **Description:** *Targeted Employers * Advertising Spending Needed per Employer per Year* **Present in 2 views:** • Advertising Effectiveness • Employers Side Decisions **Used by:** • Programme Advertising on Employers Annual Spending **Feedback loops:** 0
Adver-tising Effec-tive-ness	#9 G 	**Advertising on PWD Annual Spending** (NOK/Year [0,?]) = GAME(8.65015e+006) **Description:** *PWD in Working Age Using Welfare * Advertising Spending Needed per Disa-bled Person per Year* **Present in 2 views:** • Advertising Effectiveness • PWD Side Decisions **Used by:** • Programme Advertising on PWD Annual Spending **Feedback loops:** 0
Adver-tising Effec-	#10 C 	**Advertising Spending Needed per Disabled Person per Year** (NOK/Person/Year) = 37.4101 **Description:** *Dertouzos, James N. and Steven Garber. Summer2006. Effectiveness of Adver-*

Group	Type	Variable Name and Description
tive-ness		*tising in Different Media. Journal of Advertising 35, Nr. 2: 111-122 Samuel H. Williamson, "Seven Ways to Compute the Relative Value of a U.S. Dollar Amount, 1774 to present," MeasuringWorth, 2011. URL: www.measuringworth.com/uscompare/ http://www.oanda.com /currency/converter/ http://www.vectorgrader.com/indicators/ppp.html* **Present in 2 views:** • Advertising Effectiveness • PWD Side Decisions **Used by:** • Advertising Effectiveness on PWD • Flexible Working Hours • Programme Advertising on PWD Optimal Annual Spending **Feedback loops:** 0
Advertising Effectiveness	#11 C 	**Advertising Spending Needed per Employer per Year** (NOK/Employer/Year) = 37.4101 **Description:** *Dertouzos, James N. and Steven Garber. Summer2006. Effectiveness of Advertising in Different Media. Journal of Advertising 35, Nr. 2: 111-122 Samuel H. Williamson, "Seven Ways to Compute the Relative Value of a U.S. Dollar Amount, 1774 to present," MeasuringWorth, 2011. URL: www.measuringworth.com/uscompare/ http://www.oanda.com /currency/converter/ http://www.vectorgrader.com/indicators/ppp.html* **Present in 2 views:** • Advertising Effectiveness • Employers Side Decisions **Used by:** • Advertising Effectiveness on Employers • Disabled Employees Have Valuable Experiences • Programme Advertising on Employers Optimal Annual Spending **Feedback loops:** 0
Advertising Effectiveness	#104 A 	**Programme Advertising on Employers Annual Spending** (NOK/Year) = Programme Status* Advertising on Employers Annual Spending **Present in 3 views:** • Advertising Effectiveness • Employers Side Decisions • Programme Costs **Used by:** • Advertising Effectiveness on Employers • Disabled Employees Have Valuable Experiences • Government Spending on PWD **Feedback loops:** 0
Advertising Effectiveness	#105 A 	**Programme Advertising on Employers Optimal Annual Spending** (NOK/Year) = Targeted Employers* Advertising Spending Needed per Employer per Year **Present in 1 view:** • Advertising Effectiveness **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Advertising Effectiveness	#106 A 	**Programme Advertising on Employers Spending over Time** (Dimensionless) = Programme Advertising on Employers Spending over Time f (Time/ Unit Time) **Present in 3 views:** • Advertising Effectiveness • Employers Side Decisions

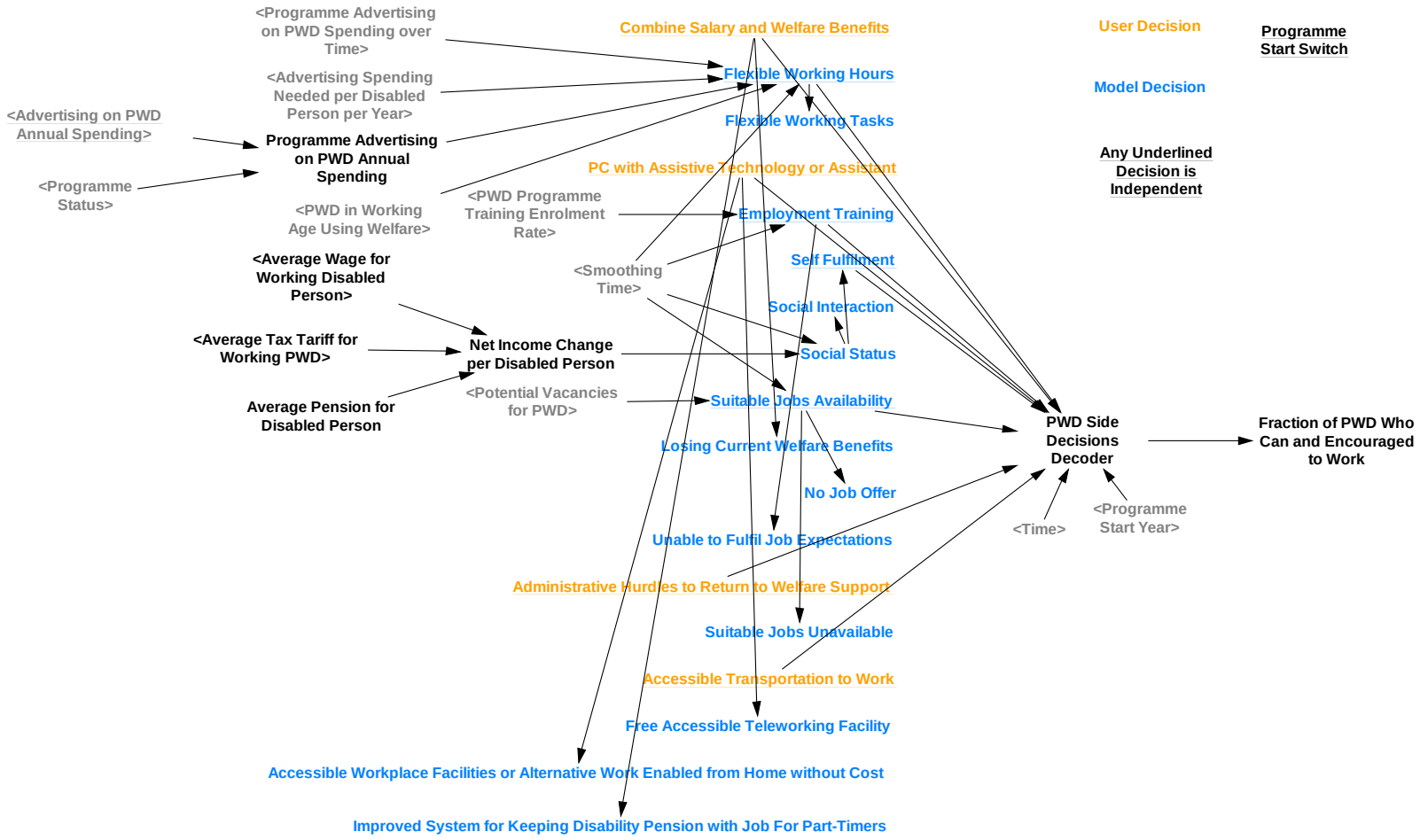
Group	Type	Variable Name and Description
		• Programme Costs **Used by:** • Advertising Effectiveness on Employers • Disabled Employees Have Valuable Experiences • Government Spending on PWD **Feedback loops:** 0
Advertising Effectiveness	#107 T	**Programme Advertising on Employers Spending over Time f** (Dimensionless) = [(2012,0)-(2047,1)],(2012,1),(2013,0.98),(2014,0.96),(2015,0.94),(2016,0.92),(2017,0.9),(2018,0.88),(2019,0.86),(2020,0.84),(2021,0.82),(2022,0.8),(2023,0.78),(2024,0.76),(2025,0.74),(2026,0.72),(2027,0.7),(2028,0.68),(2029,0.66),(2030,0.64),(2031,0.62),(2032,0.6),(2033,0.58),(2034,0.56),(2035,0.54),(2036,0.52),(2037,0.5),(2038,0.48),(2039,0.46),(2040,0.44),(2041,0.42),(2042,0.4),(2043,0.38),(2044,0.36),(2045,0.34),(2046,0.32),(2047,0.3) **Present in 1 view:** • Advertising Effectiveness **Used by:** • Programme Advertising on Employers Spending over Time **Feedback loops:** 0 Programme Advertising on Employers Spending over Time f 
Advertising Effectiveness	#108 A	**Programme Advertising on PWD Annual Spending** (NOK/Year) = Programme Status* Advertising on PWD Annual Spending **Present in 3 views:** • Advertising Effectiveness • PWD Side Decisions • Programme Costs **Used by:** • Advertising Effectiveness on PWD • Flexible Working Hours • Government Spending on PWD **Feedback loops:** 0
Advertising	#109 A	**Programme Advertising on PWD Optimal Annual Spending** (NOK/Year) = PWD in Working Age Using Welfare* Advertising Spending Needed per Disabled Person

Group	Type	Variable Name and Description
Effec-tive-ness		per Year **Present in 1 view:** • Advertising Effectiveness **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Adver-tising Effec-tive-ness	#110 A	**Programme Advertising on PWD Spending over Time** (Dimensionless) = Programme Advertising on PWD Spending over Time f (Time/ Unit Time) **Present in 3 views:** • Advertising Effectiveness • PWD Side Decisions • Programme Costs **Used by:** • Advertising Effectiveness on PWD • Flexible Working Hours • Government Spending on PWD **Feedback loops:** 0
Adver-tising Effec-tive-ness	#111 T	**Programme Advertising on PWD Spending over Time f** (Dimensionless) = [(2012,0)-(2047,1)],(2012,1),(2013,0.982857),(2014,0.965714),(2015,0.948571),(2016,0.931429),(2017,0.914286),(2018,0.897143),(2019,0.88),(2020,0.862857),(2021,0.845714),(2022,0.828571),(2023,0.811429),(2024,0.794286),(2025,0.777143),(2026,0.76),(2027,0.742857),(2028,0.725714),(2029,0.708571),(2030,0.691429),(2031,0.674286),(2032,0.657143),(2033,0.64),(2034,0.622857),(2035,0.605714),(2036,0.588571),(2037,0.571429),(2038,0.554286),(2039,0.537143),(2040,0.52),(2041,0.502857),(2042,0.485714),(2043,0.468571),(2044,0.451429),(2045,0.434286),(2046,0.417143),(2047,0.4) **Present in 1 view:** • Advertising Effectiveness **Used by:** • Programme Advertising on PWD Spending over Time **Feedback loops:** 0 Programme Advertising on PWD Spending over Time f 
PWD	#112	**Programme Start Switch** (Dimensionless [0,1,1])

Group	Type	Variable Name and Description
Side	G	= GAME(0) **Present in 6 views:** • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions • Programme Costs **Used by:** • Programme Status **Feedback loops:** 0
PWD Side	#114 A	**Programme Status** (Dimensionless) = STEP (Programme Start Switch ,Programme Start Year) **Present in 5 views:** • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions **Used by:** • Employers Recruiting PWD Adoption from Advertising • Programme Advertising on Employers Annual Spending • Programme Advertising on PWD Annual Spending • PWD Able to Work and Interested in Work Work Adoption from Advertising • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate **Feedback loops:** 0
PWD Side	#133 L	**PWD in Working Age Using Welfare** (Persons) = $\int$ (PWD in Working Age and Using Welfare Increase Rate+ PWD Fail Programme Training Rate- PWD Able to Work and Interested in Work Increase Rate- PWD in Working Age and Using Welfare Decrease Rate) $\cdot dt$ + [Initial PWD In Working Age and Using Welfare] **Description:** *The initial number of People with Disabilities using welfare is determined by the total population size and the current number of active adopters. It is reduced by adoption and increased when working disabled come back and natural total population increase.* **Present in 3 views:** • PWD Side • Advertising Effectiveness • PWD Side Decisions **Used by:** • Advertising Effectiveness on PWD • All PWD in Working Age • All PWD in Working Age Using Welfare and Not in Programme Training • Flexible Working Hours • Programme Advertising on PWD Optimal Annual Spending • PWD Able to Work and Interested in Work Increase Rate • PWD Able to Work and Interested in Work Work Adoption from Advertising • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth • PWD in Working Age and Using Welfare Decrease Rate **Feedback loops:** 170 (53.8 %)

Group	Type	Variable Name and Description
Em-ploy-ers Side	#155 L 	**Targeted Employers** (Employers) = $\int$ (Employers Increase Rate- Employers Willing to Recruit PWD Increase Rate- Employers Decrease Rate) $\cdot dt$ + [Initial Targeted Employers] **Present in 3 views:** • Employers Side • Advertising Effectiveness • Employers Side Decisions **Used by:** • Advertising Effectiveness on Employers • All Employers in the System • Disabled Employees Have Valuable Experiences • Employers Decrease Rate • Employers Recruiting PWD Adoption from Advertising • Employers Recruiting PWD Adoption from Word of Mouth • Employers Willing to Recruit PWD Increase Rate • Programme Advertising on Employers Optimal Annual Spending **Feedback loops:** 20 (6.3 %)
PWD Side	#160 C 	**Unit Time** (Year) = 1 **Present in 2 views:** • PWD Side • Advertising Effectiveness **Used by:** • All PWD in Working Age Historical Data • All PWD in Working Age Using Welfare and Not in Programme Training Historical Data • Employed PWD and in Programme Training Historical Data • Programme Advertising on Employers Spending over Time • Programme Advertising on PWD Spending over Time **Feedback loops:** 0

A.5 PWD Side Decisions Subsystem (35 variables)



Group	Type	Variable Name and Description
PWD Side Decisions	#1 G	**Accessible Transportation to Work** (Dimensionless [0,1,1]) = GAME(1) **Description:** *Availability of accessible transportation to workplace* **Present in 1 view:** • PWD Side Decisions **Used by:** • PWD Side Decisions Decoder **Feedback loops:** 0
PWD Side Decisions	#2 A	**Accessible Workplace Facilities or Alternative Work Enabled from Home without Cost** (Dimensionless [0,1,1]) = PC with Assistive Technology or Assistant **Description:** *Availability of accessible workplace facilities or alternative work enabled from home without cost on you* **Present in 1 view:** • PWD Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
PWD Side Decisions	#4 G	**Administrative Hurdles to Return to Welfare Support** (Dimensionless [0,1,1]) = GAME(1) **Description:** *Administrative hurdles in case a return to welfare support is necessary=="Administrative hurdles in case a return to welfare support is necessary"* **Present in 1 view:** • PWD Side Decisions **Used by:** • PWD Side Decisions Decoder **Feedback loops:** 0
Advertising Effectiveness	#9 G	**Advertising on PWD Annual Spending** (NOK/Year [0,?]) = GAME(8.65015e+006) **Description:** *PWD in Working Age Using Welfare * Advertising Spending Needed per Disabled Person per Year* **Present in 2 views:** • Advertising Effectiveness • PWD Side Decisions **Used by:** • Programme Advertising on PWD Annual Spending **Feedback loops:** 0
Advertising Effectiveness	#10 C	**Advertising Spending Needed per Disabled Person per Year** (NOK/Person/Year) = 37.4101 **Description:** *Dertouzos, James N. and Steven Garber. Summer2006. Effectiveness of Advertising in Different Media. Journal of Advertising 35, Nr. 2: 111-122 Samuel H. Williamson, "Seven Ways to Compute the Relative Value of a U.S. Dollar Amount, 1774 to present," MeasuringWorth, 2011. URL: www.measuringworth.com/uscompare/ http://www.oanda.com/currency/converter/ http://www.vectorgrader.com/indicators/ppp.html* **Present in 2 views:** • Advertising Effectiveness • PWD Side Decisions **Used by:** • Advertising Effectiveness on PWD • Flexible Working Hours

Group	Type	Variable Name and Description
		• Programme Advertising on PWD Optimal Annual Spending **Feedback loops:** 0
PWD Side Decisions	#23 C 	**Average Pension for Disabled Person** (NOK/(Year*Person)) = 88620 **Description:** *2006: Today, the average recipient of disability benefits has 1.46 pension points (Social Security. ?? Social Security Statistical Yearbook, table 9.37.), and the base amount for calculating social security benefits is NOK 60,699. Generally speaking, we can say that an average recipient of disability benefits receives NOK 88,620 a year. Basic amount 75641 (May 1 2010) http://corporatesolutions.swisslife.com/etc/slml/slnw/obedl/1/200/360.File.tmp /Norway.pdf 110436* **Present in 2 views:** • PWD Side Decisions • Programme Costs **Used by:** • Government Spending on PWD • Net Income Change per Disabled Person **Feedback loops:** 0
PWD Side Decisions	#25 C 	**Average Tax Tariff for Working PWD** (Dimensionless) = 0.28 **Present in 2 views:** • PWD Side Decisions • Programme Costs **Used by:** • Average Taxes from Working Disabled Person • Net Income Change per Disabled Person **Feedback loops:** 0
PWD Side Decisions	#29 C 	**Average Wage for Working Disabled Person** (NOK/(Year*Person)) = 183900 **Description:** *In 2003, the mean salary level was NOK 183,900, and mean income tax paid was NOK 52,0003. SSB May 2011: Full-time employees had average monthly earnings of NOK 38100, while the corresponding earnings for part-time employees were NOK 30600. This was a year-on-year increase of 4.1 and 4.4 per cent respectively. In order to make the part-time and full-time earnings comparable, the earnings of part-time employees are converted to earnings corresponding to full-time employees. 457200, 367200* **Present in 2 views:** • PWD Side Decisions • Programme Costs **Used by:** • Average Taxes from Working Disabled Person • Government Spending on PWD • Net Income Change per Disabled Person **Feedback loops:** 0
PWD Side Decisions	#30 G 	**Combine Salary and Welfare Benefits** (Dimensionless [0,1,1]) = GAME(1) **Description:** *Disabled Person can combine salary and welfare benefits== "Disabled Person can combine salary and welfare benefits" and "For part-time workers, improved system for keeping disability pension when having salaried employment" and not "Risk of losing current welfare benefits"* **Present in 1 view:** • PWD Side Decisions **Used by:**

Group	Type	Variable Name and Description
		• Improved System for Keeping Disability Pension with Job For Part Timers • Losing Current Welfare Benefits • PWD Side Decisions Decoder **Feedback loops:** 0
PWD Side Decisions	#55 A	**Employment Training** (Dimensionless [0,1,1]) = IF THEN ELSE (SMOOTH (PWD Programme Training Enrolment Rate ,Smoothing Time)> 0,1,0) **Description:** *Access to employment training=="Access to employment training" and not "Risk of not being able to fulfil the job expectations"* **Present in 1 view:** • PWD Side Decisions **Used by:** • PWD Side Decisions Decoder • Unable to Fulfil Job Expectations **Feedback loops:** 12 (3.8 %)
PWD Side Decisions	#61 A	**Flexible Working Hours** (Dimensionless [0,1,1]) = IF THEN ELSE (SMOOTH (Programme Advertising on PWD Annual Spending* Programme Advertising on PWD Spending over Time* ZIDZ (1,PWD in Working Age Using Welfare* Advertising Spending Needed per Disabled Person per Year) ,Smoothing Time)>= 0.5,1,0) **Description:** *Flexible working hours=="Flexible working hours" and "Flexible working tasks"* **Present in 1 view:** • PWD Side Decisions **Used by:** • Flexible Working Tasks • PWD Side Decisions Decoder **Feedback loops:** 56 (17.7 %)
PWD Side Decisions	#62 A	**Flexible Working Tasks** (Dimensionless [0,1,1]) = Flexible Working Hours **Description:** *Flexible working tasks* **Present in 1 view:** • PWD Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
PWD Side	#65 A	**Fraction of PWD Who Can and Encouraged to Work** (Dimensionless) = IF THEN ELSE (PWD Side Decisions Decoder= 0:OR: PWD Side Decisions Decoder= 4:OR: PWD Side Decisions Decoder= 8:OR: PWD Side Decisions Decoder= 12:OR: PWD Side Decisions Decoder= 16:OR: PWD Side Decisions Decoder= 20:OR: PWD Side Decisions Decoder= 24:OR: PWD Side Decisions Decoder= 28:OR: PWD Side Decisions Decoder= 32:OR: PWD Side Decisions Decoder= 64:OR:PWD Side Decisions Decoder= 68:OR: PWD Side Decisions Decoder= 72:OR: PWD Side Decisions Decoder= 76:OR: PWD Side Decisions Decoder= 80:OR: PWD Side Decisions Decoder= 84:OR: PWD Side Decisions Decoder= 88:OR: PWD Side Decisions Decoder= 92:OR:PWD Side Decisions Decoder= 128:OR: PWD Side Decisions Decoder= 132:OR: PWD Side Decisions Decoder= 136:OR: PWD Side Decisions Decoder= 140:OR: PWD Side Decisions Decoder= 144:OR: PWD Side Decisions Decoder= 148:OR: PWD Side Decisions Decoder= 152:OR: PWD Side Decisions Decoder= 156:OR: PWD Side Decisions Decoder= 160:OR: PWD Side Decisions Decoder= 192:OR: PWD Side Decisions Decoder=

Group	Type	Variable Name and Description
		196:OR: PWD Side Decisions Decoder= 200:OR: PWD Side Decisions Decoder= 204:OR: PWD Side Decisions Decoder= 208:OR: PWD Side Decisions Decoder= 212:OR: PWD Side Decisions Decoder= 216:OR: PWD Side Decisions Decoder= 220,0,IF THEN ELSE (PWD Side Decisions Decoder= 130:OR: PWD Side Decisions Decoder= 162:OR: PWD Side Decisions Decoder= 164,0.019868,IF THEN ELSE (PWD Side Decisions Decoder= 2:OR: PWD Side Decisions Decoder= 34:OR: PWD Side Decisions Decoder= 129:OR: PWD Side Decisions Decoder= 168,0.023179,IF THEN ELSE (PWD Side Decisions Decoder= 40,0.02649,IF THEN ELSE (PWD Side Decisions Decoder= 161:OR: PWD Side Decisions Decoder= 224:OR: PWD Side Decisions Decoder= 232,0.029801,IF THEN ELSE (PWD Side Decisions Decoder= 172,0.033113,IF THEN ELSE (PWD Side Decisions Decoder= 36:OR: PWD Side Decisions Decoder= 96:OR: PWD Side Decisions Decoder= 104:OR: PWD Side Decisions Decoder= 134:OR: PWD Side Decisions Decoder= 166:OR:PWD Side Decisions Decoder= 176,0.036424,IF THEN ELSE (PWD Side Decisions Decoder= 184:OR: PWD Side Decisions Decoder= 228:OR: PWD Side Decisions Decoder= 236:OR: PWD Side Decisions Decoder= 240:OR: PWD Side Decisions Decoder= 248,0.039735,IF THEN ELSE (PWD Side Decisions Decoder= 1,0.043046,IF THEN ELSE (PWD Side Decisions Decoder= 133,0.046358,IF THEN ELSE (PWD Side Decisions Decoder= 48,0.049669,IF THEN ELSE (PWD Side Decisions Decoder= 33:OR: PWD Side Decisions Decoder= 44:OR:PWD Side Decisions Decoder= 56:OR: PWD Side Decisions Decoder= 131:OR: PWD Side Decisions Decoder= 137:OR: PWD Side Decisions Decoder= 163:OR: PWD Side Decisions Decoder= 165,0.05298,IF THEN ELSE (PWD Side Decisions Decoder= 6:OR: PWD Side Decisions Decoder= 38:OR: PWD Side Decisions Decoder= 112:OR: PWD Side Decisions Decoder= 120,0.056291,IF THEN ELSE(PWD Side Decisions Decoder= 138:OR:PWD Side Decisions Decoder= 169:OR:PWD Side Decisions Decoder= 170,0.059603,IF THEN ELSE(PWD Side Decisions Decoder= 10:OR: PWD Side Decisions Decoder= 42:OR: PWD Side Decisions Decoder= 100:OR: PWD Side Decisions Decoder= 108,0.062914,IF THEN ELSE(PWD Side Decisions Decoder= 145,0.066225,IF THEN ELSE (PWD Side Decisions Decoder= 193:OR: PWD Side Decisions Decoder= 201,0.069536,IF THEN ELSE (PWD Side Decisions Decoder= 9:OR: PWD Side Decisions Decoder= 225:OR: PWD Side Decisions Decoder= 233,0.076159,IF THEN ELSE (PWD Side Decisions Decoder= 3:OR: PWD Side Decisions Decoder= 35:OR: PWD Side Decisions Decoder= 135:OR: PWD Side Decisions Decoder= 139:OR: PWD Side Decisions Decoder= 141:OR: PWD Side Decisions Decoder= 142:OR: PWD Side Decisions Decoder= 153:OR: PWD Side Decisions Decoder= 167:OR: PWD Side Decisions Decoder= 171:OR: PWD Side Decisions Decoder= 174,0.07947,IF THEN ELSE (PWD Side Decisions Decoder= 177,0.082781,IF THEN ELSE (PWD Side Decisions Decoder= 41:OR: PWD Side Decisions Decoder= 146:OR: PWD Side Decisions Decoder= 173:OR: PWD Side Decisions Decoder= 178:OR: PWD Side Decisions Decoder= 194:OR: PWD Side Decisions Decoder= 202:OR: PWD Side Decisions Decoder= 209:OR: PWD Side Decisions Decoder= 217:OR: PWD Side Decisions Decoder= 226:OR: PWD Side Decisions Decoder= 234,0.086093,IF THEN ELSE (PWD Side Decisions Decoder= 66:OR: PWD Side Decisions Decoder= 74:OR: PWD Side Decisions Decoder= 98:OR: PWD Side Decisions Decoder= 106,0.092715,IF THEN ELSE (PWD Side Decisions Decoder= 180:OR: PWD Side Decisions Decoder= 185:OR: PWD Side Decisions Decoder= 188:OR: PWD Side Decisions Decoder= 244:OR: PWD Side Decisions Decoder= 252,0.096026,IF THEN ELSE (PWD Side Decisions Decoder= 5:OR: PWD Side Decisions Decoder= 65:OR: PWD Side Decisions Decoder= 73:OR: PWD Side Decisions Decoder= 154:OR: PWD Side Decisions Decoder= 186:OR: PWD Side Decisions Decoder= 197:OR: PWD Side Decisions Decoder= 205,0.099338,IF THEN ELSE (PWD Side Decisions Decoder= 14:OR: PWD Side Decisions Decoder= 46:OR: PWD Side Decisions Decoder= 241:OR: PWD Side Decisions Decoder=

Group	Type	Variable Name and Description
		249,0.10265,IF THEN ELSE (PWD Side Decisions Decoder= 11:OR: PWD Side Decisions Decoder= 18:OR: PWD Side Decisions Decoder= 43:OR: PWD Side Decisions Decoder= 50:OR: PWD Side Decisions Decoder= 229:OR: PWD Side Decisions Decoder= 237,0.10596,IF THEN ELSE (PWD Side Decisions Decoder= 97:OR: PWD Side Decisions Decoder= 105:OR: PWD Side Decisions Decoder= 143:OR: PWD Side Decisions Decoder= 175:OR: PWD Side Decisions Decoder= 195:OR: PWD Side Decisions Decoder= 203:OR: PWD Side Decisions Decoder= 210:OR: PWD Side Decisions Decoder= 218:OR: PWD Side Decisions Decoder= 227:OR: PWD Side Decisions Decoder= 235:OR: PWD Side Decisions Decoder= 242:OR: PWD Side Decisions Decoder= 250,0.10927,IF THEN ELSE (PWD Side Decisions Decoder= 37:OR: PWD Side Decisions Decoder= 198:OR: PWD Side Decisions Decoder= 206:OR: PWD Side Decisions Decoder= 230:OR:PWD Side Decisions Decoder= 238,0.11258,IF THEN ELSE (PWD Side Decisions Decoder= 26:OR: PWD Side Decisions Decoder= 58:OR:PWD Side Decisions Decoder= 147,0.11921,IF THEN ELSE (PWD Side Decisions Decoder= 179,0.12252,IF THEN ELSE (PWD Side Decisions Decoder= 82:OR: PWD Side Decisions Decoder= 90:OR: PWD Side Decisions Decoder= 114:OR: PWD Side Decisions Decoder= 122,0.13245,IF THEN ELSE (PWD Side Decisions Decoder= 155,0.13576,IF THEN ELSE (PWD Side Decisions Decoder= 52:OR: PWD Side Decisions Decoder= 60:OR: PWD Side Decisions Decoder= 187,0.13907,IF THEN ELSE (PWD Side Decisions Decoder= 7:OR: PWD Side Decisions Decoder= 39:OR: PWD Side Decisions Decoder= 67:OR: PWD Side Decisions Decoder= 70:OR: PWD Side Decisions Decoder= 75:OR: PWD Side Decisions Decoder= 78:OR: PWD Side Decisions Decoder= 99:OR: PWD Side Decisions Decoder= 102:OR:PWD Side Decisions Decoder= 107:OR: PWD Side Decisions Decoder= 110:OR: PWD Side Decisions Decoder= 116:OR: PWD Side Decisions Decoder= 124,0.14238,IF THEN ELSE (PWD Side Decisions Decoder= 13:OR: PWD Side Decisions Decoder= 17:OR: PWD Side Decisions Decoder= 199:OR: PWD Side Decisions Decoder= 207:OR: PWD Side Decisions Decoder= 231:OR: PWD Side Decisions Decoder= 239,0.1457,IF THEN ELSE (PWD Side Decisions Decoder= 211:OR: PWD Side Decisions Decoder= 219,0.15232,IF THEN ELSE (PWD Side Decisions Decoder= 243:OR: PWD Side Decisions Decoder= 251,0.15563,IF THEN ELSE (PWD Side Decisions Decoder= 25,0.15894,IF THEN ELSE (PWD Side Decisions Decoder= 45,0.16225,IF THEN ELSE (PWD Side Decisions Decoder= 49:OR: PWD Side Decisions Decoder= 81:OR: PWD Side Decisions Decoder= 89,0.16556,IF THEN ELSE (PWD Side Decisions Decoder= 69:OR: PWD Side Decisions Decoder= 77,0.1755,IF THEN ELSE (PWD Side Decisions Decoder= 57,0.17881,IF THEN ELSE (PWD Side Decisions Decoder= 113:OR: PWD Side Decisions Decoder= 121,0.18543,IF THEN ELSE (PWD Side Decisions Decoder= 15:OR: PWD Side Decisions Decoder= 47:OR: PWD Side Decisions Decoder= 101:OR: PWD Side Decisions Decoder= 109,0.19205,IF THEN ELSE (PWD Side Decisions Decoder= 149,0.19536,IF THEN ELSE (PWD Side Decisions Decoder= 19:OR: PWD Side Decisions Decoder= 150,0.20199,IF THEN ELSE (PWD Side Decisions Decoder= 51:OR: PWD Side Decisions Decoder= 182,0.2053,IF THEN ELSE (PWD Side Decisions Decoder= 157,0.21192,IF THEN ELSE (PWD Side Decisions Decoder= 27:OR: PWD Side Decisions Decoder= 213,0.21854,IF THEN ELSE (PWD Side Decisions Decoder= 59:OR: PWD Side Decisions Decoder= 158:OR: PWD Side Decisions Decoder= 221,0.22185,IF THEN ELSE (PWD Side Decisions Decoder= 190,0.22517,IF THEN ELSE (PWD Side Decisions Decoder= 181,0.22848,IF THEN ELSE (PWD Side Decisions Decoder= 83:OR: PWD Side Decisions Decoder= 91,0.2351,IF THEN ELSE (PWD Side Decisions Decoder= 71:OR: PWD Side Decisions Decoder= 79:OR: PWD Side Decisions Decoder= 103:OR: PWD Side Decisions Decoder= 111:OR: PWD Side Decisions Decoder= 115:OR: PWD Side Decisions Decoder= 123,0.23841,IF THEN ELSE (PWD Side Decisions Decoder= 214:OR: PWD Side Decisions Decoder= 222,0.24172,IF THEN ELSE (PWD Side

Group	Type	Variable Name and Description
		Decisions Decoder= 189:OR: PWD Side Decisions Decoder= 246:OR: PWD Side Decisions Decoder= 254,0.24503,IF THEN ELSE (PWD Side Decisions Decoder= 245,0.25497,IF THEN ELSE (PWD Side Decisions Decoder= 253,0.25828,IF THEN ELSE (PWD Side Decisions Decoder= 22,0.28146,IF THEN ELSE (PWD Side Decisions Decoder= 54,0.28477,IF THEN ELSE (PWD Side Decisions Decoder= 151,0.2947,IF THEN ELSE (PWD Side Decisions Decoder= 30:OR: PWD Side Decisions Decoder= 183,0.30132,IF THEN ELSE (PWD Side Decisions Decoder= 62,0.30464,IF THEN ELSE (PWD Side Decisions Decoder= 159,0.32119,IF THEN ELSE (PWD Side Decisions Decoder= 86:OR: PWD Side Decisions Decoder= 94,0.3245,IF THEN ELSE (PWD Side Decisions Decoder= 118:OR: PWD Side Decisions Decoder= 126:OR: PWD Side Decisions Decoder= 191,0.32781,IF THEN ELSE (PWD Side Decisions Decoder= 215,0.34768,IF THEN ELSE (PWD Side Decisions Decoder= 223,0.35099,IF THEN ELSE (PWD Side Decisions Decoder= 247,0.3543,IF THEN ELSE (PWD Side Decisions Decoder= 255,0.35762,IF THEN ELSE (PWD Side Decisions Decoder= 21,0.53974,IF THEN ELSE (PWD Side Decisions Decoder= 29,0.56623,IF THEN ELSE (PWD Side Decisions Decoder= 85,0.58278,IF THEN ELSE (PWD Side Decisions Decoder= 93,0.58609,IF THEN ELSE (PWD Side Decisions Decoder= 53,0.59272,IF THEN ELSE (PWD Side Decisions Decoder= 61,0.61921,IF THEN ELSE (PWD Side Decisions Decoder= 117,0.63907,IF THEN ELSE (PWD Side Decisions Decoder= 125,0.64238,IF THEN ELSE (PWD Side Decisions Decoder= 23,0.68874,IF THEN ELSE (PWD Side Decisions Decoder= 55,0.69536,IF THEN ELSE (PWD Side Decisions Decoder= 31,0.72517,IF THEN ELSE (PWD Side Decisions Decoder= 63,0.73179,IF THEN ELSE (PWD Side Decisions Decoder= 87,0.76159,IF THEN ELSE (PWD Side Decisions Decoder= 95,0.7649,IF THEN ELSE (PWD Side Decisions Decoder= 119,0.76821,0.77152))))))) **Present in 2 views:** • PWD Side • PWD Side Decisions **Used by:** • PWD Able to Work and Interested in Work Work Adoption from Advertising • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth **Feedback loops:** 92 (29.1 %)
PWD Side Decisions	#66 A	**Free Accessible Teleworking Facility** (Dimensionless [0,1,1]) = PC with Assistive Technology or Assistant **Description:** *Availability of accessible teleworking facility from home without cost on you* **Present in 1 view:** • PWD Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
PWD Side Decisions	#71 A	**Improved System for Keeping Disability Pension with Job For Part Timers** (Dimensionless [0,1,1]) = Combine Salary and Welfare Benefits **Description:** *"For part-time workers, improved system for keeping disability pension when having salaried employment"* **Present in 1 view:** • PWD Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0

Group	Type	Variable Name and Description
PWD Side Deci-sions	#93 A	**Losing Current Welfare Benefits** (Dimensionless [0,1,1]) = IF THEN ELSE (Combine Salary and Welfare Benefits= 0,1,0) **Description:** *Risk of losing current welfare benefits* **Present in 1 view:** • PWD Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
PWD Side Deci-sions	#96 A	**Net Income Change per Disabled Person** (NOK/(Year*Person)) = (Average Wage for Working Disabled Person* (1- Average Tax Tariff for Working PWD))- Average Pension for Disabled Person **Present in 1 view:** • PWD Side Decisions **Used by:** • Social Status **Feedback loops:** 0
PWD Side Deci-sions	#98 A	**No Job Offer** (Dimensionless [0,1,1]) = IF THEN ELSE (Suitable Jobs Availability= 1,0,1) **Description:** *Expect not to get any job offer* **Present in 1 view:** • PWD Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
PWD Side Deci-sions	#99 G	**PC with Assistive Technology or Assistant** (Dimensionless [0,1,1]) = GAME(1) **Description:** *Access to Personal computer with assistive technology or assistant=="Access to Personal computer with assistive technology or assistant" and "Availability of accessible tel-eworking facility from home without cost on you" and "Availability of accessible workplace facilities or alternative work enabled from home without cost on you"* **Present in 1 view:** • PWD Side Decisions **Used by:** • Accessible Workplace Facilities or Alternative Work Enabled from Home without Cost • Free Accessible Teleworking Facility • PWD Side Decisions Decoder **Feedback loops:** 0
PWD Side	#100 L	**Potential Vacancies for PWD** (Persons) = $\int$ (PWD Jobs Quitting Rate+ Potential Vacancies for PWD Increase Rate- PWD Vacancies Occupying Rate- Potential Vacancies for PWD Decrease Rate) $\cdot dt$ + [Initial Vacancies for PWD] **Present in 4 views:** • PWD Side • Employers Side • PWD Side Decisions • Programme Costs **Used by:** • Average Potential Vacancies for PWD per Employers Recruiting PWD

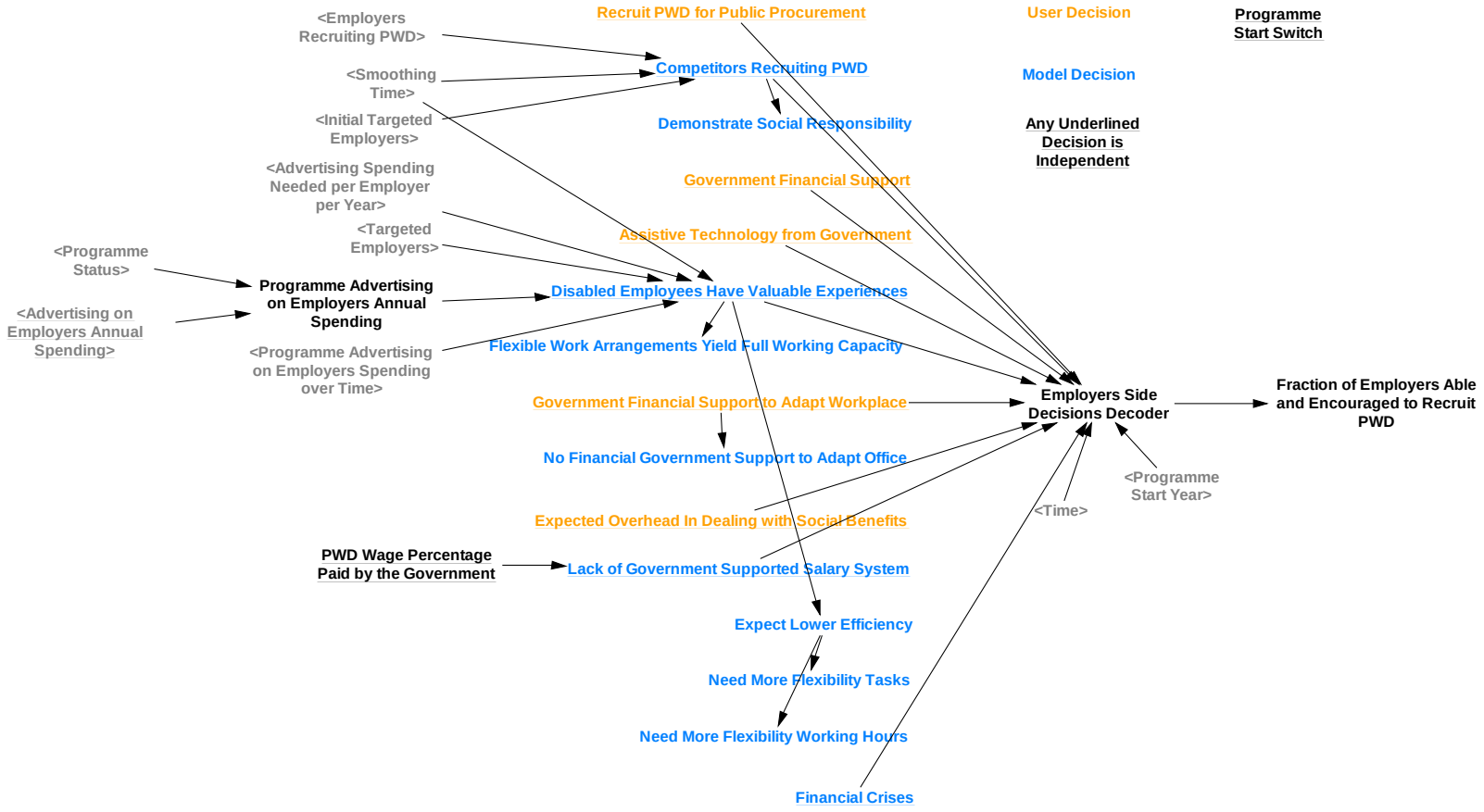
Group	Type	Variable Name and Description
		• PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate • Ratio of Job Vacancies for PWD to All Posts for PWD • Suitable Jobs Availability **Feedback loops:** 196 (62.0 %)
Advertising Effectiveness	#108 A 	**Programme Advertising on PWD Annual Spending** (NOK/Year) = Programme Status* Advertising on PWD Annual Spending **Present in 3 views:** • Advertising Effectiveness • PWD Side Decisions • Programme Costs **Used by:** • Advertising Effectiveness on PWD • Flexible Working Hours • Government Spending on PWD **Feedback loops:** 0
Advertising Effectiveness	#110 A 	**Programme Advertising on PWD Spending over Time** (Dimensionless) = Programme Advertising on PWD Spending over Time f (Time/ Unit Time) **Present in 3 views:** • Advertising Effectiveness • PWD Side Decisions • Programme Costs **Used by:** • Advertising Effectiveness on PWD • Flexible Working Hours • Government Spending on PWD **Feedback loops:** 0
PWD Side	#112 G 	**Programme Start Switch** (Dimensionless [0,1,1]) = GAME(0) **Present in 6 views:** • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions • Programme Costs **Used by:** • Programme Status **Feedback loops:** 0
PWD Side Decisions	#113 C 	**Programme Start Year** (Year) = 2012 **Present in 2 views:** • PWD Side Decisions • Employers Side Decisions **Used by:** • Employers Side Decisions Decoder • Programme Status • PWD Side Decisions Decoder **Feedback loops:** 0

Group	Type	Variable Name and Description
PWD Side	#114 A 	**Programme Status** (Dimensionless) = STEP (Programme Start Switch ,Programme Start Year) **Present in 5 views:** • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions **Used by:** • Employers Recruiting PWD Adoption from Advertising • Programme Advertising on Employers Annual Spending • Programme Advertising on PWD Annual Spending • PWD Able to Work and Interested in Work Work Adoption from Advertising • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate **Feedback loops:** 0
PWD Side	#133 L 	**PWD in Working Age Using Welfare** (Persons) = $\int$ (PWD in Working Age and Using Welfare Increase Rate+ PWD Fail Programme Training Rate- PWD Able to Work and Interested in Work Increase Rate- PWD in Working Age and Using Welfare Decrease Rate) $\cdot dt$ + [Initial PWD In Working Age and Using Welfare] **Description:** *The initial number of People with Disabilities using welfare is determined by the total population size and the current number of active adopters. It is reduced by adoption and increased when working disabled come back and natural total population increase.* **Present in 3 views:** • PWD Side • Advertising Effectiveness • PWD Side Decisions **Used by:** • Advertising Effectiveness on PWD • All PWD in Working Age • All PWD in Working Age Using Welfare and Not in Programme Training • Flexible Working Hours • Programme Advertising on PWD Optimal Annual Spending • PWD Able to Work and Interested in Work Increase Rate • PWD Able to Work and Interested in Work Work Adoption from Advertising • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth • PWD in Working Age and Using Welfare Decrease Rate **Feedback loops:** 170 (53.8 %)
PWD Side	#136 F,A 	**PWD Programme Training Enrolment Rate** (Persons/Year) = IF THEN ELSE (Programme Status= 1,(PWD Able to Work and Interested in Work / Shortest Time to Fill All Available Vacancies)* Fraction of Max f (XIDZ (Potential Vacancies for PWD/ Shortest Time to Fill All Available Vacancies ,PWD Able to Work and Interested in Work/Shortest Time to Fill All Available Vacancies ,10))* (1- PWD Fraction Recruited in Old Jobs after Disability) ,0) **Description:** *(Level to drain / Fastest draining time) * Fraction of Max f (xidz (Desired draining , Level to drain / Fastest draining time , 10))* **Present in 4 views:** • PWD Side • Employers Side

Group	Type	Variable Name and Description
		• PWD Side Decisions • Programme Costs **Used by:** • Employment Training • Government Spending on PWD • PWD Able to Work and Interested in Work • PWD in Programme Training • PWD Vacancies Occupying Rate **Feedback loops:** 230 (72.8 %)
PWD Side Decisions	#137 A	**PWD Side Decisions Decoder** (Dimensionless [0,1,1]) = IF THEN ELSE (Time> Programme Start Year ,Combine Salary and Welfare Benefits* 1+ PC with Assistive Technology or Assistant* 2+Employment Training* 4+ Self Fulfilment* 8+ Suitable Jobs Availability* 16+ Accessible Transportation to Work* 32+ Flexible Working Hours* 64+ Administrative Hurdles to Return to Welfare Support* 128,187) **Description:** *PWD Side Decisions Input* **Present in 1 view:** • PWD Side Decisions **Used by:** • Fraction of PWD Who Can and Encouraged to Work **Feedback loops:** 92 (29.1 %)
PWD Side Decisions	#148 A	**Self Fulfilment** (Dimensionless [0,1,1]) = Social Status **Description:** *Achieve self fulfilment=="Achieve self fulfilment" and "Increase your social interaction" and "Enhance your social status"* **Present in 1 view:** • PWD Side Decisions **Used by:** • PWD Side Decisions Decoder **Feedback loops:** 0
PWD Side Decisions	#150 C	**Smoothing Time** (Year) = 5 **Description:** *Labor Ratio Perception Time=5 year--from: Forrester, Jay W. 1969. Urban Dynamics. Pegasus Communications, Inc.* **Present in 2 views:** • PWD Side Decisions • Employers Side Decisions **Used by:** • Competitors Recruiting PWD • Disabled Employees Have Valuable Experiences • Employment Training • Flexible Working Hours • Social Status • Suitable Jobs Availability **Feedback loops:** 0
PWD Side Decisions	#151 A	**Social Interaction** (Dimensionless [0,1,1]) = Social Status **Description:** *Increase your social interaction* **Present in 1 view:** • PWD Side Decisions **Used by:**

Group	Type	Variable Name and Description
		This is a supplementary variable. **Feedback loops:** 0
PWD Side Deci-sions	#152 A 	**Social Status** (Dimensionless [0,1,1]) = IF THEN ELSE (SMOOTH (Net Income Change per Disabled Person ,Smoothing Time)> 0,1,0) **Description:** *Enhance your social status* **Present in 1 view:** • PWD Side Decisions **Used by:** • Self Fulfilment • Social Interaction **Feedback loops:** 0
PWD Side Deci-sions	#153 A 	**Suitable Jobs Availability** (Dimensionless [0,1,1]) = IF THEN ELSE (SMOOTH (Potential Vacancies for PWD ,Smoothing Time)> 0,1,0) **Description:** *Availability of suitable jobs=="Availability of suitable jobs" and not "Expect not to get any job offer" and not "No suitable jobs available"* **Present in 1 view:** • PWD Side Decisions **Used by:** • No Job Offer • PWD Side Decisions Decoder • Suitable Jobs Unavailable **Feedback loops:** 24 (7.6 %)
PWD Side Deci-sions	#154 A 	**Suitable Jobs Unavailable** (Dimensionless [0,1,1]) = IF THEN ELSE (Suitable Jobs Availability= 1,0,1) **Description:** *No suitable jobs available* **Present in 1 view:** • PWD Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
PWD Side Deci-sions	#159 A 	**Unable to Fulfil Job Expectations** (Dimensionless [0,1,1]) = IF THEN ELSE (Employment Training= 0,1,0) **Description:** *Risk of not being able to fulfil the job expectations* **Present in 1 view:** • PWD Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0

A.6 Employers Side Decisions Subsystem (29 variables)



Group	Type	Variable Name and Description
Advertising Effectiveness	#8 G	**Advertising on Employers Annual Spending** (NOK/Year [0,?]) = GAME(2.97126e+006) **Description:** *Targeted Employers * Advertising Spending Needed per Employer per Year* **Present in 2 views:** • Advertising Effectiveness • Employers Side Decisions **Used by:** • Programme Advertising on Employers Annual Spending **Feedback loops:** 0
Advertising Effectiveness	#11 C	**Advertising Spending Needed per Employer per Year** (NOK/Employer/Year) = 37.4101 **Description:** *Dertouzos, James N. and Steven Garber. Summer2006. Effectiveness of Advertising in Different Media. Journal of Advertising 35, Nr. 2: 111-122 Samuel H. Williamson, "Seven Ways to Compute the Relative Value of a U.S. Dollar Amount, 1774 to present," MeasuringWorth, 2011. URL: www.measuringworth.com/uscompare/ http://www.oanda.com /currency/converter/ http://www.vectorgrader.com/indicators/ppp.html* **Present in 2 views:** • Advertising Effectiveness • Employers Side Decisions **Used by:** • Advertising Effectiveness on Employers • Disabled Employees Have Valuable Experiences • Programme Advertising on Employers Optimal Annual Spending **Feedback loops:** 0
Employers Side Decisions	#19 G	**Assistive Technology from Government** (Dimensionless [0,1,1]) = GAME(1) **Description:** *The government will provide your organisation with the needed assistive technology when employing PWD* **Present in 1 view:** • Employers Side Decisions **Used by:** • Employers Side Decisions Decoder **Feedback loops:** 0
Employers Side Decisions	#31 A	**Competitors Recruiting PWD** (Dimensionless [0,1,1]) = IF THEN ELSE (SMOOTH (Employers Recruiting PWD ,Smoothing Time)>= Initial Targeted Employers* 0.5,1,0) **Description:** *"Other organisations (competitors of your organisation) are recruiting PWD"=="Other organisations (competitors of your organisation) are recruiting PWD" and "Your organisation wants to demonstrate social responsibility"* **Present in 1 view:** • Employers Side Decisions **Used by:** • Demonstrate Social Responsibility • Employers Side Decisions Decoder **Feedback loops:** 2 (0.6 %)
Employers Side Decisions	#32 A	**Demonstrate Social Responsibility** (Dimensionless [0,1,1]) = Competitors Recruiting PWD **Description:** *Your organisation wants to demonstrate social responsibility* **Present in 1 view:** • Employers Side Decisions

Group	Type	Variable Name and Description
sions		**Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Em-ploy-ers Side Deci-sions	#33 A	**Disabled Employees Have Valuable Experiences** (Dimensionless [0,1,1]) = IF THEN ELSE (SMOOTH (Programme Advertising on Employers Annual Spend-ing* Programme Advertising on Employers Spending over Time* ZIDZ (1,Targeted Employ-ers* Advertising Spending Needed per Employer per Year) ,Smoothing Time)>= 0.5,1,0) **Description:** *Disabled and elderly employees can benefit your organisation with their valua-ble experiences=="Disabled and elderly employees can benefit your organisation with their valuable experiences" and "Certain flexible work arrangement can yield full working capacity from employees with disabilities" and "May expect lower efficiency from disabled employees" and "May expect disabled employees to need more flexibility tasks" and "May expect disabled employees to need more flexibility working hours"* **Present in 1 view:** • Employers Side Decisions **Used by:** • Employers Side Decisions Decoder • Expect Lower Efficiency • Flexible Work Arrangements Yield Full Working Capacity **Feedback loops:** 6 (1.9 %)
Em-ploy-ers Side	#46 L	**Employers Recruiting PWD** (Employers) = $\int$ (Employers Recruiting PWD Increase Rate- Employers Recruiting PWD Decrease Rate) $\cdot dt$ + [Initial Employers Recruiting PWD] **Description:** *Employers Recruiting or Having Vacancies for PWD* **Present in 3 views:** • Employers Side • Employers Side Decisions • Programme Costs **Used by:** • All Employers in the System • Average Jobs for PWD per Employers Recruiting PWD • Average Potential Vacancies for PWD per Employers Recruiting PWD • Competitors Recruiting PWD • Employers Recruiting PWD Adoption from Word of Mouth • Employers Recruiting PWD Decrease Rate • Ratio of Employers Recruiting PWD to All Employers in the System **Feedback loops:** 10 (3.2 %)
Em-ploy-ers Side Deci-sions	#52 A	**Employers Side Decisions Decoder** (Dimensionless [0,1,1]) = IF THEN ELSE (Time> Programme Start Year ,Recruit PWD for Public Procurement* 1+ Competitors Recruiting PWD* 2+ Government Financial Support* 4+ Assistive Technolo-gy from Government* 8+ Disabled Employees Have Valuable Experiences* 16+ Government Financial Support to Adapt Workplace* 32+ Lack of Government Supported Salary System* 64+ Financial Crises* 128+ Expected Overhead In Dealing with Social Benefits* 256,366) **Description:** *Employers Side Decisions Input* **Present in 1 view:** • Employers Side Decisions **Used by:** • Fraction of Employers Able and Encouraged to Recruit PWD **Feedback loops:** 8 (2.5 %)

Group	Type	Variable Name and Description
Employers Side Decisions	#56 A	**Expect Lower Efficiency** (Dimensionless [0,1,1]) = IF THEN ELSE (Disabled Employees Have Valuable Experiences= 0,1,0) **Description:** *May expect lower efficiency from disabled employees* **Present in 1 view:** • Employers Side Decisions **Used by:** • Need More Flexibility Tasks • Need More Flexibility Working Hours **Feedback loops:** 0
Employers Side Decisions	#57 G	**Expected Overhead In Dealing with Social Benefits** (Dimensionless [0,1,1]) = GAME(1) **Description:** *Expected overhead in dealing with social benefits because of for example lack of easily accessed information or lack of fast response from public authorities when help related to disabled employees is needed* **Present in 1 view:** • Employers Side Decisions **Used by:** • Employers Side Decisions Decoder **Feedback loops:** 0
Employers Side Decisions	#59 C	**Financial Crises** (Dimensionless [0,1,1]) = 0 **Description:** *"General difficult financial situation, crisis ... etc."* **Present in 1 view:** • Employers Side Decisions **Used by:** • Employers Side Decisions Decoder **Feedback loops:** 0
Employers Side Decisions	#60 A	**Flexible Work Arrangements Yield Full Working Capacity** (Dimensionless [0,1,1]) = Disabled Employees Have Valuable Experiences **Description:** *Certain flexible work arrangement can yield full working capacity from employees with disabilities* **Present in 1 view:** • Employers Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Employers Side	#63 A	**Fraction of Employers Able and Encouraged to Recruit PWD** (Dimensionless) = IF THEN ELSE (Employers Side Decisions Decoder= 0:OR: Employers Side Decisions Decoder= 64:OR: Employers Side Decisions Decoder= 128:OR: Employers Side Decisions Decoder= 129:OR: Employers Side Decisions Decoder= 192:OR: Employers Side Decisions Decoder= 193:OR: Employers Side Decisions Decoder= 256:OR: Employers Side Decisions Decoder= 257:OR: Employers Side Decisions Decoder= 320:OR: Employers Side Decisions Decoder= 321:OR: Employers Side Decisions Decoder= 384:OR: Employers Side Decisions Decoder= 385:OR: Employers Side Decisions Decoder= 448:OR: Employers Side Decisions Decoder= 449,0,IF THEN ELSE (Employers Side Decisions Decoder= 1:OR: Employers Side Decisions Decoder= 65:OR: Employers Side Decisions Decoder= 352:OR: Employers Side Decisions Decoder= 353:OR: Employers Side Decisions Decoder= 416:OR: Employers Side Decisions Decoder= 417:OR: Employers Side Decisions Decoder= 480:OR: Employers Side Decisions Decoder= 481,0.0097087,IF THEN ELSE (Employers Side Decisions Decoder= 264:OR: Employers Side Decisions Decoder= 265:OR: Employers Side Decisions Decod-

Group	Type	Variable Name and Description
		er= 288:OR: Employers Side Decisions Decoder= 289:OR: Employers Side Decisions Decoder= 328:OR: Employers Side Decisions Decoder= 329:OR: Employers Side Decisions Decoder= 360:OR: Employers Side Decisions Decoder= 361:OR: Employers Side Decisions Decoder= 392:OR: Employers Side Decisions Decoder= 393:OR: Employers Side Decisions Decoder= 424:OR: Employers Side Decisions Decoder= 425:OR: Employers Side Decisions Decoder= 456:OR: Employers Side Decisions Decoder= 457:OR: Employers Side Decisions Decoder= 488:OR: Employers Side Decisions Decoder= 489,0.019417,IF THEN ELSE (Employers Side Decisions Decoder= 260:OR: Employers Side Decisions Decoder= 261:OR: Employers Side Decisions Decoder= 268:OR: Employers Side Decisions Decoder= 269:OR: Employers Side Decisions Decoder= 296:OR: Employers Side Decisions Decoder= 297:OR: Employers Side Decisions Decoder= 324:OR: Employers Side Decisions Decoder= 325:OR: Employers Side Decisions Decoder= 332:OR: Employers Side Decisions Decoder= 333:OR: Employers Side Decisions Decoder= 388:OR: Employers Side Decisions Decoder= 389:OR: Employers Side Decisions Decoder= 396:OR: Employers Side Decisions Decoder= 397:OR: Employers Side Decisions Decoder= 452:OR: Employers Side Decisions Decoder= 453:OR: Employers Side Decisions Decoder= 460:OR: Employers Side Decisions Decoder= 461,0.029126,IF THEN ELSE (Employers Side Decisions Decoder= 224:OR: Employers Side Decisions Decoder= 225:OR: Employers Side Decisions Decoder= 356:OR: Employers Side Decisions Decoder= 357:OR: Employers Side Decisions Decoder= 364:OR: Employers Side Decisions Decoder= 365:OR: Employers Side Decisions Decoder= 420:OR: Employers Side Decisions Decoder= 421:OR: Employers Side Decisions Decoder= 428:OR: Employers Side Decisions Decoder= 429:OR: Employers Side Decisions Decoder= 484:OR: Employers Side Decisions Decoder= 485:OR: Employers Side Decisions Decoder= 492:OR: Employers Side Decisions Decoder= 493,0.038835,IF THEN ELSE (Employers Side Decisions Decoder= 132:OR: Employers Side Decisions Decoder= 133:OR: Employers Side Decisions Decoder= 136:OR: Employers Side Decisions Decoder= 137:OR: Employers Side Decisions Decoder= 196:OR: Employers Side Decisions Decoder= 197:OR: Employers Side Decisions Decoder= 200:OR: Employers Side Decisions Decoder= 201:OR: Employers Side Decisions Decoder= 258:OR: Employers Side Decisions Decoder= 259:OR: Employers Side Decisions Decoder= 292:OR: Employers Side Decisions Decoder= 293:OR: Employers Side Decisions Decoder= 300:OR: Employers Side Decisions Decoder= 301:OR: Employers Side Decisions Decoder= 322:OR: Employers Side Decisions Decoder= 323:OR: Employers Side Decisions Decoder= 386:OR: Employers Side Decisions Decoder= 387:OR: Employers Side Decisions Decoder= 450:OR: Employers Side Decisions Decoder= 451,0.048544,IF THEN ELSE (Employers Side Decisions Decoder= 96:OR: Employers Side Decisions Decoder= 97:OR: Employers Side Decisions Decoder= 140:OR: Employers Side Decisions Decoder= 141:OR: Employers Side Decisions Decoder= 204:OR: Employers Side Decisions Decoder= 205:OR: Employers Side Decisions Decoder= 262:OR: Employers Side Decisions Decoder= 263:OR: Employers Side Decisions Decoder= 266:OR: Employers Side Decisions Decoder= 267:OR: Employers Side Decisions Decoder= 270:OR: Employers Side Decisions Decoder= 271:OR: Employers Side Decisions Decoder= 326:OR: Employers Side Decisions Decoder= 327:OR: Employers Side Decisions Decoder= 330:OR: Employers Side Decisions Decoder= 331:OR: Employers Side Decisions Decoder= 334:OR: Employers Side Decisions Decoder= 335:OR: Employers Side Decisions Decoder= 390:OR: Employers Side Decisions Decoder= 391:OR: Employers Side Decisions Decoder= 394:OR: Employers Side Decisions Decoder= 395:OR: Employers Side Decisions Decoder= 398:OR: Employers Side Decisions Decoder= 399:OR: Employers Side Decisions Decoder= 454:OR: Employers Side Decisions Decoder= 455:OR: Employers Side Decisions Decoder= 458:OR: Employers Side Decisions Decoder= 459:OR: Employers Side Decisions Decoder= 462:OR: Employers Side Decisions Decoder= 463,0.058252,IF THEN ELSE (Employers Side Decisions Decoder= 4:OR: Employers Side Decisions Decod-

Group	Type	Variable Name and Description
		er= 5:OR: Employers Side Decisions Decoder= 8:OR: Employers Side Decisions Decoder= 9:OR: Employers Side Decisions Decoder= 68:OR: Employers Side Decisions Decoder= 69:OR: Employers Side Decisions Decoder= 72:OR: Employers Side Decisions Decoder= 73:OR: Employers Side Decisions Decoder= 232:OR: Employers Side Decisions Decoder= 233:OR: Employers Side Decisions Decoder= 354:OR: Employers Side Decisions Decoder= 355:OR: Employers Side Decisions Decoder= 358:OR: Employers Side Decisions Decoder= 359:OR: Employers Side Decisions Decoder= 362:OR: Employers Side Decisions Decoder= 363:OR: Employers Side Decisions Decoder= 366:OR: Employers Side Decisions Decoder= 367:OR: Employers Side Decisions Decoder= 418:OR: Employers Side Decisions Decoder= 419:OR: Employers Side Decisions Decoder= 422:OR: Employers Side Decisions Decoder= 423:OR: Employers Side Decisions Decoder= 426:OR: Employers Side Decisions Decoder= 427:OR: Employers Side Decisions Decoder= 430:OR: Employers Side Decisions Decoder= 431:OR: Employers Side Decisions Decoder= 482:OR: Employers Side Decisions Decoder= 483:OR: Employers Side Decisions Decoder= 486:OR: Employers Side Decisions Decoder= 487:OR: Employers Side Decisions Decoder= 490:OR: Employers Side Decisions Decoder= 491:OR: Employers Side Decisions Decoder= 494:OR: Employers Side Decisions Decoder= 495,0.067961,IF THEN ELSE (Employers Side Decisions Decoder= 12:OR: Employers Side Decisions Decoder= 13:OR: Employers Side Decisions Decoder= 76:OR: Employers Side Decisions Decoder= 77:OR: Employers Side Decisions Decoder= 228:OR: Employers Side Decisions Decoder= 229:OR: Employers Side Decisions Decoder= 290:OR: Employers Side Decisions Decoder= 291:OR: Employers Side Decisions Decoder= 294:OR: Employers Side Decisions Decoder= 295:OR: Employers Side Decisions Decoder= 298:OR: Employers Side Decisions Decoder= 299:OR: Employers Side Decisions Decoder= 302:OR: Employers Side Decisions Decoder= 303,0.07767,IF THEN ELSE (Employers Side Decisions Decoder= 104:OR: Employers Side Decisions Decoder= 105:OR: Employers Side Decisions Decoder= 130:OR: Employers Side Decisions Decoder= 131:OR: Employers Side Decisions Decoder= 160:OR: Employers Side Decisions Decoder= 161:OR: Employers Side Decisions Decoder= 194:OR: Employers Side Decisions Decoder= 195:OR: Employers Side Decisions Decoder= 236:OR: Employers Side Decisions Decoder= 237,0.087379,IF THEN ELSE (Employers Side Decisions Decoder= 2:OR: Employers Side Decisions Decoder= 66:OR: Employers Side Decisions Decoder= 100:OR: Employers Side Decisions Decoder= 101:OR: Employers Side Decisions Decoder= 134:OR: Employers Side Decisions Decoder= 135:OR: Employers Side Decisions Decoder= 198:OR: Employers Side Decisions Decoder= 199,0.097087,IF THEN ELSE (Employers Side Decisions Decoder= 3:OR: Employers Side Decisions Decoder= 67:OR: Employers Side Decisions Decoder= 108:OR: Employers Side Decisions Decoder= 109:OR: Employers Side Decisions Decoder= 138:OR: Employers Side Decisions Decoder= 139:OR: Employers Side Decisions Decoder= 142:OR: Employers Side Decisions Decoder= 143:OR: Employers Side Decisions Decoder= 202:OR: Employers Side Decisions Decoder= 203:OR: Employers Side Decisions Decoder= 206:OR: Employers Side Decisions Decoder= 207,0.1068,IF THEN ELSE (Employers Side Decisions Decoder= 6:OR: Employers Side Decisions Decoder= 7:OR: Employers Side Decisions Decoder= 70:OR:Employers Side Decisions Decoder= 71:OR: Employers Side Decisions Decoder= 168:OR: Employers Side Decisions Decoder= 169,0.1165,IF THEN ELSE(Employers Side Decisions Decoder= 10:OR:Employers Side Decisions Decoder= 11:OR:Employers Side Decisions Decoder= 14:OR:Employers Side Decisions Decoder= 15:OR:Employers Side Decisions Decoder= 74:OR:Employers Side Decisions Decoder= 75:OR:Employers Side Decisions Decoder= 78:OR:Employers Side Decisions Decoder= 79:OR:Employers Side Decisions Decoder= 164:OR:Employers Side Decisions Decoder= 165:OR:Employers Side Decisions Decoder= 226:OR:Employers Side Decisions Decoder= 227:OR:Employers Side Decisions Decoder= 230:OR:Employers Side Decisions Decoder= 231:OR:Employers Side Decisions Decoder=

Group	Type	Variable Name and Description
		400:OR:Employers Side Decisions Decoder= 401:OR:Employers Side Decisions Decoder= 408:OR:Employers Side Decisions Decoder= 409:OR:Employers Side Decisions Decoder= 464:OR:Employers Side Decisions Decoder= 465:OR:Employers Side Decisions Decoder= 472:OR:Employers Side Decisions Decoder= 473,0.12621,IF THEN ELSE(Employers Side Decisions Decoder= 172:OR: Employers Side Decisions Decoder= 173:OR: Employers Side Decisions Decoder= 234:OR: Employers Side Decisions Decoder= 235:OR: Employers Side Decisions Decoder= 238:OR: Employers Side Decisions Decoder= 239:OR: Employers Side Decisions Decoder= 404:OR: Employers Side Decisions Decoder= 405:OR: Employers Side Decisions Decoder= 412:OR: Employers Side Decisions Decoder= 413:OR: Employers Side Decisions Decoder= 468:OR: Employers Side Decisions Decoder= 469:OR: Employers Side Decisions Decoder= 476:OR: Employers Side Decisions Decoder= 477,0.13592,IF THEN ELSE(Employers Side Decisions Decoder= 98:OR: Employers Side Decisions Decoder= 99:OR: Employers Side Decisions Decoder= 102:OR: Employers Side Decisions Decoder= 103:OR: Employers Side Decisions Decoder= 272:OR: Employers Side Decisions Decoder= 273:OR: Employers Side Decisions Decoder= 280:OR: Employers Side Decisions Decoder= 281:OR: Employers Side Decisions Decoder= 336:OR: Employers Side Decisions Decoder= 337:OR: Employers Side Decisions Decoder= 344:OR: Employers Side Decisions Decoder= 345:OR: Employers Side Decisions Decoder= 402:OR: Employers Side Decisions Decoder= 403:OR: Employers Side Decisions Decoder= 406:OR: Employers Side Decisions Decoder= 407:OR: Employers Side Decisions Decoder= 410:OR: Employers Side Decisions Decoder= 411:OR: Employers Side Decisions Decoder= 414:OR: Employers Side Decisions Decoder= 415:OR: Employers Side Decisions Decoder= 466:OR: Employers Side Decisions Decoder= 467:OR: Employers Side Decisions Decoder= 470:OR: Employers Side Decisions Decoder= 471:OR: Employers Side Decisions Decoder= 474:OR: Employers Side Decisions Decoder= 475:OR: Employers Side Decisions Decoder= 478:OR: Employers Side Decisions Decoder= 479:OR: Employers Side Decisions Decoder= 496:OR: Employers Side Decisions Decoder= 497:OR: Employers Side Decisions Decoder= 504:OR: Employers Side Decisions Decoder= 505,0.14563,IF THEN ELSE (Employers Side Decisions Decoder= 106:OR: Employers Side Decisions Decoder= 107:OR: Employers Side Decisions Decoder= 110:OR: Employers Side Decisions Decoder= 111:OR: Employers Side Decisions Decoder= 276:OR: Employers Side Decisions Decoder= 277:OR: Employers Side Decisions Decoder= 284:OR: Employers Side Decisions Decoder= 285:OR: Employers Side Decisions Decoder= 340:OR: Employers Side Decisions Decoder= 341:OR: Employers Side Decisions Decoder= 348:OR: Employers Side Decisions Decoder= 349:OR: Employers Side Decisions Decoder= 432:OR: Employers Side Decisions Decoder= 433:OR: Employers Side Decisions Decoder= 440:OR: Employers Side Decisions Decoder= 441,0.15534,IF THEN ELSE (Employers Side Decisions Decoder= 274:OR: Employers Side Decisions Decoder= 275:OR: Employers Side Decisions Decoder= 278:OR: Employers Side Decisions Decoder= 279:OR: Employers Side Decisions Decoder= 282:OR: Employers Side Decisions Decoder= 283:OR: Employers Side Decisions Decoder= 286:OR: Employers Side Decisions Decoder= 287:OR: Employers Side Decisions Decoder= 338:OR: Employers Side Decisions Decoder= 339:OR: Employers Side Decisions Decoder= 342:OR: Employers Side Decisions Decoder= 343:OR: Employers Side Decisions Decoder= 346:OR: Employers Side Decisions Decoder= 347:OR: Employers Side Decisions Decoder= 350:OR: Employers Side Decisions Decoder= 351:OR: Employers Side Decisions Decoder= 500:OR: Employers Side Decisions Decoder= 501:OR: Employers Side Decisions Decoder= 508:OR: Employers Side Decisions Decoder= 509,0.16505,IF THEN ELSE (Employers Side Decisions Decoder= 162:OR: Employers Side Decisions Decoder= 163:OR: Employers Side Decisions Decoder= 166:OR: Employers Side Decisions Decoder= 167:OR: Employers Side Decisions Decoder= 368:OR: Employers Side Decisions Decoder= 369:OR: Employers Side Decisions Decoder= 376:OR: Employers Side Decisions Decoder= 377:OR: Employers Side

Group	Type	Variable Name and Description
		Decisions Decoder= 436:OR: Employers Side Decisions Decoder= 437:OR: Employers Side Decisions Decoder= 444:OR: Employers Side Decisions Decoder= 445:OR: Employers Side Decisions Decoder= 498:OR: Employers Side Decisions Decoder= 499:OR: Employers Side Decisions Decoder= 502:OR: Employers Side Decisions Decoder= 503:OR: Employers Side Decisions Decoder= 506:OR: Employers Side Decisions Decoder= 507:OR: Employers Side Decisions Decoder= 510:OR: Employers Side Decisions Decoder= 511,0.17476,IF THEN ELSE (Employers Side Decisions Decoder= 170:OR: Employers Side Decisions Decoder= 171:OR: Employers Side Decisions Decoder= 174:OR: Employers Side Decisions Decoder= 175:OR: Employers Side Decisions Decoder= 434:OR: Employers Side Decisions Decoder= 435:OR: Employers Side Decisions Decoder= 438:OR: Employers Side Decisions Decoder= 439:OR: Employers Side Decisions Decoder= 442:OR: Employers Side Decisions Decoder= 443:OR: Employers Side Decisions Decoder= 446:OR: Employers Side Decisions Decoder= 447,0.18447,IF THEN ELSE (Employers Side Decisions Decoder= 32:OR: Employers Side Decisions Decoder= 33:OR: Employers Side Decisions Decoder= 372:OR: Employers Side Decisions Decoder= 373:OR: Employers Side Decisions Decoder= 380:OR: Employers Side Decisions Decoder= 381,0.19417,IF THEN ELSE (Employers Side Decisions Decoder= 208:OR: Employers Side Decisions Decoder= 209:OR: Employers Side Decisions Decoder= 216:OR: Employers Side Decisions Decoder= 217:OR: Employers Side Decisions Decoder= 370:OR: Employers Side Decisions Decoder= 371:OR: Employers Side Decisions Decoder= 374:OR: Employers Side Decisions Decoder= 375:OR: Employers Side Decisions Decoder= 378:OR: Employers Side Decisions Decoder= 379:OR: Employers Side Decisions Decoder= 382:OR: Employers Side Decisions Decoder= 383,0.20388,IF THEN ELSE (Employers Side Decisions Decoder= 144:OR: Employers Side Decisions Decoder= 145:OR: Employers Side Decisions Decoder= 152:OR: Employers Side Decisions Decoder= 153:OR: Employers Side Decisions Decoder= 212:OR: Employers Side Decisions Decoder= 213:OR: Employers Side Decisions Decoder= 220:OR: Employers Side Decisions Decoder= 221,0.21359,IF THEN ELSE (Employers Side Decisions Decoder= 40:OR: Employers Side Decisions Decoder= 41:OR: Employers Side Decisions Decoder= 148:OR: Employers Side Decisions Decoder= 149:OR: Employers Side Decisions Decoder= 156:OR: Employers Side Decisions Decoder= 157:OR: Employers Side Decisions Decoder= 210:OR: Employers Side Decisions Decoder= 211:OR: Employers Side Decisions Decoder= 214:OR: Employers Side Decisions Decoder= 215:OR: Employers Side Decisions Decoder= 218:OR: Employers Side Decisions Decoder= 219:OR: Employers Side Decisions Decoder= 222:OR: Employers Side Decisions Decoder= 223:OR: Employers Side Decisions Decoder= 304:OR: Employers Side Decisions Decoder= 305:OR: Employers Side Decisions Decoder= 312:OR: Employers Side Decisions Decoder= 313,0.2233,IF THEN ELSE (Employers Side Decisions Decoder= 36:OR: Employers Side Decisions Decoder= 37:OR: Employers Side Decisions Decoder= 146:OR:Employers Side Decisions Decoder= 147:OR: Employers Side Decisions Decoder= 150:OR: Employers Side Decisions Decoder= 151:OR:Employers Side Decisions Decoder= 154:OR: Employers Side Decisions Decoder= 155:OR: Employers Side Decisions Decoder= 158:OR:Employers Side Decisions Decoder= 159,0.23301,IF THEN ELSE (Employers Side Decisions Decoder= 44:OR: Employers Side Decisions Decoder= 45:OR: Employers Side Decisions Decoder= 308:OR: Employers Side Decisions Decoder= 309:OR: Employers Side Decisions Decoder= 316:OR: Employers Side Decisions Decoder= 317,0.24272,IF THEN ELSE (Employers Side Decisions Decoder= 306:OR:Employers Side Decisions Decoder= 307:OR: Employers Side Decisions Decoder= 310:OR: Employers Side Decisions Decoder= 311:OR:Employers Side Decisions Decoder= 314:OR: Employers Side Decisions Decoder= 315:OR: Employers Side Decisions Decoder= 318:OR:Employers Side Decisions Decoder= 319,0.25243,IF THEN ELSE (Employers Side Decisions Decoder= 34:OR: Employers Side Decisions Decoder= 35:OR: Employers Side Decisions Decoder= 38:OR: Employers Side Decisions Decoder=

Group	Type	Variable Name and Description
		39:OR: Employers Side Decisions Decoder= 80:OR: Employers Side Decisions Decoder= 81:OR: Employers Side Decisions Decoder= 88:OR: Employers Side Decisions Decoder= 89,0.28155,IF THEN ELSE (Employers Side Decisions Decoder= 42:OR: Employers Side Decisions Decoder= 43:OR: Employers Side Decisions Decoder= 46:OR: Employers Side Decisions Decoder= 47:OR: Employers Side Decisions Decoder= 84:OR: Employers Side Decisions Decoder= 85:OR: Employers Side Decisions Decoder= 92:OR: Employers Side Decisions Decoder= 93,0.29126,IF THEN ELSE (Employers Side Decisions Decoder= 240:OR: Employers Side Decisions Decoder= 241:OR: Employers Side Decisions Decoder= 248:OR:Employers Side Decisions Decoder= 249,0.30097,IF THEN ELSE (Employers Side Decisions Decoder= 16:OR: Employers Side Decisions Decoder= 17:OR: Employers Side Decisions Decoder= 24:OR: Employers Side Decisions Decoder= 25:OR: Employers Side Decisions Decoder= 82:OR: Employers Side Decisions Decoder= 83:OR: Employers Side Decisions Decoder= 86:OR: Employers Side Decisions Decoder= 87:OR: Employers Side Decisions Decoder= 90:OR: Employers Side Decisions Decoder= 91:OR: Employers Side Decisions Decoder= 94:OR: Employers Side Decisions Decoder= 95,0.31068,IF THEN ELSE (Employers Side Decisions Decoder= 20:OR: Employers Side Decisions Decoder= 21:OR: Employers Side Decisions Decoder= 28:OR: Employers Side Decisions Decoder= 29:OR: Employers Side Decisions Decoder= 244:OR: Employers Side Decisions Decoder= 245:OR: Employers Side Decisions Decoder= 252:OR: Employers Side Decisions Decoder= 253,0.32039,IF THEN ELSE (Employers Side Decisions Decoder= 242:OR: Employers Side Decisions Decoder= 243:OR: Employers Side Decisions Decoder= 246:OR: Employers Side Decisions Decoder= 247:OR: Employers Side Decisions Decoder= 250:OR: Employers Side Decisions Decoder= 251:OR: Employers Side Decisions Decoder= 254:OR: Employers Side Decisions Decoder= 255,0.3301,IF THEN ELSE (Employers Side Decisions Decoder= 18:OR: Employers Side Decisions Decoder= 19:OR: Employers Side Decisions Decoder= 22:OR: Employers Side Decisions Decoder= 23:OR: Employers Side Decisions Decoder= 26:OR: Employers Side Decisions Decoder= 27:OR: Employers Side Decisions Decoder= 30:OR: Employers Side Decisions Decoder= 31,0.33981,IF THEN ELSE (Employers Side Decisions Decoder= 112:OR: Employers Side Decisions Decoder= 113:OR: Employers Side Decisions Decoder= 120:OR:Employers Side Decisions Decoder= 121,0.42718,IF THEN ELSE (Employers Side Decisions Decoder= 116:OR: Employers Side Decisions Decoder= 117:OR: Employers Side Decisions Decoder= 124:OR: Employers Side Decisions Decoder= 125,0.4466,IF THEN ELSE (Employers Side Decisions Decoder= 176:OR: Employers Side Decisions Decoder= 177:OR: Employers Side Decisions Decoder= 184:OR:Employers Side Decisions Decoder= 185,0.45631,IF THEN ELSE (Employers Side Decisions Decoder= 114:OR: Employers Side Decisions Decoder= 115:OR: Employers Side Decisions Decoder= 118:OR: Employers Side Decisions Decoder= 119:OR: Employers Side Decisions Decoder= 122:OR: Employers Side Decisions Decoder= 123:OR: Employers Side Decisions Decoder= 126:OR: Employers Side Decisions Decoder= 127,0.46602,IF THEN ELSE (Employers Side Decisions Decoder= 180:OR: Employers Side Decisions Decoder= 181:OR:Employers Side Decisions Decoder= 188:OR: Employers Side Decisions Decoder= 189,0.47573,IF THEN ELSE (Employers Side Decisions Decoder= 178:OR: Employers Side Decisions Decoder= 179:OR: Employers Side Decisions Decoder= 182:OR: Employers Side Decisions Decoder= 183:OR: Employers Side Decisions Decoder= 186:OR: Employers Side Decisions Decoder= 187:OR: Employers Side Decisions Decoder= 190:OR: Employers Side Decisions Decoder= 191,0.48544,IF THEN ELSE (Employers Side Decisions Decoder= 48:OR:Employers Side Decisions Decoder= 49:OR: Employers Side Decisions Decoder= 56:OR: Employers Side Decisions Decoder= 57,0.94175,IF THEN ELSE (Employers Side Decisions Decoder= 52:OR: Employers Side Decisions Decoder= 53:OR: Employers Side Decisions Decoder= 60:OR: Employers Side Decisions Decoder= 61,0.96117,0.98058)))))))))))))))))))

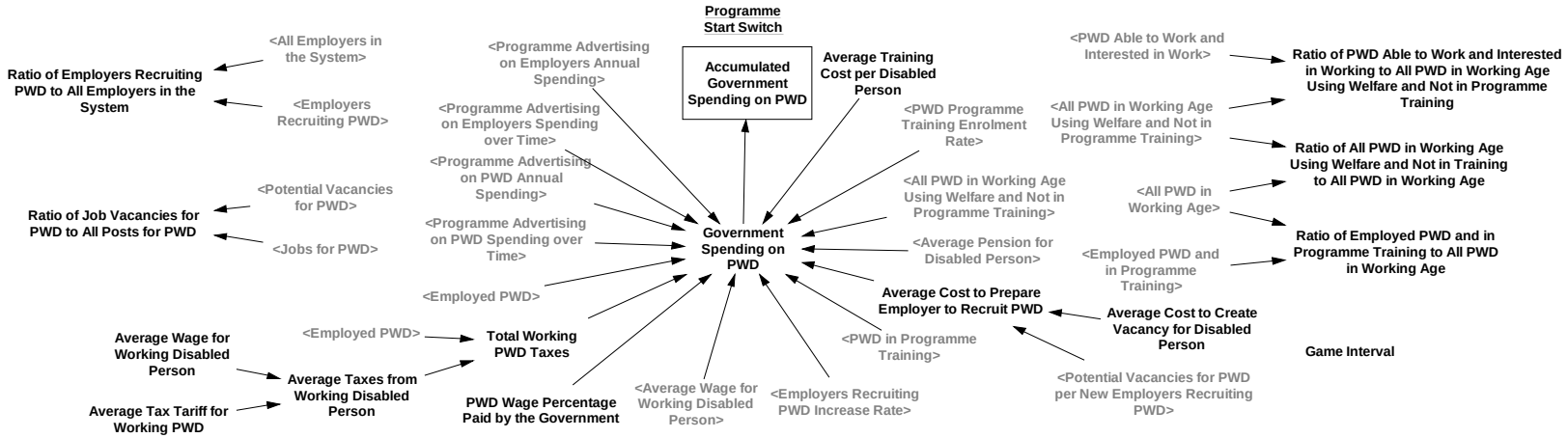
Group	Type	Variable Name and Description
		) **Present in 2 views:** • Employers Side • Employers Side Decisions **Used by:** • Employers Recruiting PWD Adoption from Advertising • Employers Recruiting PWD Adoption from Word of Mouth **Feedback loops:** 8 (2.5 %)
Employers Side Decisions	#68 G	**Government Financial Support** (Dimensionless [0,1,1]) = GAME(1) **Description:** *The government will financially support your organisation employing PWD* **Present in 1 view:** • Employers Side Decisions **Used by:** • Employers Side Decisions Decoder **Feedback loops:** 0
Employers Side Decisions	#69 G	**Government Financial Support to Adapt Workplace** (Dimensionless [0,1,1]) = GAME(1) **Description:** *Your organisation can receive financial support from the government to adapt its workplace to suit disabled employees=="Your organisation can receive financial support from the government to adapt its workplace to suit disabled employees" and "The need to adapt office, if costs are believed not to be covered by government"* **Present in 1 view:** • Employers Side Decisions **Used by:** • Employers Side Decisions Decoder • No Financial Government Support to Adapt Office **Feedback loops:** 0
Employers Side	#86 LI,A	**Initial Targeted Employers** (Employers) = Initial All Employers Fraction Having No Disabled Employees but Possible to Have* Initial All Employers Having Employees* Initial All Employers Fraction Having No Disabled Employees* (1- Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees without Special Arrangements- Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees with Accomodations or Assistive Aid) **Description:** *Employers having 15 Employees and More Enterprises in 2001 = 388269 (all enterprises) * Percentage of Employers having 15 Employees and More of the total (0.0561891) Percentage of Employers having 10 Employees and More of the total (0.0776299) PWD overrepresented in small firms-->PWDs' labour market participation in Norway–a sort of literature review by Jan Tøssebro NTNU http://www.nova.no/asset/3941/1/3941_1.pdf* **Present in 2 views:** • Employers Side • Employers Side Decisions **Used by:** • Competitors Recruiting PWD • Targeted Employers **Feedback loops:** 0
Employers	#92 A	**Lack of Government Supported Salary System** (Dimensionless [0,1,1]) = IF THEN ELSE (PWD Wage Percentage Paid by the Government= 0,1,0) **Description:** *Lack of government supported salary system*

Group	Type	Variable Name and Description
Side Decisions		**Present in 1 view:** • Employers Side Decisions **Used by:** • Employers Side Decisions Decoder **Feedback loops:** 0
Employers Side Decisions	#94 A 	**Need More Flexibility Tasks** (Dimensionless [0,1,1]) = Expect Lower Efficiency **Description:** *May expect disabled employees to need more flexibility tasks* **Present in 1 view:** • Employers Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Employers Side Decisions	#95 A 	**Need More Flexibility Working Hours** (Dimensionless [0,1,1]) = Expect Lower Efficiency **Description:** *May expect disabled employees to need more flexibility working hours* **Present in 1 view:** • Employers Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Employers Side Decisions	#97 A 	**No Financial Government Support to Adapt Office** (Dimensionless [0,1,1]) = IF THEN ELSE (Government Financial Support to Adapt Workplace= 1,0,1) **Description:** *"The need to adapt office, if costs are believed not to be covered by government"* **Present in 1 view:** • Employers Side Decisions **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Advertising Effectiveness	#104 A 	**Programme Advertising on Employers Annual Spending** (NOK/Year) = Programme Status* Advertising on Employers Annual Spending **Present in 3 views:** • Advertising Effectiveness • Employers Side Decisions • Programme Costs **Used by:** • Advertising Effectiveness on Employers • Disabled Employees Have Valuable Experiences • Government Spending on PWD **Feedback loops:** 0
Advertising Effectiveness	#106 A 	**Programme Advertising on Employers Spending over Time** (Dimensionless) = Programme Advertising on Employers Spending over Time f (Time/ Unit Time) **Present in 3 views:** • Advertising Effectiveness • Employers Side Decisions • Programme Costs **Used by:** • Advertising Effectiveness on Employers • Disabled Employees Have Valuable Experiences

Group	Type	Variable Name and Description
		• Government Spending on PWD **Feedback loops:** 0
PWD Side	#112 G	**Programme Start Switch** (Dimensionless [0,1,1]) = GAME(0) **Present in 6 views:** • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions • Programme Costs **Used by:** • Programme Status **Feedback loops:** 0
PWD Side Decisions	#113 C	**Programme Start Year** (Year) = 2012 **Present in 2 views:** • PWD Side Decisions • Employers Side Decisions **Used by:** • Employers Side Decisions Decoder • Programme Status • PWD Side Decisions Decoder **Feedback loops:** 0
PWD Side	#114 A	**Programme Status** (Dimensionless) = STEP (Programme Start Switch ,Programme Start Year) **Present in 5 views:** • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions **Used by:** • Employers Recruiting PWD Adoption from Advertising • Programme Advertising on Employers Annual Spending • Programme Advertising on PWD Annual Spending • PWD Able to Work and Interested in Work Work Adoption from Advertising • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate **Feedback loops:** 0
Employers Side Decisions	#139 C	**PWD Wage Percentage Paid by the Government** (Dimensionless [0,1,0.5]) = 0 **Present in 2 views:** • Employers Side Decisions • Programme Costs **Used by:** • Government Spending on PWD • Lack of Government Supported Salary System **Feedback loops:** 0

Group	Type	Variable Name and Description
Em-ploy-ers Side Deci-sions	#146 G	**Recruit PWD for Public Procurement** (Dimensionless [0,1,1]) = GAME(0) **Description:** *"Employing PWD will increase the chances of your organisation to sell to public sector (Public Procurement)"* **Present in 1 view:** • Employers Side Decisions **Used by:** • Employers Side Decisions Decoder **Feedback loops:** 0
PWD Side Deci-sions	#150 C	**Smoothing Time** (Year) = 5 **Description:** *Labor Ratio Perception Time=5 year--from: Forrester, Jay W. 1969. Urban Dynamics. Pegasus Communications, Inc.* **Present in 2 views:** • PWD Side Decisions • Employers Side Decisions **Used by:** • Competitors Recruiting PWD • Disabled Employees Have Valuable Experiences • Employment Training • Flexible Working Hours • Social Status • Suitable Jobs Availability **Feedback loops:** 0
Em-ploy-ers Side	#155 L	**Targeted Employers** (Employers) = $\int$ (Employers Increase Rate- Employers Willing to Recruit PWD Increase Rate- Employers Decrease Rate) $\cdot dt$ + [Initial Targeted Employers] **Present in 3 views:** • Employers Side • Advertising Effectiveness • Employers Side Decisions **Used by:** • Advertising Effectiveness on Employers • All Employers in the System • Disabled Employees Have Valuable Experiences • Employers Decrease Rate • Employers Recruiting PWD Adoption from Advertising • Employers Recruiting PWD Adoption from Word of Mouth • Employers Willing to Recruit PWD Increase Rate • Programme Advertising on Employers Optimal Annual Spending **Feedback loops:** 20 (6.3 %)

A.7 Programme Costs Subsystem (38 variables)



Group	Type	Variable Name and Description
Pro-gramme Costs	#3 L	**Accumulated Government Spending on PWD** (NOK) = $\int$ (Government Spending on PWD) $\cdot dt$ + [0] **Present in 1 view:** • Programme Costs **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Em-ploy-ers Side	#12 A	**All Employers in the System** (Employers) = Targeted Employers+ Employers Recruiting PWD+ Employers Willing to Recruit PWD **Present in 2 views:** • Employers Side • Programme Costs **Used by:** • Employers Increase Rate • Ratio of Employers Recruiting PWD to All Employers in the System **Feedback loops:** 13 (4.1 %)
PWD Side	#13 A	**All PWD in Working Age** (Persons) = PWD in Working Age Using Welfare+ PWD Able to Work and Interested in Work+ PWD in Programme Training+ Employed PWD **Present in 2 views:** • PWD Side • Programme Costs **Used by:** • All PWD in Working Age Historical Data • PWD in Working Age and Using Welfare Increase Rate • Ratio of All PWD in Working Age Using Welfare and Not in Training to All PWD in Working Age • Ratio of Employed PWD and in Programme Training to All PWD in Working Age **Feedback loops:** 127 (40.2 %)
PWD Side	#16 A	**All PWD in Working Age Using Welfare and Not in Programme Training** (Persons) = PWD Able to Work and Interested in Work+ PWD in Working Age Using Welfare **Present in 2 views:** • PWD Side • Programme Costs **Used by:** • All PWD in Working Age Using Welfare and Not in Programme Training Historical Data • Government Spending on PWD • Ratio of All PWD in Working Age Using Welfare and Not in Training to All PWD in Working Age • Ratio of PWD Able to Work and Interested in Working to All PWD in Working Age Using Welfare and Not in Programme Training **Feedback loops:** 0
Pro-gramme Costs	#20 A	**Average Cost to Create Vacancy for Disabled Person** (NOK/Person) = 30623.6+ 34800 **Present in 1 view:** • Programme Costs **Used by:** • Average Cost to Prepare Employer to Recruit PWD

Group	Type	Variable Name and Description
		Feedback loops: 0
Programme Costs	#21 A 	**Average Cost to Prepare Employer to Recruit PWD** (NOK/Employer) = Average Cost to Create Vacancy for Disabled Person* Potential Vacancies for PWD per New Employers Recruiting PWD **Description:** *NAV 2007 Technical aids NOK 2.56 billion to technical aids 152,416 people received one or more technical aids 89 per cent of stock items are delivered within three weeks* **Present in 1 view:** • Programme Costs **Used by:** • Government Spending on PWD **Feedback loops:** 0
PWD Side Decisions	#23 C 	**Average Pension for Disabled Person** (NOK/(Year*Person)) = 88620 **Description:** *2006: Today, the average recipient of disability benefits has 1.46 pension points (Social Security. ?? Social Security Statistical Yearbook, table 9.37.), and the base amount for calculating social security benefits is NOK 60,699. Generally speaking, we can say that an average recipient of disability benefits receives NOK 88,620 a year. Basic amount 75641 (May 1 2010) http://corporatesolutions.swisslife.com/etc/slml/slnw/obedl/1/200/360.File.tmp /Norway.pdf 110436* **Present in 2 views:** • PWD Side Decisions • Programme Costs **Used by:** • Government Spending on PWD • Net Income Change per Disabled Person **Feedback loops:** 0
PWD Side Decisions	#25 C 	**Average Tax Tariff for Working PWD** (Dimensionless) = 0.28 **Present in 2 views:** • PWD Side Decisions • Programme Costs **Used by:** • Average Taxes from Working Disabled Person • Net Income Change per Disabled Person **Feedback loops:** 0
Programme Costs	#26 A 	**Average Taxes from Working Disabled Person** (NOK/(Person*Year)) = Average Wage for Working Disabled Person* Average Tax Tariff for Working PWD **Present in 1 view:** • Programme Costs **Used by:** • Total Working PWD Taxes **Feedback loops:** 0
Programme Costs	#28 C 	**Average Training Cost per Disabled Person** (NOK/Person) = 444444 **Description:** *The costs of running the Handicap-Programme are in the order of NOK 2 million a year, if we exclude the disability benefits paid to the participants. An average of eight to ten persons pass through the course every year.* **Present in 1 view:** • Programme Costs

Group	Type	Variable Name and Description
		Used by: • Government Spending on PWD **Feedback loops:** 0
PWD Side Deci-sions	#29 C	**Average Wage for Working Disabled Person** (NOK/(Year*Person)) = 183900 **Description:** *In 2003, the mean salary level was NOK 183,900, and mean income tax paid was NOK 52,0003. SSB May 2011: Full-time employees had average monthly earnings of NOK 38100, while the corresponding earnings for part-time employees were NOK 30600. This was a year-on-year increase of 4.1 and 4.4 per cent respectively. In order to make the part-time and full-time earnings comparable, the earnings of part-time employees are converted to earnings corresponding to full-time employees. 457200, 367200* **Present in 2 views:** • PWD Side Decisions • Programme Costs **Used by:** • Average Taxes from Working Disabled Person • Government Spending on PWD • Net Income Change per Disabled Person **Feedback loops:** 0
PWD Side	#34 L	**Employed PWD** (Persons) = $\int$ (PWD Direct Recruitment Rate+ PWD after Programme Training Recruitment Rate- Employed PWD End Employment Rate- Employed PWD Decrease Rate) $\cdot dt$ + [Initial Employed PWD] **Description:** *The number of working People with Disabilities in the system. Increased by adoption and decreased when adopters discard the idea.* **Present in 3 views:** • PWD Side • Employers Side • Programme Costs **Used by:** • All PWD in Working Age • Employed PWD and in Programme Training • Employed PWD Decrease Rate • Employed PWD End Employment Rate • Government Spending on PWD • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth • PWD Jobs Quitting Rate • Total Working PWD Taxes **Feedback loops:** 212 (67.1 %)
PWD Side	#35 A	**Employed PWD and in Programme Training** (Persons) = PWD in Programme Training+ Employed PWD **Present in 2 views:** • PWD Side • Programme Costs **Used by:** • Employed PWD and in Programme Training Historical Data • Ratio of Employed PWD and in Programme Training to All PWD in Working Age **Feedback loops:** 0
Em-	#46	**Employers Recruiting PWD** (Employers)

Group	Type	Variable Name and Description
ploy-ers Side	L	= $\int$ (Employers Recruiting PWD Increase Rate- Employers Recruiting PWD Decrease Rate) $\cdot dt$ + [Initial Employers Recruiting PWD] **Description:** *Employers Recruiting or Having Vacancies for PWD* **Present in 3 views:** • Employers Side • Employers Side Decisions • Programme Costs **Used by:** • All Employers in the System • Average Jobs for PWD per Employers Recruiting PWD • Average Potential Vacancies for PWD per Employers Recruiting PWD • Competitors Recruiting PWD • Employers Recruiting PWD Adoption from Word of Mouth • Employers Recruiting PWD Decrease Rate • Ratio of Employers Recruiting PWD to All Employers in the System **Feedback loops:** 10 (3.2 %)
Em-ploy-ers Side	#51 F,A	**Employers Recruiting PWD Increase Rate** (Employers/Year) = Employers Willing to Recruit PWD/ Average Time to Prepare Employer to Recruit PWD **Present in 2 views:** • Employers Side • Programme Costs **Used by:** • Employers Recruiting PWD • Employers Willing to Recruit PWD • Government Spending on PWD • Potential Vacancies for PWD Increase Rate **Feedback loops:** 10 (3.2 %)
Pro-gramm e Costs	#67 C	**Game Interval** (Year) = 1 **Description:** *"Use GAME INTERVAL to specify how far a model should advance during gaming. This value can be changed later using the Gaming Control Dialog or GAME commands." Vensim Reference Manual* **Present in 1 view:** • Programme Costs **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Pro-gramm e Costs	#70 F,A	**Government Spending on PWD** (NOK/Year) = -1* (Total Working PWD Taxes- (All PWD in Working Age Using Welfare and Not in Programme Training+ PWD in Programme Training)*Average Pension for Disabled Person- Employed PWD* Average Wage for Working Disabled Person* PWD Wage Percentage Paid by the Government- Programme Advertising on PWD Annual Spending* Programme Advertising on PWD Spending over Time- Programme Advertising on Employers Annual Spending* Programme Advertising on Employers Spending over Time- Average Training Cost per Disabled Person* PWD Programme Training Enrolment Rate- Average Cost to Prepare Employer to Recruit PWD* Employers Recruiting PWD Increase Rate) **Present in 1 view:** • Programme Costs **Used by:**

Group	Type	Variable Name and Description
		• Accumulated Government Spending on PWD **Feedback loops:** 0
Em-ploy-ers Side	#90 L	**Jobs for PWD** (Persons) $= \int ($ PWD Vacancies Occupying Rate- PWD Jobs Quitting Rate- Jobs for PWD Decrease Rate $) \cdot dt$ + [Initial Employed PWD] **Present in 2 views:** • Employers Side • Programme Costs **Used by:** • Average Jobs for PWD per Employers Recruiting PWD • Ratio of Job Vacancies for PWD to All Posts for PWD **Feedback loops:** 125 (39.6 %)
PWD Side	#100 L	**Potential Vacancies for PWD** (Persons) $= \int ($ PWD Jobs Quitting Rate+ Potential Vacancies for PWD Increase Rate- PWD Vacancies Occupying Rate- Potential Vacancies for PWD Decrease Rate $) \cdot dt$ + [Initial Vacancies for PWD] **Present in 4 views:** • PWD Side • Employers Side • PWD Side Decisions • Programme Costs **Used by:** • Average Potential Vacancies for PWD per Employers Recruiting PWD • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate • Ratio of Job Vacancies for PWD to All Posts for PWD • Suitable Jobs Availability **Feedback loops:** 196 (62.0 %)
Em-ploy-ers Side	#103 C	**Potential Vacancies for PWD per New Employers Recruiting PWD** (Persons/Employer) = 2.71891 **Description:** *2.95-3.94898 Computed : employed disabled persons http://www.ssb.no /akutu_en/ and enterprises with 1 or more employees http://statbank.ssb.no/statistikkbanken /Default_FR.asp?PXSid=0&nvl=true&PLanguage=1&tilside=selectvarval /define.asp&Tabellid=07196 1.097* **Present in 2 views:** • Employers Side • Programme Costs **Used by:** • Average Cost to Prepare Employer to Recruit PWD • Initial Vacancies for PWD • Potential Vacancies for PWD Increase Rate **Feedback loops:** 0
Adver-tising Effec-tive-ness	#104 A	**Programme Advertising on Employers Annual Spending** (NOK/Year) = Programme Status* Advertising on Employers Annual Spending **Present in 3 views:** • Advertising Effectiveness • Employers Side Decisions • Programme Costs

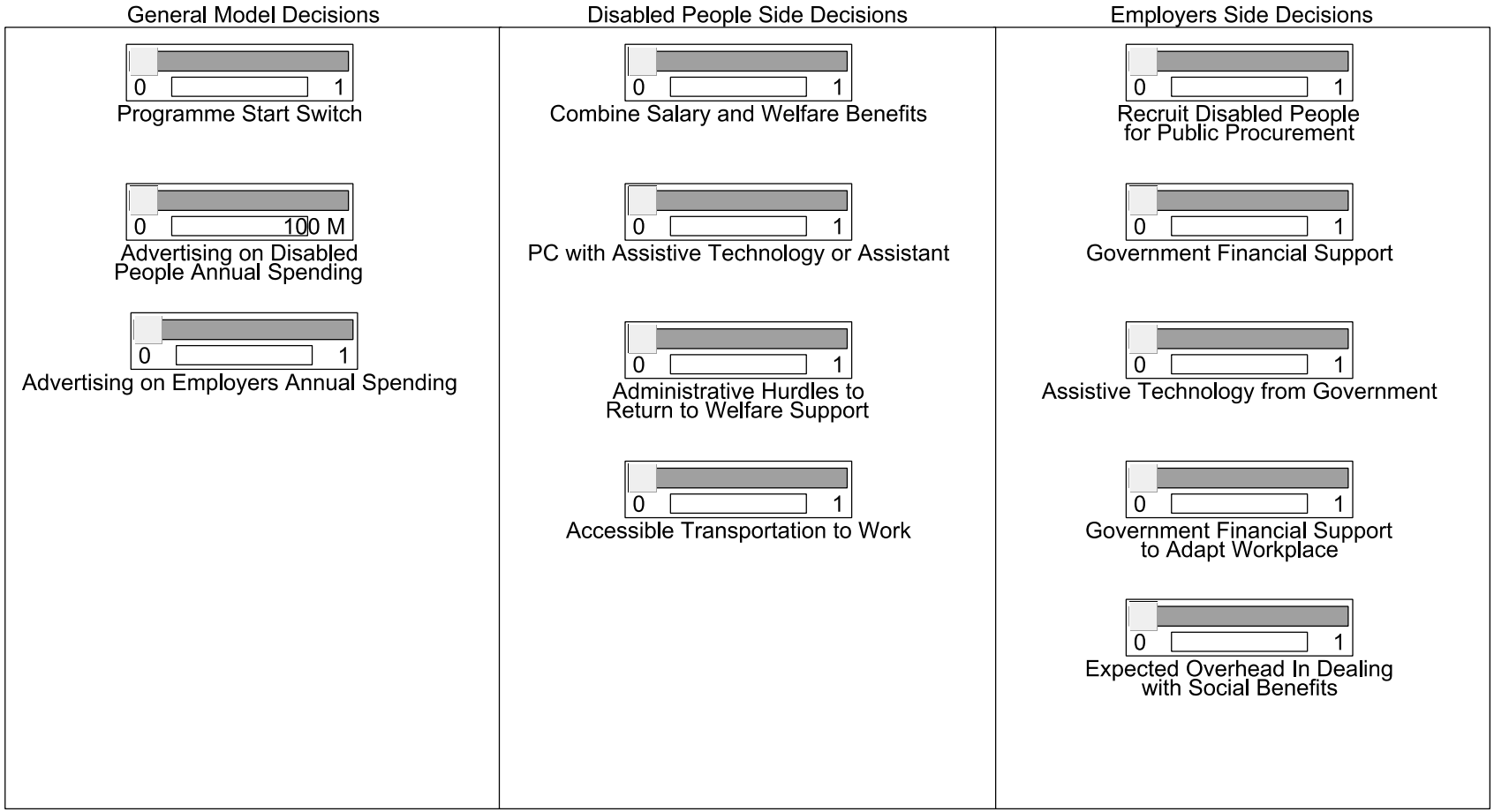
Group	Type	Variable Name and Description
		Used by: • Advertising Effectiveness on Employers • Disabled Employees Have Valuable Experiences • Government Spending on PWD **Feedback loops:** 0
Advertising Effectiveness	#106 A 	**Programme Advertising on Employers Spending over Time** (Dimensionless) = Programme Advertising on Employers Spending over Time f (Time/ Unit Time) **Present in 3 views:** • Advertising Effectiveness • Employers Side Decisions • Programme Costs **Used by:** • Advertising Effectiveness on Employers • Disabled Employees Have Valuable Experiences • Government Spending on PWD **Feedback loops:** 0
Advertising Effectiveness	#108 A 	**Programme Advertising on PWD Annual Spending** (NOK/Year) = Programme Status* Advertising on PWD Annual Spending **Present in 3 views:** • Advertising Effectiveness • PWD Side Decisions • Programme Costs **Used by:** • Advertising Effectiveness on PWD • Flexible Working Hours • Government Spending on PWD **Feedback loops:** 0
Advertising Effectiveness	#110 A 	**Programme Advertising on PWD Spending over Time** (Dimensionless) = Programme Advertising on PWD Spending over Time f (Time/ Unit Time) **Present in 3 views:** • Advertising Effectiveness • PWD Side Decisions • Programme Costs **Used by:** • Advertising Effectiveness on PWD • Flexible Working Hours • Government Spending on PWD **Feedback loops:** 0
PWD Side	#112 G 	**Programme Start Switch** (Dimensionless [0,1,1]) = GAME(0) **Present in 6 views:** • PWD Side • Employers Side • Advertising Effectiveness • PWD Side Decisions • Employers Side Decisions • Programme Costs **Used by:** • Programme Status **Feedback loops:** 0

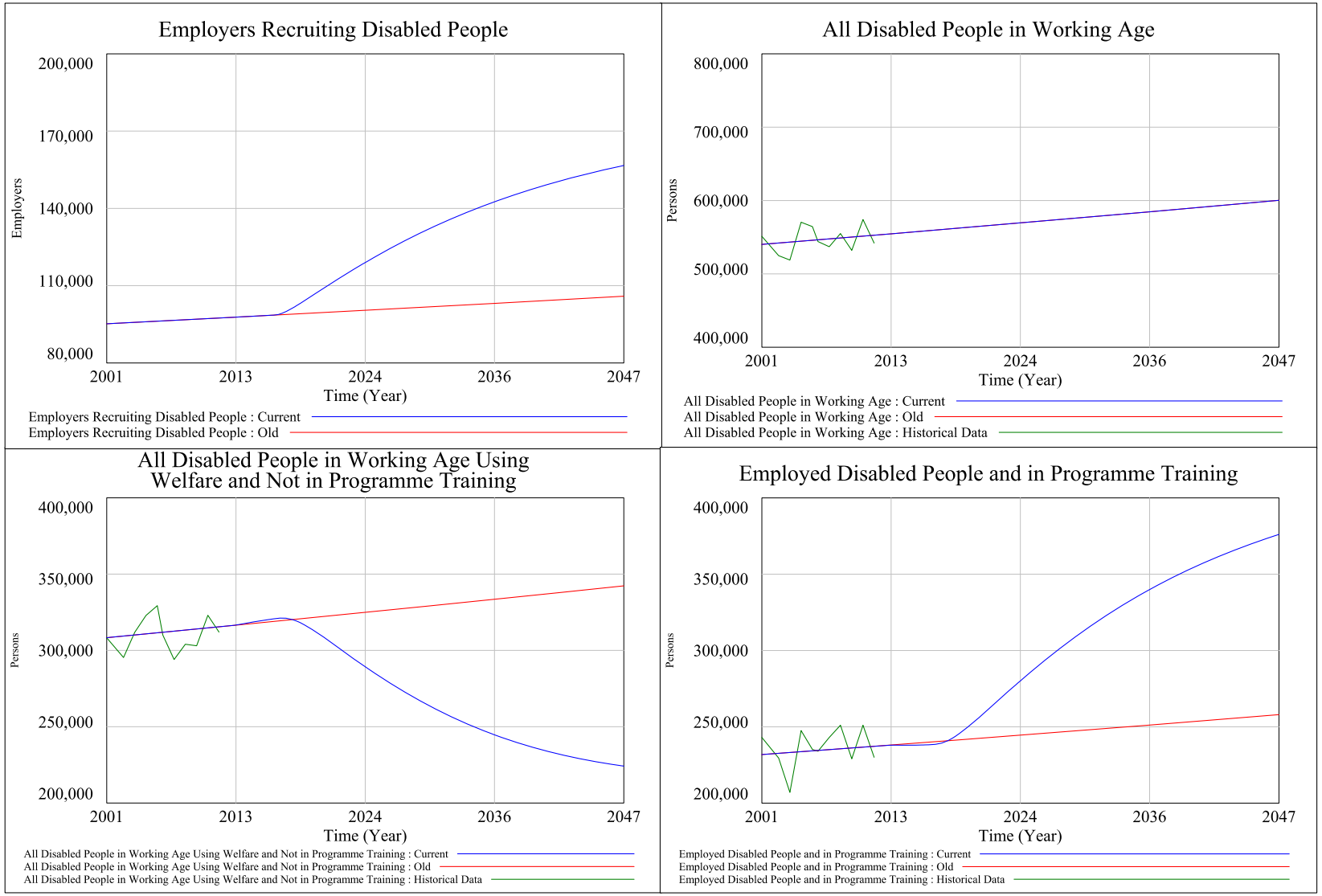
Group	Type	Variable Name and Description
PWD Side	#116 L 	**PWD Able to Work and Interested in Work** (Persons) = $\int$ (PWD Able to Work and Interested in Work Increase Rate+ Employed PWD End Employment Rate- PWD Direct Recruitment Rate- PWD Programme Training Enrolment Rate- PWD Able to Work Interested in Work Decrease Rate) $\cdot dt$ + [Initial PWD Able to Work Interested in Work] **Description:** *18% of inactive Persons permanently disabled who say they want to work* **Present in 2 views:** • PWD Side • Programme Costs **Used by:** • All PWD in Working Age • All PWD in Working Age Using Welfare and Not in Programme Training • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth • PWD Able to Work Interested in Work Decrease Rate • PWD Direct Recruitment Rate • PWD Programme Training Enrolment Rate • Ratio of PWD Able to Work and Interested in Working to All PWD in Working Age Using Welfare and Not in Programme Training **Feedback loops:** 260 (82.3 %)
PWD Side	#127 L 	**PWD in Programme Training** (Persons) = $\int$ (PWD Programme Training Enrolment Rate- PWD after Programme Training Recruitment Rate- PWD Fail Programme Training Rate- PWD in Training Decrease Rate) $\cdot dt$ + [Initial PWD in Programme Training] **Present in 2 views:** • PWD Side • Programme Costs **Used by:** • All PWD in Working Age • Employed PWD and in Programme Training • Government Spending on PWD • PWD Able to Work and Interested in Work Work Adoption from Word of Mouth • PWD after Programme Training Recruitment Rate • PWD Fail Programme Training Rate • PWD in Training Decrease Rate **Feedback loops:** 183 (57.9 %)
PWD Side	#136 F,A 	**PWD Programme Training Enrolment Rate** (Persons/Year) = IF THEN ELSE (Programme Status= 1,(PWD Able to Work and Interested in Work / Shortest Time to Fill All Available Vacancies)* Fraction of Max f (XIDZ (Potential Vacancies for PWD/ Shortest Time to Fill All Available Vacancies ,PWD Able to Work and Interested in Work/Shortest Time to Fill All Available Vacancies ,10))* (1- PWD Fraction Recruited in Old Jobs after Disability) ,0) **Description:** *(Level to drain / Fastest draining time) * Fraction of Max f (xidz (Desired draining , Level to drain / Fastest draining time , 10))* **Present in 4 views:** • PWD Side • Employers Side • PWD Side Decisions • Programme Costs

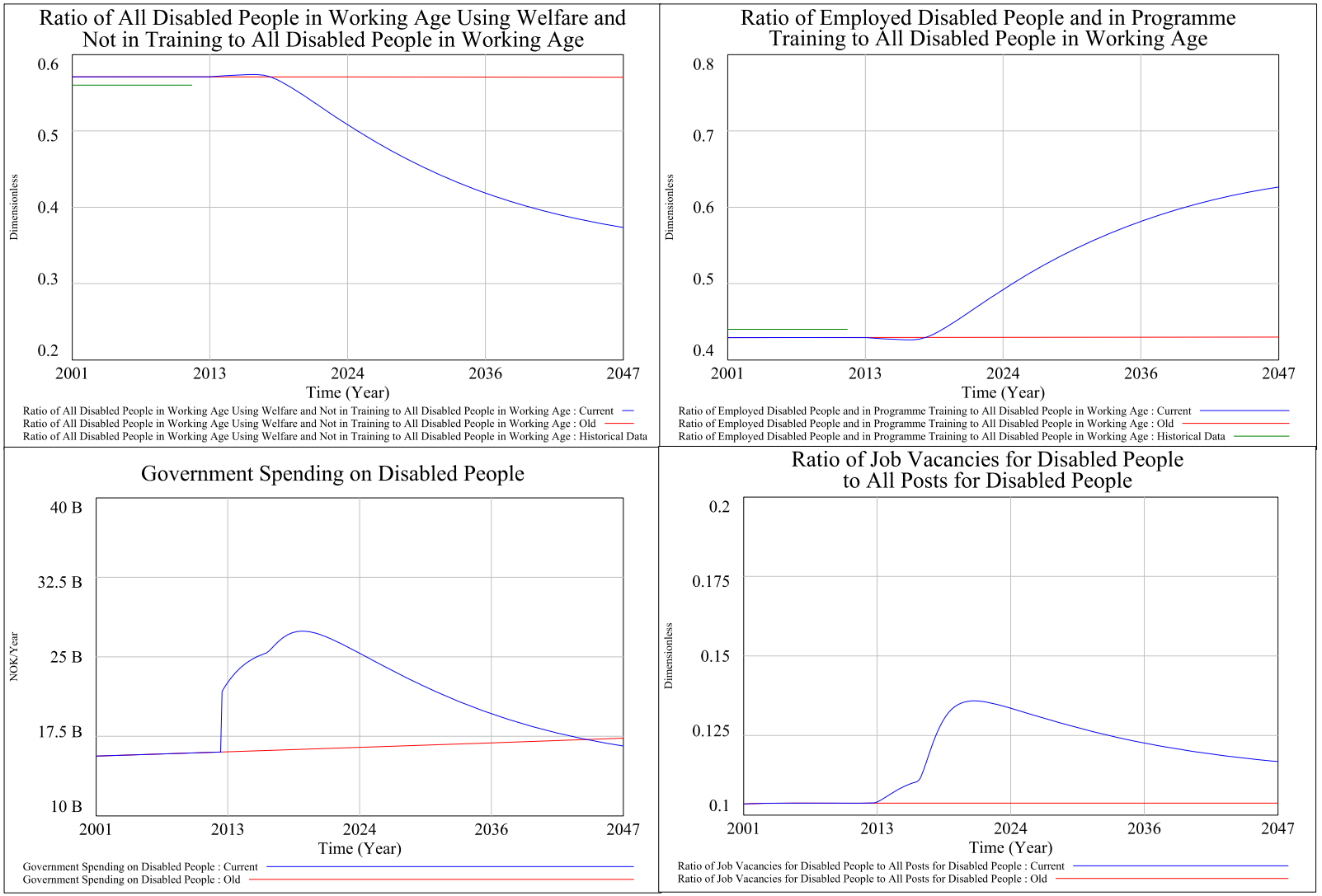
Group	Type	Variable Name and Description
		Used by: • Employment Training • Government Spending on PWD • PWD Able to Work and Interested in Work • PWD in Programme Training • PWD Vacancies Occupying Rate **Feedback loops:** 230 (72.8 %)
Employers Side Decisions	#139 C 	**PWD Wage Percentage Paid by the Government** (Dimensionless [0,1,0.5]) = 0 **Present in 2 views:** • Employers Side Decisions • Programme Costs **Used by:** • Government Spending on PWD • Lack of Government Supported Salary System **Feedback loops:** 0
Programme Costs	#141 A 	**Ratio of All PWD in Working Age Using Welfare and Not in Training to All PWD in Working Age** (Dimensionless) = XIDZ (All PWD in Working Age Using Welfare and Not in Programme Training ,All PWD in Working Age ,:NA:) **Description:** *Ratio of Disabled in Working Age Using Welfare and Not in Training to All Ratio of All PWD in Working Age Using Welfare and Not in Training to All PWD in Working Age* **Present in 1 view:** • Programme Costs **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Programme Costs	#142 A 	**Ratio of Employed PWD and in Programme Training to All PWD in Working Age** (Dimensionless) = XIDZ (Employed PWD and in Programme Training ,All PWD in Working Age ,:NA:) **Present in 1 view:** • Programme Costs **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Programme Costs	#143 A 	**Ratio of Employers Recruiting PWD to All Employers in the System** (Dimensionless) = XIDZ (Employers Recruiting PWD ,All Employers in the System ,:NA:) **Present in 1 view:** • Programme Costs **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Programme Costs	#144 A 	**Ratio of Job Vacancies for PWD to All Posts for PWD** (Dimensionless [0,1,1]) = XIDZ (Potential Vacancies for PWD ,Jobs for PWD+ Potential Vacancies for PWD ,:NA:) **Description:** *Job vacancy rate, by major industry division. Percentage of job vacancies in relation to the number of posts (job vacancies and occupied posts) compare with http://www.ssb.no/ledstill_en/tab-2012-02-15-02-en.html* **Present in 1 view:** • Programme Costs

Group	Type	Variable Name and Description
		Used by: **This is a supplementary variable.** **Feedback loops:** 0
Programme Costs	#145 A 	**Ratio of PWD Able to Work and Interested in Working to All PWD in Working Age Using Welfare and Not in Programme Training**(Dimensionless) = XIDZ (PWD Able to Work and Interested in Work ,All PWD in Working Age Using Welfare and Not in Programme Training ,:NA:) **Present in 1 view:** • Programme Costs **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Programme Costs	#158 A 	**Total Working PWD Taxes** (NOK/Year) = Employed PWD* Average Taxes from Working Disabled Person **Present in 1 view:** • Programme Costs **Used by:** • Government Spending on PWD **Feedback loops:** 0

A.8 Vensim ILE GUI




Employers Recruiting Disabled People
200,000
170,000
140,000
110,000
80,000
Employers
2001
2013
2024
2036
2047
Time (Year)
Employers Recruiting Disabled People : Current
Employers Recruiting Disabled People : Old
All Disabled People in Working Age
800,000
700,000
600,000
500,000
400,000
Persons
2001
2013
2024
2036
2047
Time (Year)
All Disabled People in Working Age : Current
All Disabled People in Working Age : Old
All Disabled People in Working Age : Historical Data
All Disabled People in Working Age Using Welfare and Not in Programme Training
400,000
350,000
300,000
250,000
200,000
Persons
2001
2013
2024
2036
2047
Time (Year)
All Disabled People in Working Age Using Welfare and Not in Programme Training : Current
All Disabled People in Working Age Using Welfare and Not in Programme Training : Old
All Disabled People in Working Age Using Welfare and Not in Programme Training : Historical Data
Employed Disabled People and in Programme Training
400,000
350,000
300,000
250,000
200,000
Persons
2001
2013
2024
2036
2047
Time (Year)
Employed Disabled People and in Programme Training : Current
Employed Disabled People and in Programme Training : Old
Employed Disabled People and in Programme Training : Historical Data


Ratio of All Disabled People in Working Age Using Welfare and Not in Training to All Disabled People in Working Age
0.6
0.5
0.4
0.3
0.2
Dimensionless
2001
2013
2024
2036
2047
Time (Year)
Ratio of All Disabled People in Working Age Using Welfare and Not in Training to All Disabled People in Working Age : Current
Ratio of All Disabled People in Working Age Using Welfare and Not in Training to All Disabled People in Working Age : Old
Ratio of All Disabled People in Working Age Using Welfare and Not in Training to All Disabled People in Working Age : Historical Data
Ratio of Employed Disabled People and in Programme Training to All Disabled People in Working Age
0.8
0.7
0.6
0.5
0.4
Dimensionless
2001
2013
2024
2036
2047
Time (Year)
Ratio of Employed Disabled People and in Programme Training to All Disabled People in Working Age : Current
Ratio of Employed Disabled People and in Programme Training to All Disabled People in Working Age : Old
Ratio of Employed Disabled People and in Programme Training to All Disabled People in Working Age : Historical Data
Government Spending on Disabled People
40 B
32.5 B
25 B
17.5 B
10 B
NOK/Year
2001
2013
2024
2036
2047
Time (Year)
Government Spending on Disabled People : Current
Government Spending on Disabled People : Old
Ratio of Job Vacancies for Disabled People to All Posts for Disabled People
0.2
0.175
0.15
0.125
0.1
Dimensionless
2001
2013
2024
2036
2047
Time (Year)
Ratio of Job Vacancies for Disabled People to All Posts for Disabled People : Current
Ratio of Job Vacancies for Disabled People to All Posts for Disabled People : Old

B Documentation of eAccessibility of Norwegian Municipal Website SD Model[89]

B.1 Model Assessment Results

Model Information	Number
Total Number of Variables	230
Total Number of State Variables (Level+Smooth+Delay Variables)	19 (8.3%)
Total Number of Stocks (Stocks in Level+Smooth+Delay Variables) †	18 (7.8%)
Total Number of Macros	0
Variables with Source Information	0
Variables with Dimensionless Units	62 (27%)
Variables without Predefined Min or Max Values	194 (84.3%)
Function Sensitivity Parameters	0
Data Lookup Tables	0
Time Unit	Week
Initial Time	0
Final Time	208
Reported Time Interval	TIME STEP
Time Step	0.0625
Model Is Fully Formulated	Yes
Modeler-Defined Groups	Yes
VPM File Available	Yes
Equations with Embedded Data (0 and 1 constants ignored)	5 (2.2%)
Equations With Unit Errors or Warnings	0
Variables Not in Any View	0
Incompletely Defined Subscripted Variables	0
Nonmonotonic Lookup Functions	0
Cascading (Chained) Lookup Functions	0
Non-Zero End Sloped Lookup Functions	9 (3.9%)
Equations with "IF THEN ELSE" Functions	15 (6.5%)
Equations with "MIN" or "MAX" Functions	11 (4.8%)
Equations with "STEP", "PULSE", or Related Functions	4 (1.7%)
Unused Variables	0
Supplementary Variables	8
Supplementary Variables Being Used	0
Complex Variable Formulations (Richardson's Rule = 3)	58
Complex Stock Formulations	0

Symbols, Types, Group and abbreviations used in the model documentation

Types:	**L** : Level (16 / **16**) *	"A variable whose value does not change over time." [229]

[89] The model (Vensim file format) is available at: https://forio.com/app/ahmedg/eaccessibility/helper/

DE : Delay (3 / **2**) *, **	"Returns the value of the input delayed by the delay time." [229]
LI : Level Initial (20)	"Levels (also called accumulations, stocks and states). These change only over time and the values they take on at any time depend on the value they (and other variables) took on at previous times. … The Level variables ultimately determine the dynamic behavior of a system." [229]
C : Constant (64)	These are constants used as the initial values for the Levels. Sometimes we chose to initialise the Level directly within its equation, without the need to have an independent constant to inilaise it.
F : Flow (33)	Also called Rate. "These are the variables that directly change the Levels. Rates are essentially the same as Auxiliaries and differ only in the way they are used in a model." [229]
A : Auxiliary (112)	"Any dynamic variable that is computed from other variables at a given time. Auxiliaries are typically the most numerous variable type. An auxiliary variable has an expression involving other variables in its equation." [229]
G : Game (35)	A constant value, except when the model is set to run in the gaming mode. In the gaming mode, the user input is used instead of the constant value.
T : Lookup (9 / **9**) ***	"Nonlinear functions with numerical parameters (where the parameters are the x- and y-axis values). They are defined in equations beginning with a left parenthesis (and ending with a right parenthesis)." [229]

* (state variables / **total stocks**)

** Total stocks do not include fixed delay variables.

*** (lookup variables / **lookup tables**).

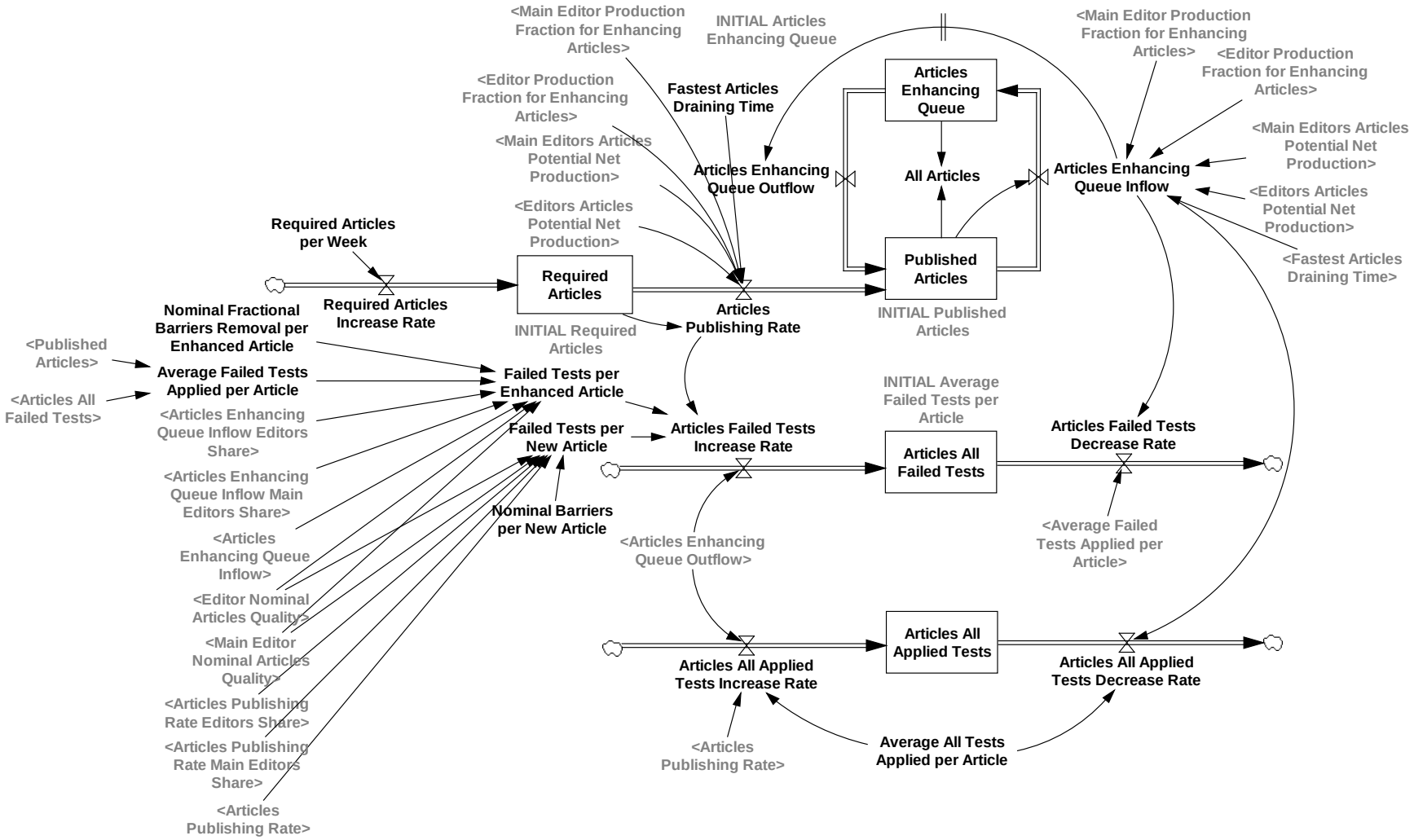
Groups*:	**Articles** (30)	**Consultancies** (7)	**Control** (26) Simulation Control Parameters	**Costs Computations** (15)	**Editors Effective Experience**(13)
	Main Editors Effective Experience (26)	**Productivity** (9)	**Quality** (12)	**Technology** (5)	**Templates** (31)
	Training (15)	**Website Accessibility Score**(6)	**Workforce** (35)		

* "Groups are not really variables, but a way to group different variables together. They have no values, but can be used to access collections of other variable types." [229]

Views*:	**Articles** (48)	**Templates** (49)	**Website Accessibility Score** (11)	**Workforce** (57)	**Productivity and Work Quality** (24)
	Editors Effective Experience (24)	**Main Editors Effective Experience** (50)	**Training** (27)	**Consultancies** (10)	**Technology** (6)
	Costs (35)	**Not Present In Any View** (1)			

* "A model is a set of causal dependencies and equations defining the mathematical relationship among variables. A view is a visual representation of some subset of those relationships." [229]

B.2 Articles Subsystem (48 variables)



Group	Type	Variable Name and Description
Articles	#2 A 	**All Articles** (Articles) = Published Articles + Articles Enhancing Queue **Present in 1 view:** • Articles **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Articles	#5 L 	**Articles All Applied Tests** (Tests) = $\int$ (Articles All Applied Tests Increase Rate - Articles All Applied Tests Decrease Rate) $\cdot dt$ + [Published Articles * Average All Tests Applied per Article] **Present in 1 view:** • Articles **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Articles	#6 F,A 	**Articles All Applied Tests Decrease Rate** (Tests/Week) = Articles Enhancing Queue Inflow * Average All Tests Applied per Article **Present in 1 view:** • Articles **Used by:** • Articles All Applied Tests **Feedback loops:** 0
Articles	#7 F,A 	**Articles All Applied Tests Increase Rate** (Tests/Week) = Average All Tests Applied per Article * (Articles Publishing Rate + Articles Enhancing Queue Outflow) **Present in 1 view:** • Articles **Used by:** • Articles All Applied Tests **Feedback loops:** 0
Articles	#8 L 	**Articles All Failed Tests** (Tests) = $\int$ (Articles Failed Tests Increase Rate - Articles Failed Tests Decrease Rate) $\cdot dt$ + [Published Articles * INITIAL Average Failed Tests per Article] **Present in 1 view:** • Articles **Used by:** • Average Failed Tests Applied per Article **Feedback loops:** 2 (3.5 %)
Articles	#9 L 	**Articles Enhancing Queue** (Articles) = $\int$ (Articles Enhancing Queue Inflow - Articles Enhancing Queue Outflow) $\cdot dt$ + [INITIAL Articles Enhancing Queue] **Present in 1 view:** • Articles **Used by:** • All Articles **Feedback loops:** 0
Articles	#10	**Articles Enhancing Queue Inflow** (Articles/Week)

Group	Type	Variable Name and Description
	F,A 	= MIN (Published Articles / Fastest Articles Draining Time, Main Editors Articles Potential Net Production * Main Editor Production Fraction for Enhancing Articles+ Editors Articles Potential Net Production * Editor Production Fraction for Enhancing Articles) **Present in 1 view:** • Articles **Used by:** • Articles All Applied Tests Decrease Rate • Articles Enhancing Queue • Articles Enhancing Queue Inflow Editors Share • Articles Enhancing Queue Inflow Main Editors Share • Articles Enhancing Queue Outflow • Articles Failed Tests Decrease Rate • Failed Tests per Enhanced Article • Published Articles **Feedback loops:** 16 (28.1 %)
Articles	#11 A 	**Articles Enhancing Queue Inflow Editors Share** (Articles/Week) = ZIDZ (Articles Enhancing Queue Inflow* Editors Articles Potential Net Production * Editor Production Fraction for Enhancing Articles , Editors Articles Potential Net Production * Editor Production Fraction for Enhancing Articles+ Main Editors Articles Potential Net Production *Main Editor Production Fraction for Enhancing Articles) **Present in 2 views:** • Articles • Editors Effective Experience **Used by:** • Editors Effective Experience Increase Rate due to on Job Experience • Failed Tests per Enhanced Article **Feedback loops:** 13 (22.8 %)
Articles	#12 A 	**Articles Enhancing Queue Inflow Main Editors Share** (Articles/Week) = ZIDZ (Articles Enhancing Queue Inflow* Main Editors Articles Potential Net Production * Main Editor Production Fraction for Enhancing Articles, Editors Articles Potential Net Production * Editor Production Fraction for Enhancing Articles+ Main Editors Articles Potential Net Production * Main Editor Production Fraction for Enhancing Articles) **Present in 2 views:** • Articles • Main Editors Effective Experience **Used by:** • Failed Tests per Enhanced Article • Main Editors Effective Experience Increase Rate due to on Job Experience **Feedback loops:** 13 (22.8 %)
Articles	#13 DE,F 	**Articles Enhancing Queue Outflow** (Articles/Week) = DELAY FIXED (Articles Enhancing Queue Inflow ,1, 0) **Present in 1 view:** • Articles **Used by:** • Articles All Applied Tests Increase Rate • Articles Enhancing Queue • Articles Failed Tests Increase Rate • Published Articles **Feedback loops:** 1 (1.8 %)
Articles	#14	**Articles Failed Tests Decrease Rate** (Tests/Week)

Group	Type	Variable Name and Description
	F,A	= Articles Enhancing Queue Inflow * Average Failed Tests Applied per Article **Present in 1 view:** • Articles **Used by:** • Articles All Failed Tests **Feedback loops:** 1 (1.8 %)
Articles	#15 F,A	**Articles Failed Tests Increase Rate** (Tests/Week) = Articles Publishing Rate * Failed Tests per New Article+ Articles Enhancing Queue Outflow * Failed Tests per Enhanced Article **Present in 1 view:** • Articles **Used by:** • Articles All Failed Tests **Feedback loops:** 1 (1.8 %)
Articles	#16 F,A	**Articles Publishing Rate** (Articles/Week) = MIN (Required Articles / Fastest Articles Draining Time ,Main Editors Articles Potential Net Production * (1 - Main Editor Production Fraction for Enhancing Articles) + Editors Articles Potential Net Production * (1 - Editor Production Fraction for Enhancing Articles)) **Present in 1 view:** • Articles **Used by:** • Articles All Applied Tests Increase Rate • Articles Failed Tests Increase Rate • Articles Publishing Rate Editors Share • Articles Publishing Rate Main Editors Share • Failed Tests per New Article • Published Articles • Required Articles **Feedback loops:** 15 (26.3 %)
Articles	#17 A	**Articles Publishing Rate Editors Share** (Articles/Week) = ZIDZ (Articles Publishing Rate * (1 - Editor Production Fraction for Enhancing Articles) * Editors Articles Potential Net Production , (1 -Editor Production Fraction for Enhancing Articles) * Editors Articles Potential Net Production + (1 - Main Editor Production Fraction for Enhancing Articles) * Main Editors Articles Potential Net Production) **Present in 2 views:** • Articles • Editors Effective Experience **Used by:** • Editors Effective Experience Increase Rate due to on Job Experience • Failed Tests per New Article **Feedback loops:** 10 (17.5 %)
Articles	#18 A	**Articles Publishing Rate Main Editors Share** (Articles/Week) = ZIDZ (Articles Publishing Rate * (1 -Main Editor Production Fraction for Enhancing Articles) * Main Editors Articles Potential Net Production, (1 - Editor Production Fraction for Enhancing Articles) * Editors Articles Potential Net Production+ (1 - Main Editor Production Fraction for Enhancing Articles) * Main Editors Articles Potential Net Production) **Present in 2 views:** • Articles • Main Editors Effective Experience

Group	Type	Variable Name and Description
		Used by: • Failed Tests per New Article • Main Editors Effective Experience Increase Rate due to on Job Experience **Feedback loops:** 10 (17.5 %)
Articles	#19 LI,C	**Average All Tests Applied per Article** (Tests/Article) = 23.3363 **Description:** *Average number of tests applied per article (computed from eGovMon database).* **Present in 2 views:** • Articles • Website Accessibility Score **Used by:** • Article Average UWEM Score • Articles All Applied Tests • Articles All Applied Tests Decrease Rate • Articles All Applied Tests Increase Rate • Templates Average UWEM Score • Website UWEM Score **Feedback loops:** 0
Articles	#22 A	**Average Failed Tests Applied per Article** (Tests/Article) = ZIDZ (Articles All Failed Tests , Published Articles) **Present in 2 views:** • Articles • Website Accessibility Score **Used by:** • Article Average UWEM Score • Articles Failed Tests Decrease Rate • Failed Tests per Enhanced Article • Website UWEM Score **Feedback loops:** 2 (3.5 %)
Quality	#41 A	**Editor Nominal Articles Quality** (Dimensionless) = MIN (1, Editor Normal Articles Quality * Effect of Editor Average Effective Experience on Editor Article Quality) **Present in 2 views:** • Articles • Productivity and Work Quality **Used by:** • Failed Tests per Enhanced Article • Failed Tests per New Article **Feedback loops:** 0
Control	#45 G	**Editor Production Fraction for Enhancing Articles** (Dimensionless [0,1,0.05]) = GAME(0.5) **Description:** *In general, no one is enhancing articles. However, we assumed that editors spend half of their time devoted to article production in updating old articles, and it safe to assume that they fix accessibility barriers while doing that.* **Present in 1 view:** • Articles **Used by:** • Articles Enhancing Queue Inflow • Articles Enhancing Queue Inflow Editors Share

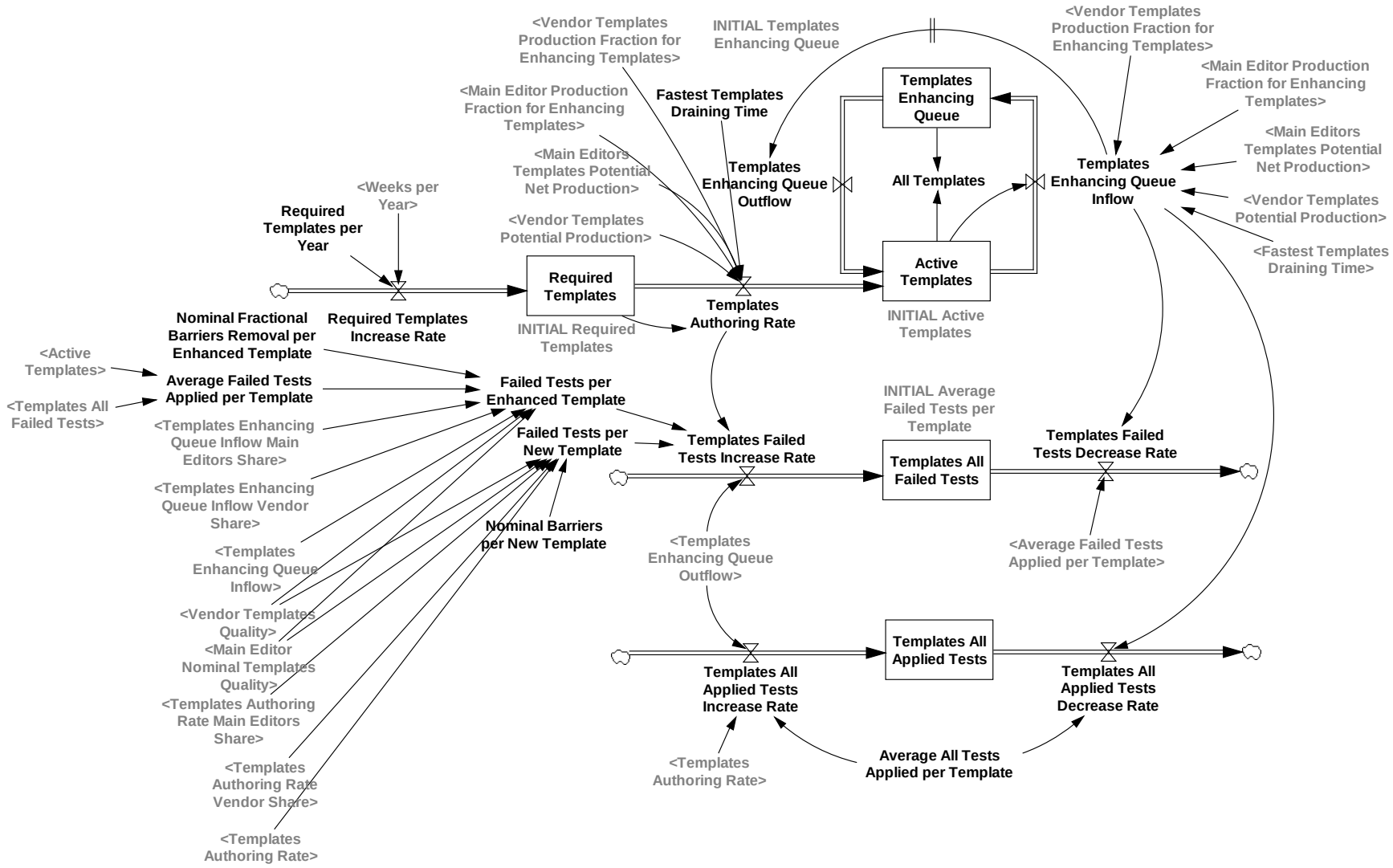
Group	Type	Variable Name and Description
		• Articles Enhancing Queue Inflow Main Editors Share • Articles Publishing Rate • Articles Publishing Rate Editors Share • Articles Publishing Rate Main Editors Share **Feedback loops:** 0
Work-force	#50 A 	**Editors Articles Potential Net Production** (Articles/Week) = Editor Nominal Articles Productivity * Editors* Editor Time Fraction Dedicated to Website * Editor Time Fraction Left to Work in the Website **Present in 2 views:** • Articles • Workforce **Used by:** • Articles Enhancing Queue Inflow • Articles Enhancing Queue Inflow Editors Share • Articles Enhancing Queue Inflow Main Editors Share • Articles Publishing Rate • Articles Publishing Rate Editors Share • Articles Publishing Rate Main Editors Share **Feedback loops:** 23 (40.4 %)
Articles	#79 A 	**Failed Tests per Enhanced Article** (Tests/Article) = Average Failed Tests Applied per Article * (1 - (Nominal Fractional Barriers Removal per Enhanced Article * (ZIDZ (Articles Enhancing Queue Inflow Editors Share* Editor Nominal Articles Quality , Articles Enhancing Queue Inflow) + ZIDZ (Articles Enhancing Queue Inflow Main Editors Share* Main Editor Nominal Articles Quality , Articles Enhancing Queue Inflow)))) **Description:** *This is the percentage of errors found during inspection. 71% (Madachy, 2008)* **Present in 1 view:** • Articles **Used by:** • Articles Failed Tests Increase Rate **Feedback loops:** 1 (1.8 %)
Articles	#81 A 	**Failed Tests per New Article** (Tests/Article) = Nominal Barriers per New Article * (1 - (ZIDZ (Articles Publishing Rate Editors Share* Editor Nominal Articles Quality , Articles Publishing Rate) + ZIDZ (Articles Publishing Rate Main Editors Share* Main Editor Nominal Articles Quality , Articles Publishing Rate))) **Description:** *barriers per article on average - eGovMon DB Computations Matlab (Normalised by avgs)* **Present in 1 view:** • Articles **Used by:** • Articles Failed Tests Increase Rate **Feedback loops:** 0
Articles	#83 C 	**Fastest Articles Draining Time** (Week) = 1 **Present in 1 view:** • Articles **Used by:** • Articles Enhancing Queue Inflow

Group	Type	Variable Name and Description
		• Articles Publishing Rate **Feedback loops:** 0
Articles	#88 LI,C	**INITIAL Articles Enhancing Queue** (Articles) = 0 **Present in 1 view:** • Articles **Used by:** • Articles Enhancing Queue **Feedback loops:** 0
Articles	#89 LI,C	**INITIAL Average Failed Tests per Article** (Tests/Article) = 2.144 **Present in 1 view:** • Articles **Used by:** • Articles All Failed Tests **Feedback loops:** 0
Articles	#94 LI,C	**INITIAL Published Articles** (Articles) = 667 **Present in 1 view:** • Articles **Used by:** • Published Articles **Feedback loops:** 0
Articles	#95 LI,C	**INITIAL Required Articles** (Articles) = 13.6 **Present in 1 view:** • Articles **Used by:** • Required Articles **Feedback loops:** 0
Quality	#109 A	**Main Editor Nominal Articles Quality** (Dimensionless) = MIN (1, Main Editor Normal Articles Quality *Effect of Main Editor Average Effective Experience on Main Editor Article Quality) **Present in 2 views:** • Articles • Productivity and Work Quality **Used by:** • Failed Tests per Enhanced Article • Failed Tests per New Article **Feedback loops:** 0
Control	#118 G	**Main Editor Production Fraction for Enhancing Articles** (Dimensionless [0,1,0.05]) = GAME(0) **Description:** *In general, no one is enhancing articles. However, we assumed that they invest half of the time devoted to article production in updating old articles.* **Present in 1 view:** • Articles **Used by:** • Articles Enhancing Queue Inflow • Articles Enhancing Queue Inflow Editors Share

Group	Type	Variable Name and Description
		• Articles Enhancing Queue Inflow Main Editors Share • Articles Publishing Rate • Articles Publishing Rate Editors Share • Articles Publishing Rate Main Editors Share **Feedback loops:** 0
Work-force	#126 A 	**Main Editors Articles Potential Net Production** (Articles/Week) = Main Editor Nominal Articles Productivity* Main Editors * (1 - Main Editor Time Fraction Dedicated to Templates Production) * Main Editor Time Fraction Dedicated to Website * Main Editor Time Fraction Left to Work in the Website **Description:** *It is well known that people may use some time during the day to catch up on personal errands or do other non-productive activities. Several studies have indicated that usually only about 60% of a person's time is actually spent producing. This is related to Parkinson's Law, which holds that work expands to fill up the available time.* **Present in 2 views:** • Articles • Workforce **Used by:** • Articles Enhancing Queue Inflow • Articles Enhancing Queue Inflow Editors Share • Articles Enhancing Queue Inflow Main Editors Share • Articles Publishing Rate • Articles Publishing Rate Editors Share • Articles Publishing Rate Main Editors Share **Feedback loops:** 23 (40.4 %)
Articles	#171 C 	**Nominal Barriers per New Article** (Tests/Article) = 1.54336 **Description:** *Computed from eGovMon db.* **Present in 1 view:** • Articles **Used by:** • Failed Tests per New Article **Feedback loops:** 0
Articles	#173 C 	**Nominal Fractional Barriers Removal per Enhanced Article** (Dimensionless) = 0.5 **Description:** *instead of using 71 % as the templates we used the lowest percentage suggested as a result of enhancing to accommodate for the updating process.* **Present in 1 view:** • Articles **Used by:** • Failed Tests per Enhanced Article **Feedback loops:** 0
Articles	#176 L,LI 	**Published Articles** (Articles) = $\int$ (Articles Enhancing Queue Outflow + Articles Publishing Rate- Articles Enhancing Queue Inflow) $\cdot dt$ + [INITIAL Published Articles] **Present in 1 view:** • Articles **Used by:** • All Articles • Articles All Applied Tests

Group	Type	Variable Name and Description
		• Articles All Failed Tests • Articles Enhancing Queue Inflow • Average Failed Tests Applied per Article **Feedback loops:** 8 (14.0 %)
Articles	#177 L	**Required Articles** (Articles) = $\int$ (Required Articles Increase Rate - Articles Publishing Rate) $\cdot dt$ + [INITIAL Required Articles] **Present in 1 view:** • Articles **Used by:** • Articles Publishing Rate **Feedback loops:** 1 (1.8 %)
Articles	#178 F,A	**Required Articles Increase Rate** (Articles/Week) = Required Articles per Week **Present in 1 view:** • Articles **Used by:** • Required Articles **Feedback loops:** 0
Articles	#179 C	**Required Articles per Week** (Articles/Week) = 13.6 **Description:** *Computed from the website download.* **Present in 1 view:** • Articles **Used by:** • Required Articles Increase Rate **Feedback loops:** 0

B.3 Templates Subsystem (49 variables)



Group	Type	Variable Name and Description
Templates	#1 L,LI	**Active Templates** (Templates) = $\int$ (Templates Authoring Rate + Templates Enhancing Queue Outflow- Templates Enhancing Queue Inflow) $\cdot dt$ + [INITIAL Active Templates] **Present in 1 view:** • Templates **Used by:** • All Templates • Average Failed Tests Applied per Template • Templates All Applied Tests • Templates All Failed Tests • Templates Enhancing Queue Inflow **Feedback loops:** 3 (5.3 %)
Templates	#3 A	**All Templates** (Articles) = Active Templates + Templates Enhancing Queue **Present in 1 view:** • Templates **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Templates	#20 LI,C	**Average All Tests Applied per Template** (Tests/Templates) = 107.48 **Description:** *Average number of tests applied per template (computed from eGovMon database).* **Present in 2 views:** • Templates • Website Accessibility Score **Used by:** • Article Average UWEM Score • Templates All Applied Tests • Templates All Applied Tests Decrease Rate • Templates All Applied Tests Increase Rate • Templates Average UWEM Score • Website UWEM Score **Feedback loops:** 0
Templates	#23 A	**Average Failed Tests Applied per Template** (Tests/Template) = ZIDZ (Templates All Failed Tests , Active Templates) **Present in 2 views:** • Templates • Website Accessibility Score **Used by:** • Failed Tests per Enhanced Template • Templates Average UWEM Score • Templates Failed Tests Decrease Rate • Website UWEM Score **Feedback loops:** 2 (3.5 %)
Templates	#80 A	**Failed Tests per Enhanced Template** (Tests/Template) = Average Failed Tests Applied per Template * (1 - (Nominal Fractional Barriers Removal per Enhanced Template * (ZIDZ (Templates Enhancing Queue Inflow Vendor Share* Vendor Templates Quality , Templates Enhancing Queue Inflow) + ZIDZ (Tem-

Group	Type	Variable Name and Description
		plates Enhancing Queue Inflow Main Editors Share* Main Editor Nominal Templates Quality , Templates Enhancing Queue Inflow)))) **Description:** *This is the percentage of errors found during inspection. 71% (Madachy, 2008)* **Present in 1 view:** • Templates **Used by:** • Templates Failed Tests Increase Rate **Feedback loops:** 1 (1.8 %)
Templates	#82 A 	**Failed Tests per New Template** (Tests/Template) = Nominal Barriers per New Template * (1 - (ZIDZ (Templates Authoring Rate Vendor Share* Vendor Templates Quality , Templates Authoring Rate) + ZIDZ (Templates Authoring Rate Main Editors Share* Main Editor Nominal Templates Quality , Templates Authoring Rate))) **Description:** *eGovMon db Computations (Normalised by avgs)* **Present in 1 view:** • Templates **Used by:** • Templates Failed Tests Increase Rate **Feedback loops:** 0
Templates	#84 C 	**Fastest Templates Draining Time** (Week) = 1 **Present in 1 view:** • Templates **Used by:** • Templates Authoring Rate • Templates Enhancing Queue Inflow **Feedback loops:** 0
Templates	#87 LI,C 	**INITIAL Active Templates** (Templates) = 18 **Present in 1 view:** • Templates **Used by:** • Active Templates **Feedback loops:** 0
Templates	#90 LI,C 	**INITIAL Average Failed Tests per Template** (Tests/Template) = 15.5 **Present in 1 view:** • Templates **Used by:** • Templates All Failed Tests **Feedback loops:** 0
Templates	#96 LI,C 	**INITIAL Required Templates** (Templates) = 0.325 **Present in 1 view:** • Templates **Used by:** • Required Templates **Feedback loops:** 0

Group	Type	Variable Name and Description
Templates	#97 LI,C	**INITIAL Templates Enhancing Queue** (Templates) = 0 **Present in 1 view:** • Templates **Used by:** • Templates Enhancing Queue **Feedback loops:** 0
Quality	#111 A	**Main Editor Nominal Templates Quality** (Dimensionless) = MIN (1, Main Editor Normal Templates Quality* Effect of Main Editor Average Effective Experience on Main Editor Template Quality) **Present in 2 views:** • Templates • Productivity and Work Quality **Used by:** • Failed Tests per Enhanced Template • Failed Tests per New Template **Feedback loops:** 0
Control	#119 G	**Main Editor Production Fraction for Enhancing Templates** (Dimensionless [0,1,0.05]) = GAME(0) **Present in 1 view:** • Templates **Used by:** • Templates Authoring Rate • Templates Authoring Rate Main Editors Share • Templates Authoring Rate Vendor Share • Templates Enhancing Queue Inflow • Templates Enhancing Queue Inflow Main Editors Share • Templates Enhancing Queue Inflow Vendor Share **Feedback loops:** 0
Workforce	#148 A	**Main Editors Templates Potential Net Production** (Articles/Week) = Main Editor Nominal Templates Productivity* Main Editors * Main Editor Time Fraction Dedicated to Templates Production * Main Editor Time Fraction Dedicated to Website* Main Editor Time Fraction Left to Work in the Website **Description:** *It is well known that people may use some time during the day to catch up on personal errands or do other non-productive activities. Several studies have indicated that usually only about 60% of a person's time is actually spent producing. This is related to Parkinson's Law, which holds that work expands to fill up the available time.* **Present in 2 views:** • Templates • Workforce **Used by:** • Templates Authoring Rate • Templates Authoring Rate Main Editors Share • Templates Authoring Rate Vendor Share • Templates Enhancing Queue Inflow • Templates Enhancing Queue Inflow Main Editors Share • Templates Enhancing Queue Inflow Vendor Share **Feedback loops:** 5 (8.8 %)
Templates	#172 C	**Nominal Barriers per New Template** (Tests/Template) = 11.9779

Group	Type	Variable Name and Description
		Present in 1 view: • Templates **Used by:** • Failed Tests per New Template **Feedback loops:** 0
Templates	#174 C	**Nominal Fractional Barriers Removal per Enhanced Template** (Dimensionless) = 0.71 **Description:** *This is the percentage of errors found during inspection. 71% (Madachy, 2008) Defect detection efficiency, which is a dimensionless parameter that quantifies the fraction of total defects found. Process defect detection efficiencies (also called yields) should be readily available in organizations that have good software defect and review metrics across the life cycle. Typically, these may vary from about 50% to 90%.* **Present in 1 view:** • Templates **Used by:** • Failed Tests per Enhanced Template **Feedback loops:** 0
Templates	#181 L	**Required Templates** (Templates) = $\int$ (Required Templates Increase Rate - Templates Authoring Rate) $\cdot dt$ + [INITIAL Required Templates] **Present in 1 view:** • Templates **Used by:** • Templates Authoring Rate **Feedback loops:** 1 (1.8 %)
Templates	#182 F,A	**Required Templates Increase Rate** (Templates/Week) = Required Templates per Year / Weeks per Year **Present in 1 view:** • Templates **Used by:** • Required Templates **Feedback loops:** 0
Templates	#183 C	**Required Templates per Year** (Templates/Year) = 0.9 **Present in 1 view:** • Templates **Used by:** • Required Templates Increase Rate **Feedback loops:** 0
Templates	#196 L	**Templates All Applied Tests** (Tests) = $\int$ (- Templates All Applied Tests Decrease Rate + Templates All Applied Tests Increase Rate) $\cdot dt$ + [Active Templates * Average All Tests Applied per Template] **Present in 1 view:** • Templates **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Templates	#197	**Templates All Applied Tests Decrease Rate** (Tests/Week)

Group	Type	Variable Name and Description
plates	F,A	= Templates Enhancing Queue Inflow * Average All Tests Applied per Template **Present in 1 view:** • Templates **Used by:** • Templates All Applied Tests **Feedback loops:** 0
Templates	#198 F,A	**Templates All Applied Tests Increase Rate** (Tests/Week) = Average All Tests Applied per Template * (Templates Authoring Rate + Templates Enhancing Queue Outflow) **Present in 1 view:** • Templates **Used by:** • Templates All Applied Tests **Feedback loops:** 0
Templates	#199 L	**Templates All Failed Tests** (Tests) = $\int$ (Templates Failed Tests Increase Rate - Templates Failed Tests Decrease Rate) $\cdot dt$ + [Active Templates * INITIAL Average Failed Tests per Template] **Present in 1 view:** • Templates **Used by:** • Average Failed Tests Applied per Template **Feedback loops:** 2 (3.5 %)
Templates	#200 F,A	**Templates Authoring Rate** (Templates/Week) = MIN (Required Templates / Fastest Templates Draining Time, Main Editors Templates Potential Net Production * (1 - Main Editor Production Fraction for Enhancing Templates) + Vendor Templates Potential Production * (1 - Vendor Templates Production Fraction for Enhancing Templates)) **Present in 1 view:** • Templates **Used by:** • Active Templates • Failed Tests per New Template • Required Templates • Templates All Applied Tests Increase Rate • Templates Authoring Rate Main Editors Share • Templates Authoring Rate Vendor Share • Templates Failed Tests Increase Rate **Feedback loops:** 3 (5.3 %)
Templates	#201 A	**Templates Authoring Rate Main Editors Share** (Templates/Week) = ZIDZ (Templates Authoring Rate * (1 -Main Editor Production Fraction for Enhancing Templates) * Main Editors Templates Potential Net Production, (1 - Vendor Templates Production Fraction for Enhancing Templates) * Vendor Templates Potential Production+ (1 - Main Editor Production Fraction for Enhancing Templates) * Main Editors Templates Potential Net Production) **Present in 2 views:** • Templates • Main Editors Effective Experience **Used by:** • Failed Tests per New Template

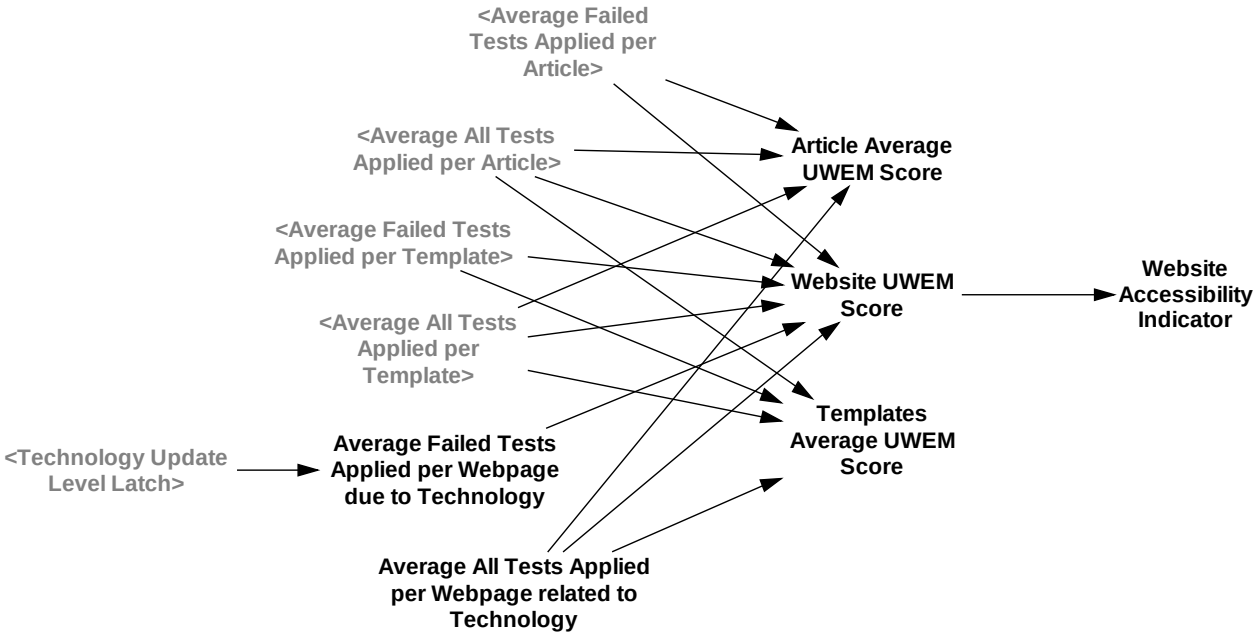
Group	Type	Variable Name and Description
		• Main Editors Effective Experience in Templates Increase Rate due to on Job Experience **Feedback loops:** 2 (3.5 %)
Templates	#202 A 	**Templates Authoring Rate Vendor Share** (Templates/Week) = ZIDZ (Templates Authoring Rate * (1 - Vendor Templates Production Fraction for Enhancing Templates) * Vendor Templates Potential Production , (1 - Vendor Templates Production Fraction for Enhancing Templates) * Vendor Templates Potential Production + (1 - Main Editor Production Fraction for Enhancing Templates) * Main Editors Templates Potential Net Production) **Present in 1 view:** • Templates **Used by:** • Failed Tests per New Template **Feedback loops:** 0
Templates	#204 L 	**Templates Enhancing Queue** (Templates) = $\int$ (Templates Enhancing Queue Inflow - Templates Enhancing Queue Outflow) $\cdot dt$ + [INITIAL Templates Enhancing Queue] **Present in 1 view:** • Templates **Used by:** • All Templates **Feedback loops:** 0
Templates	#205 F,A 	**Templates Enhancing Queue Inflow** (Templates/Week) = MIN (Active Templates / Fastest Templates Draining Time, Main Editors Templates Potential Net Production * Main Editor Production Fraction for Enhancing Templates+ Vendor Templates Potential Production * Vendor Templates Production Fraction for Enhancing Templates) **Present in 1 view:** • Templates **Used by:** • Active Templates • Failed Tests per Enhanced Template • Templates All Applied Tests Decrease Rate • Templates Enhancing Queue • Templates Enhancing Queue Inflow Main Editors Share • Templates Enhancing Queue Inflow Vendor Share • Templates Enhancing Queue Outflow • Templates Failed Tests Decrease Rate **Feedback loops:** 4 (7.0 %)
Templates	#206 A 	**Templates Enhancing Queue Inflow Main Editors Share** (Templates/Week) = ZIDZ (Templates Enhancing Queue Inflow* Main Editors Templates Potential Net Production * Main Editor Production Fraction for Enhancing Templates, Vendor Templates Potential Production * Vendor Templates Production Fraction for Enhancing Templates+ Main Editors Templates Potential Net Production * Main Editor Production Fraction for Enhancing Templates) **Present in 2 views:** • Templates • Main Editors Effective Experience **Used by:**

Group	Type	Variable Name and Description
		• Failed Tests per Enhanced Template • Main Editors Effective Experience in Templates Increase Rate due to on Job Experience **Feedback loops:** 3 (5.3 %)
Templates	#207 A	**Templates Enhancing Queue Inflow Vendor Share** (Templates/Week) = ZIDZ (Templates Enhancing Queue Inflow* Vendor Templates Potential Production * Vendor Templates Production Fraction for Enhancing Templates, Vendor Templates Potential Production * Vendor Templates Production Fraction for Enhancing Templates+ Main Editors Templates Potential Net Production * Main Editor Production Fraction for Enhancing Templates) **Present in 1 view:** • Templates **Used by:** • Failed Tests per Enhanced Template **Feedback loops:** 0
Templates	#208 DE,F	**Templates Enhancing Queue Outflow** (Templates/Week) = DELAY FIXED (Templates Enhancing Queue Inflow ,1, 0) **Present in 1 view:** • Templates **Used by:** • Active Templates • Templates All Applied Tests Increase Rate • Templates Enhancing Queue • Templates Failed Tests Increase Rate **Feedback loops:** 1 (1.8 %)
Templates	#209 F,A	**Templates Failed Tests Decrease Rate** (Tests/Week) = Templates Enhancing Queue Inflow * Average Failed Tests Applied per Template **Present in 1 view:** • Templates **Used by:** • Templates All Failed Tests **Feedback loops:** 1 (1.8 %)
Templates	#210 F,A	**Templates Failed Tests Increase Rate** (Tests/Week) = Templates Authoring Rate * Failed Tests per New Template+ Templates Enhancing Queue Outflow * Failed Tests per Enhanced Template **Present in 1 view:** • Templates **Used by:** • Templates All Failed Tests **Feedback loops:** 1 (1.8 %)
Consultancies	#221 A	**Vendor Templates Potential Production** (Templates/Week) = Vendor Templates Production per Consultancy Week* Consultancy Time Fraction Dedicated to Templates * Consultancy Schedule **Present in 2 views:** • Templates • Consultancies **Used by:** • Templates Authoring Rate • Templates Authoring Rate Main Editors Share

Group	Type	Variable Name and Description
		• Templates Authoring Rate Vendor Share • Templates Enhancing Queue Inflow • Templates Enhancing Queue Inflow Main Editors Share • Templates Enhancing Queue Inflow Vendor Share **Feedback loops:** 0
Control	#222 G 	**Vendor Templates Production Fraction for Enhancing Templates** (Dimensionless [0,1,0.05]) = GAME(0.45) **Description:** *This was used to tune the templates UWEM* **Present in 1 view:** • Templates **Used by:** • Templates Authoring Rate • Templates Authoring Rate Main Editors Share • Templates Authoring Rate Vendor Share • Templates Enhancing Queue Inflow • Templates Enhancing Queue Inflow Main Editors Share • Templates Enhancing Queue Inflow Vendor Share **Feedback loops:** 0
Tem- plates	#224 C 	**Vendor Templates Quality** (Dimensionless [0,6]) = 0.8 **Present in 1 view:** • Templates **Used by:** • Failed Tests per Enhanced Template • Failed Tests per New Template **Feedback loops:** 0
Control	#227 C 	**Weeks per Year** (Weeks/Year) = 52 **Present in 7 views:** • Templates • Workforce • Editors Effective Experience • Main Editors Effective Experience • Training • Consultancies • Costs **Used by:** • Consultancy Schedule • Editors Effective Experience Decay Rate • Editors Leave and Transfer Rate • Editors Training Schedule • Main Editors Effective Experience Decay Rate • Main Editors Effective Experience in Templates Decay Rate • Main Editors Leave Rate • Main Editors Training on Templates Schedule • Main Editors Training Schedule • Required Templates Increase Rate • Sum All Editors Weekly Wages Cost • Sum All Main Editors Weekly Wages Cost

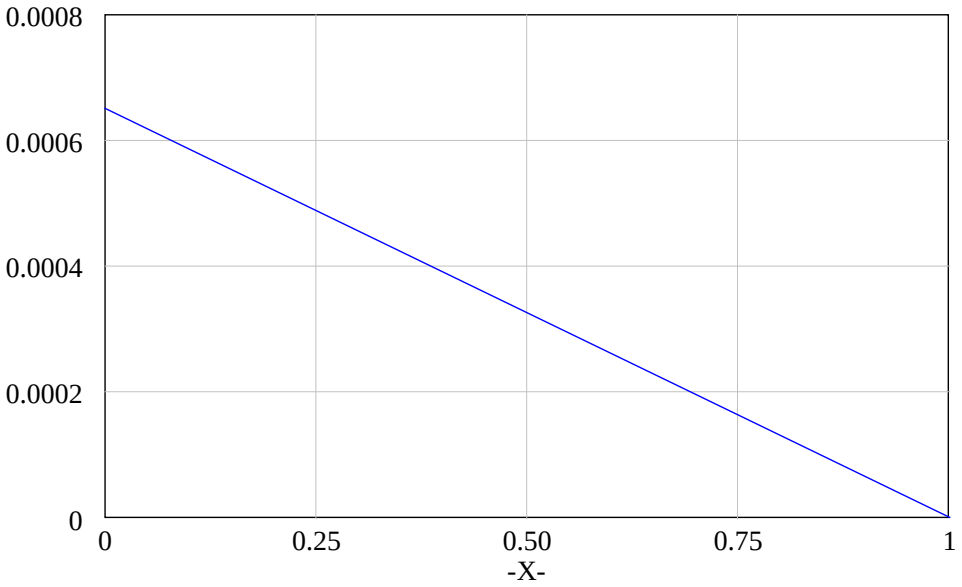
Group	Type	Variable Name and Description
		Feedback loops: 0

B.4 Website Accessibility Score Subsystem (11 variables)



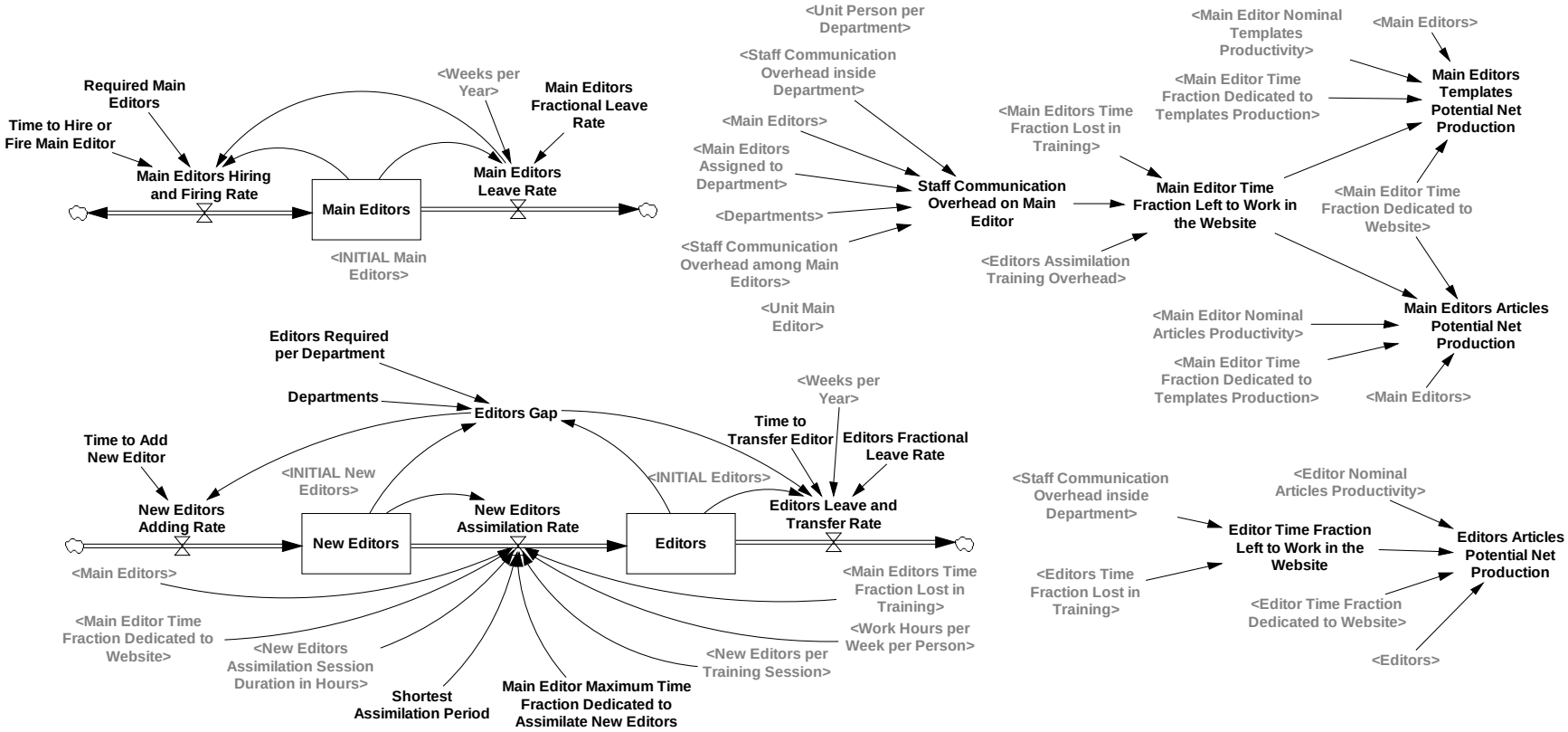
Group	Type	Variable Name and Description
Website Accessibility Score	#4 A	**Article Average UWEM Score** (Dimensionless) = ZIDZ (Average Failed Tests Applied per Article , Average All Tests Applied per Article+ Average All Tests Applied per Template + Average All Tests Applied per Webpage related to Technology) **Description:** *Using averages instead of all values in the model is OK. Because in the model it is all about averages, consequently to have the all values we will just multiply both numerator and denominator by Articles in this case.* **Present in 1 view:** • Website Accessibility Score **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Articles	#19 LI,C	**Average All Tests Applied per Article** (Tests/Article) = 23.3363 **Description:** *Average number of tests applied per article (computed from eGovMon database).* **Present in 2 views:** • Articles • Website Accessibility Score **Used by:** • Article Average UWEM Score • Articles All Applied Tests • Articles All Applied Tests Decrease Rate • Articles All Applied Tests Increase Rate • Templates Average UWEM Score • Website UWEM Score

Group	Type	Variable Name and Description
		Feedback loops: 0
Tem-plates	#20 LI,C 	**Average All Tests Applied per Template** (Tests/Templates) = 107.48 **Description:** *Average number of tests applied per template (computed from eGovMon database).* **Present in 2 views:** • Templates • Website Accessibility Score **Used by:** • Article Average UWEM Score • Templates All Applied Tests • Templates All Applied Tests Decrease Rate • Templates All Applied Tests Increase Rate • Templates Average UWEM Score • Website UWEM Score **Feedback loops:** 0
Website Accessi-bility Score	#21 C 	**Average All Tests Applied per Webpage related to Technology** (Tests/Webpage) = 0.906839 **Description:** *Average number of tests related to CMS applied per webpage (computed from eGovMon database).* **Present in 1 view:** • Website Accessibility Score **Used by:** • Article Average UWEM Score • Templates Average UWEM Score • Website UWEM Score **Feedback loops:** 0
Articles	#22 A 	**Average Failed Tests Applied per Article** (Tests/Article) = ZIDZ (Articles All Failed Tests , Published Articles) **Present in 2 views:** • Articles • Website Accessibility Score **Used by:** • Article Average UWEM Score • Articles Failed Tests Decrease Rate • Failed Tests per Enhanced Article • Website UWEM Score **Feedback loops:** 2 (3.5 %)
Tem-plates	#23 A 	**Average Failed Tests Applied per Template** (Tests/Template) = ZIDZ (Templates All Failed Tests , Active Templates) **Present in 2 views:** • Templates • Website Accessibility Score **Used by:** • Failed Tests per Enhanced Template • Templates Average UWEM Score • Templates Failed Tests Decrease Rate • Website UWEM Score **Feedback loops:** 2 (3.5 %)
Website	#24	**Average Failed Tests Applied per Webpage due to Technology** (Tests/Webpage)

Group	Type	Variable Name and Description
Accessi-bility Score	T,A	= WITH LOOKUP(Technology Update Level Latch, ([(0,0)-(1,0.0008)],(0,0.000651465),(1,0))) **Present in 1 view:** • Website Accessibility Score **Used by:** • Website UWEM Score **Feedback loops:** 0 #Average Failed Tests Applied per Webpage due to Technology# 
Technol-ogy	#193 A	**Technology Update Level Latch** (Dimensionless) = SAMPLE IF TRUE(Technology Update Level = 1, 1, 0) **Present in 3 views:** • Website Accessibility Score • Technology • Costs **Used by:** • Average Failed Tests Applied per Webpage due to Technology • Delayed Technology Update Level • Editors Effective Experience Fractional Decay Rate due to Technology Change • Main Editors Effective Experience Fractional Decay Rate due to Technology Change • Technology Cost **Feedback loops:** 0
Website Accessi-bility Score	#203 A	**Templates Average UWEM Score** (Dimensionless) = ZIDZ (Average Failed Tests Applied per Template , Average All Tests Applied per Arti-cle+ Average All Tests Applied per Template +Average All Tests Applied per Webpage related to Technology) **Present in 1 view:** • Website Accessibility Score **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Website Accessi-	#225 A	**Website Accessibility Indicator** (Dimensionless) = 1 - Website UWEM Score

Group	Type	Variable Name and Description
bility Score	VAB	**Present in 1 view:** • Website Accessibility Score **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Website Accessi-bility Score	#226 A VAB	**Website UWEM Score** (Dimensionless) = ZIDZ (Average Failed Tests Applied per Article + Average Failed Tests Applied per Template+ Average Failed Tests Applied per Webpage due to Technology , Average All Tests Applied per Article+ Average All Tests Applied per Template + Average All Tests Applied per Webpage related to Technology) **Present in 1 view:** • Website Accessibility Score **Used by:** • Website Accessibility Indicator **Feedback loops:** 0

B.5 Workforce Subsystem (57 variables)



Group	Type	Variable Name and Description
Work-force	#34 C	**Departments** (Departments) = 5 **Present in 1 view:** • Workforce **Used by:** • Editors Gap • INITIAL Editors • INITIAL New Editors • Staff Communication Overhead inside Department • Staff Communication Overhead on Main Editor **Feedback loops:** 0
Produc-tivity	#40 A	**Editor Nominal Articles Productivity** (Articles/(Person* Week)) = Editor Normal Articles Productivity * Effect of Editor Average Effective Experience on Editor Article Productivity **Present in 2 views:** • Workforce • Productivity and Work Quality **Used by:** • Editors Articles Potential Net Production **Feedback loops:** 23 (40.4 %)
Control	#46 G	**Editor Time Fraction Dedicated to Website** (Dimensionless [0,1,0.05]) = GAME(0.08) **Description:** *The time fraction dedicated by the editor to the website. The number is based on Trondheim municipality interview (part-time 20%)* **Present in 2 views:** • Workforce • Costs **Used by:** • Editors Articles Potential Net Production • Staff Communication Overhead inside Department • Sum All Editors Weekly Wages Cost **Feedback loops:** 0
Work-force	#47 A	**Editor Time Fraction Left to Work in the Website** (Dimensionless) = MAX (0, 1 - Editors Time Fraction Lost in Training- Staff Communication Overhead inside Department) **Present in 1 view:** • Workforce **Used by:** • Editors Articles Potential Net Production **Feedback loops:** 0
Work-force	#49 L,LI	**Editors** (Persons) = $\int$ (New Editors Assimilation Rate - Editors Leave and Transfer Rate) $\cdot dt$ + [INITIAL Editors] **Present in 3 views:** • Workforce • Editors Effective Experience • Costs **Used by:** • Editor Average Effective Experience

Group	Type	Variable Name and Description
		• Editors Articles Potential Net Production • Editors Effective Experience Increase Rate due to Training • Editors Gap • Editors Leave and Transfer Rate • Editors Training Cost • Staff Communication Overhead inside Department • Sum All Editors Weekly Wages Cost • Total Editors Effective Experience **Feedback loops:** 3 (5.3 %)
Work-force	#50 A 	**Editors Articles Potential Net Production** (Articles/Week) = Editor Nominal Articles Productivity * Editors* Editor Time Fraction Dedicated to Website * Editor Time Fraction Left to Work in the Website **Present in 2 views:** • Articles • Workforce **Used by:** • Articles Enhancing Queue Inflow • Articles Enhancing Queue Inflow Editors Share • Articles Enhancing Queue Inflow Main Editors Share • Articles Publishing Rate • Articles Publishing Rate Editors Share • Articles Publishing Rate Main Editors Share **Feedback loops:** 23 (40.4 %)
Work-force	#51 A 	**Editors Assimilation Training Overhead** (Dimensionless) = ZIDZ (New Editors Assimilation Session Duration in Hours* New Editors Assimilation Rate / New Editors per Training Session , Main Editors * Main Editor Time Fraction Dedicated to Website * Work Hours per Week per Person) **Description:** *5 Hours training is what an editor get in groups of 20 editors. Brooks' law -- assumption of 0.25 main editors work Weeks per new editor. 0.2 * ZIDZ (Editors to Be , 20 * Main Editors)* **Present in 1 view:** • Workforce **Used by:** • Main Editor Time Fraction Left to Work in the Website **Feedback loops:** 0
Work-force	#61 C 	**Editors Fractional Leave Rate** (Dimensionless/Year) = 0.5 **Description:** *Civil servants 5%-10% per year (Madachy 2008). Certain municipalities claim higher editors leave rate up to 50%* **Present in 1 view:** • Workforce **Used by:** • Editors Leave and Transfer Rate **Feedback loops:** 0
Work-force	#62 A 	**Editors Gap** (Persons) = (1.01925 * Departments * Editors Required per Department) - Editors -New Editors **Present in 1 view:** • Workforce **Used by:** • Editors Leave and Transfer Rate

Group	Type	Variable Name and Description
		• New Editors Adding Rate **Feedback loops:** 3 (5.3 %)
Work-force	#63 F,A	**Editors Leave and Transfer Rate** (Persons/Week) = Editors * Editors Fractional Leave Rate / Weeks per Year+ IF THEN ELSE (Editors Gap < 0, - Editors Gap / Time to Transfer Editor , 0) **Present in 2 views:** • Workforce • Editors Effective Experience **Used by:** • Editors • Editors Effective Experience Decrease Rate due to Attrition **Feedback loops:** 2 (3.5 %)
Work-force	#64 G	**Editors Required per Department** (Persons/Department [1,5,1]) = GAME(1) **Description:** *Certain municipalities has a policy like not less than 2 editors per department.* **Present in 1 view:** • Workforce **Used by:** • Editors Gap • INITIAL Editors • INITIAL New Editors **Feedback loops:** 0
Work-force	#65 A	**Editors Time Fraction Lost in Training** (Dimensionless) = Editors Training Schedule * Editors Fraction to Be Trained **Present in 1 view:** • Workforce **Used by:** • Editor Time Fraction Left to Work in the Website **Feedback loops:** 0
Work-force	#91 LI,A	**INITIAL Editors** (Persons) = Editors Required per Department * Departments **Present in 1 view:** • Workforce **Used by:** • Editors **Feedback loops:** 0
Work-force	#92 LI,A	**INITIAL Main Editors** (Persons) = Required Main Editors **Description:** *Required Main Editors* **Present in 1 view:** • Workforce **Used by:** • Main Editors **Feedback loops:** 0
Work-force	#93 LI,A	**INITIAL New Editors** (Persons) = 0.01 * Editors Required per Department * Departments **Present in 1 view:** • Workforce **Used by:**

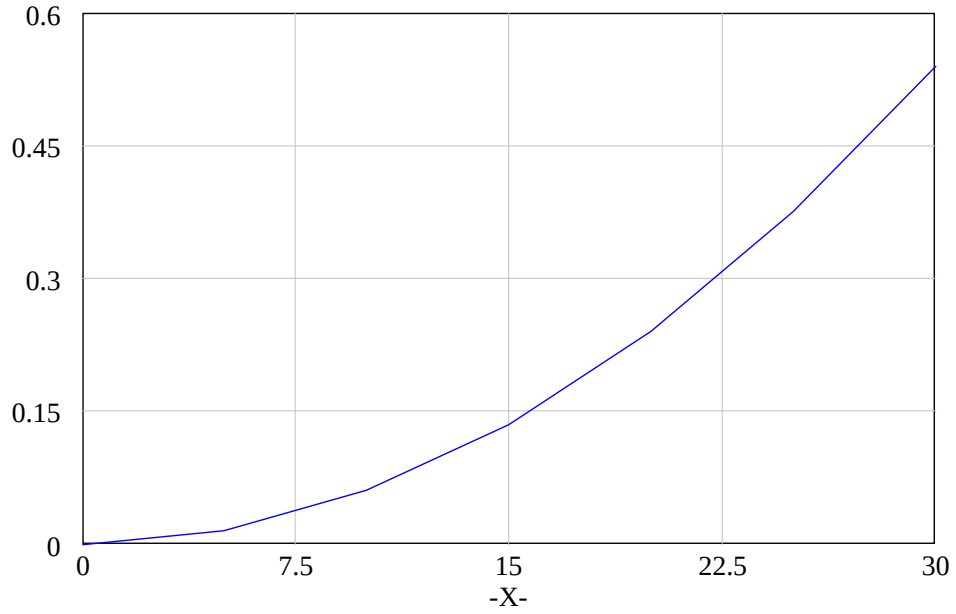
Group	Type	Variable Name and Description
		• New Editors **Feedback loops:** 0
Work-force	#107 G	**Main Editor Maximum Time Fraction Dedicated to Assimilate New Editors** (Dimensionless) = GAME(0.2) **Description:** *This represents the percentage of a Pro's time that is spent training Rookies. We set it to 20% here which is based on generally found rules-of-thumb.* **Present in 1 view:** • Workforce **Used by:** • New Editors Assimilation Rate **Feedback loops:** 0
Produc-tivity	#108 A	**Main Editor Nominal Articles Productivity** (Articles/(Person* Week)) = Main Editor Normal Articles Productivity * Effect of Main Editor Average Effective Experience on Main Editor Article Productivity **Present in 2 views:** • Workforce • Productivity and Work Quality **Used by:** • Main Editors Articles Potential Net Production **Feedback loops:** 23 (40.4 %)
Produc-tivity	#110 A	**Main Editor Nominal Templates Productivity** (Articles/(Person* Week)) = Main Editor Normal Templates Productivity* Effect of Main Editor Average Effective Experience on Main Editor Template Productivity **Present in 2 views:** • Workforce • Productivity and Work Quality **Used by:** • Main Editors Templates Potential Net Production **Feedback loops:** 5 (8.8 %)
Control	#120 G	**Main Editor Time Fraction Dedicated to Templates Production** (Dimensionless [0,1,0.05]) = GAME(0) **Description:** *This value is the average fraction of time each day that each Main Editor staff member spends on templates production. Although main editors in general are full-time working on the website, not all of their time is devoted to articles and templates production. They work on the top level responsible for ordering and managing new templates, new designs, new technologies, new modules ...* **Present in 1 view:** • Workforce **Used by:** • Main Editors Articles Potential Net Production • Main Editors Templates Potential Net Production **Feedback loops:** 0
Control	#121 G	**Main Editor Time Fraction Dedicated to Website** (Dimensionless [0,1,0.05]) = GAME(1) **Description:** *The time fraction dedicated by the main editor to the website. The number is based on municipalities interview (full-time)* **Present in 2 views:** • Workforce

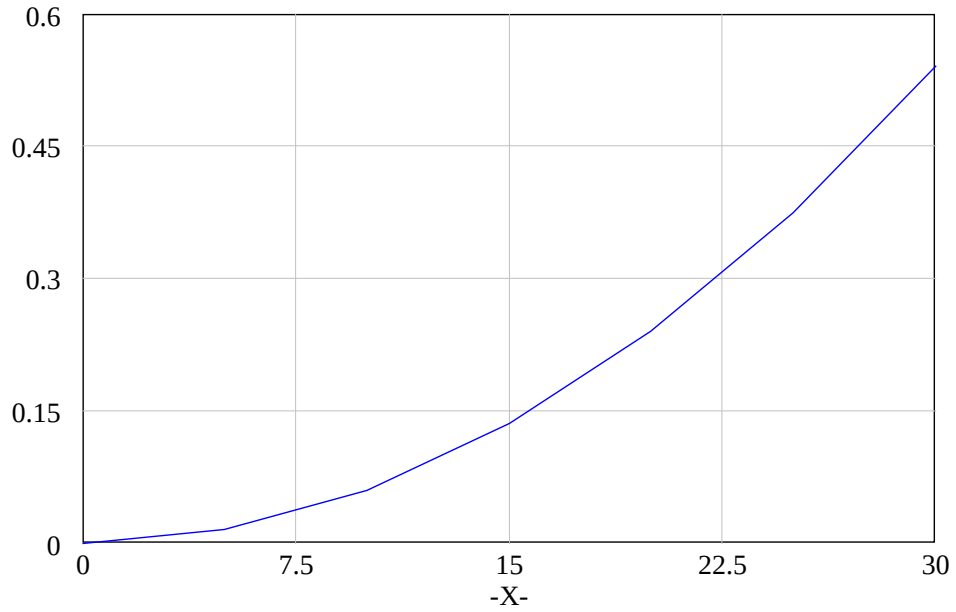
Group	Type	Variable Name and Description
		• Costs **Used by:** • Editors Assimilation Training Overhead • Main Editors Articles Potential Net Production • Main Editors Templates Potential Net Production • New Editors Assimilation Rate • Staff Communication Overhead among Main Editors • Staff Communication Overhead inside Department • Sum All Main Editors Weekly Wages Cost **Feedback loops:** 0
Work-force	#122 A 	**Main Editor Time Fraction Left to Work in the Website** (Dimensionless) = MAX (0, 1 - Main Editors Time Fraction Lost in Training- Editors Assimilation Training Overhead - Staff Communication Overhead on Main Editor) **Present in 1 view:** • Workforce **Used by:** • Main Editors Articles Potential Net Production • Main Editors Templates Potential Net Production **Feedback loops:** 0
Work-force	#125 L,LI 	**Main Editors** (Persons) = $\int$ (Main Editors Hiring and Firing Rate - Main Editors Leave Rate) $\cdot dt$ + [INITIAL Main Editors] **Present in 3 views:** • Workforce • Main Editors Effective Experience • Costs **Used by:** • Editors Assimilation Training Overhead • Main Editor Average Effective Experience • Main Editor Average Effective Experience in Templates • Main Editors Articles Potential Net Production • Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Effective Experience Increase Rate due to Training • Main Editors Hiring and Firing Rate • Main Editors Leave Rate • Main Editors Templates Potential Net Production • Main Editors Training Cost • New Editors Assimilation Rate • Staff Communication Overhead among Main Editors • Staff Communication Overhead on Main Editor • Sum All Main Editors Weekly Wages Cost • Total Main Editors Effective Experience • Total Main Editors Effective Experience in Templates **Feedback loops:** 3 (5.3 %)
Work-force	#126 A 	**Main Editors Articles Potential Net Production** (Articles/Week) = Main Editor Nominal Articles Productivity* Main Editors * (1 - Main Editor Time Fraction Dedicated to Templates Production) * Main Editor Time Fraction Dedicated to Website * Main Editor Time Fraction Left to Work in the Website **Description:** *It is well known that people may use some time during the day to catch up on*

Group	Type	Variable Name and Description
		personal errands or do other non-productive activities. Several studies have indicated that usually only about 60% of a person's time is actually spent producing. This is related to Parkinson's Law, which holds that work expands to fill up the available time. **Present in 2 views:** • Articles • Workforce **Used by:** • Articles Enhancing Queue Inflow • Articles Enhancing Queue Inflow Editors Share • Articles Enhancing Queue Inflow Main Editors Share • Articles Publishing Rate • Articles Publishing Rate Editors Share • Articles Publishing Rate Main Editors Share **Feedback loops:** 23 (40.4 %)
Control	#127 G	**Main Editors Assigned to Department** (Persons/Department [1,3,1]) = GAME(1) **Present in 1 view:** • Workforce **Used by:** • Staff Communication Overhead inside Department • Staff Communication Overhead on Main Editor **Feedback loops:** 0
Work-force	#145 C	**Main Editors Fractional Leave Rate** (Dimensionless/Year) = 0.002 **Description:** *Civil servants 5%-10% per year (Madachy 2008). In many municipalities there was no leaving at all. In (Sterman 2000) experienced employees quit rate is only 0.002.* **Present in 1 view:** • Workforce **Used by:** • Main Editors Leave Rate **Feedback loops:** 0
Work-force	#146 F,A	**Main Editors Hiring and Firing Rate** (Persons/Week) = Main Editors Leave Rate + (Required Main Editors- Main Editors) / Time to Hire or Fire Main Editor **Present in 2 views:** • Workforce • Main Editors Effective Experience **Used by:** • Main Editors • Main Editors Effective Experience Decrease Rate due to Attrition • Main Editors Effective Experience in Templates Decrease Rate due to Attrition • Main Editors Effective Experience in Templates Increase Rate due to Hiring • Main Editors Effective Experience Increase Rate due to Hiring **Feedback loops:** 2 (3.5 %)
Work-force	#147 F,A	**Main Editors Leave Rate** (Persons/Week) = Main Editors * Main Editors Fractional Leave Rate / Weeks per Year **Present in 2 views:** • Workforce • Main Editors Effective Experience

Group	Type	Variable Name and Description
		Used by: • Main Editors • Main Editors Effective Experience Decrease Rate due to Attrition • Main Editors Effective Experience in Templates Decrease Rate due to Attrition • Main Editors Hiring and Firing Rate **Feedback loops:** 2 (3.5 %)
Work-force	#148 A 	**Main Editors Templates Potential Net Production** (Articles/Week) = Main Editor Nominal Templates Productivity* Main Editors * Main Editor Time Fraction Dedicated to Templates Production * Main Editor Time Fraction Dedicated to Web-site* Main Editor Time Fraction Left to Work in the Website **Description:** *It is well known that people may use some time during the day to catch up on personal errands or do other non-productive activities. Several studies have indicated that usually only about 60% of a person's time is actually spent producing. This is related to Parkinson's Law, which holds that work expands to fill up the available time.* **Present in 2 views:** • Templates • Workforce **Used by:** • Templates Authoring Rate • Templates Authoring Rate Main Editors Share • Templates Authoring Rate Vendor Share • Templates Enhancing Queue Inflow • Templates Enhancing Queue Inflow Main Editors Share • Templates Enhancing Queue Inflow Vendor Share **Feedback loops:** 5 (8.8 %)
Work-force	#149 A 	**Main Editors Time Fraction Lost in Training** (Dimensionless) = Main Editors Training Schedule * Main Editors Fraction to Be Trained+ Main Editors Training on Templates Schedule * Main Editors Fraction to Be Trained on Templates **Present in 1 view:** • Workforce **Used by:** • Main Editor Time Fraction Left to Work in the Website • New Editors Assimilation Rate **Feedback loops:** 0
Work-force	#164 L 	**New Editors** (Persons) = $\int$ (New Editors Adding Rate - New Editors Assimilation Rate) $\cdot dt$ + [INITIAL New Editors] **Present in 1 view:** • Workforce **Used by:** • Editors Gap • New Editors Assimilation Rate **Feedback loops:** 3 (5.3 %)
Work-force	#165 F,A 	**New Editors Adding Rate** (Persons/Week) = IF THEN ELSE (Editors Gap > 0, Editors Gap / Time to Add New Editor, 0) **Present in 1 view:** • Workforce **Used by:** • New Editors

Group	Type	Variable Name and Description
		Feedback loops: 2 (3.5 %)
Work-force	#166 F,A 	**New Editors Assimilation Rate** (Persons/Week) = IF THEN ELSE (Main Editors * Main Editor Time Fraction Dedicated to Website* MAX (0, 1 - Main Editors Time Fraction Lost in Training) > 0, MIN (New Editors/ Shortest Assimilation Period , Main Editor Maximum Time Fraction Dedicated to Assimilate New Editors* Main Editors* Main Editor Time Fraction Dedicated to Website * (1 - Main Editors Time Fraction Lost in Training) * Work Hours per Week per Person *New Editors per Training Session / New Editors Assimilation Session Duration in Hours) , 0) **Present in 2 views:** • Workforce • Editors Effective Experience **Used by:** • Editors • Editors Assimilation Training Overhead • Editors Effective Experience Increase Rate due to Adding Editors • New Editors **Feedback loops:** 2 (3.5 %)
Work-force	#167 G 	**New Editors Assimilation Session Duration in Hours** (Hours [0,480,1]) = GAME(5) **Present in 1 view:** • Workforce **Used by:** • Editors Assimilation Training Overhead • New Editors Assimilation Rate **Feedback loops:** 0
Work-force	#168 G 	**New Editors per Training Session** (Persons [0,40,1]) = GAME(20) **Present in 1 view:** • Workforce **Used by:** • Editors Assimilation Training Overhead • New Editors Assimilation Rate **Feedback loops:** 0
Work-force	#180 G 	**Required Main Editors** (Persons) = GAME(1) **Present in 1 view:** • Workforce **Used by:** • INITIAL Main Editors • Main Editors Hiring and Firing Rate **Feedback loops:** 0
Work-force	#185 C 	**Shortest Assimilation Period** (Weeks) = 1 **Present in 1 view:** • Workforce **Used by:** • New Editors Assimilation Rate **Feedback loops:** 0
Work-	#186	**Staff Communication Overhead among Main Editors** (Dimensionless)

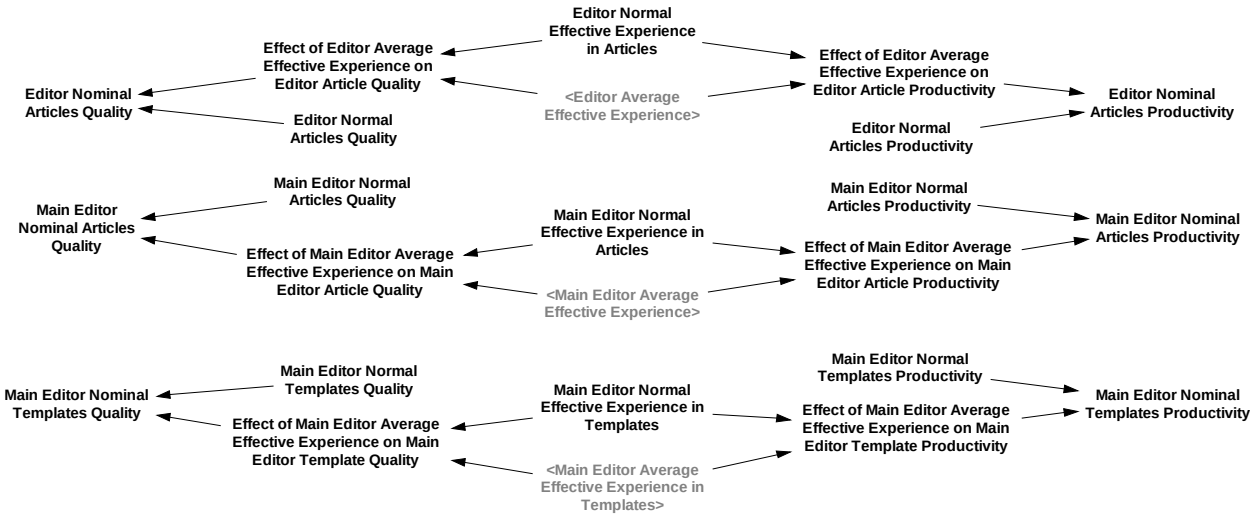
Group	Type	Variable Name and Description
force	T,A	= WITH LOOKUP(Main Editor Time Fraction Dedicated to Website* Main Editors / Unit Main Editor , ([(0,0)-(30,0.6)],(0,0),(5,0.015),(10,0.06),(15,0.135),(20,0.24),(25,0.375),(30,0.54))) **Description:** *Main editors have intra-communication to organise work of different departments and manage the website.. Communication overhead depends on the number of people. The number of communication "paths" increases proportionally to the square of the number of "people communicating" (Madachy 2008). --> This is like inter-team communication overhead.* **Present in 1 view:** • Workforce **Used by:** • Staff Communication Overhead on Main Editor **Feedback loops:** 0 #Staff Communication Overhead among Main Editors# 
Work-force	#187 T,A	**Staff Communication Overhead inside Department** (Dimensionless) = WITH LOOKUP((Main Editor Time Fraction Dedicated to Website* Main Editors Assigned to Department + Editor Time Fraction Dedicated to Website * Editors / Departments) / Unit Person per Department , ([(0,0)-(30,0.6)],(0,0),(5,0.015),(10,0.06),(15,0.135),(20,0.24),(25,0.375),(30,0.54))) **Description:** *Each department has a group of editors working 20% in the website. Each group communicates with one main editor. Communication overhead depends on the number of people. The number of communication "paths" increases proportionally to the square of the number of "people communicating" (Madachy 2008). --> Departments are like being involved in different projects for main editors. (This is like inter-team communication overhead)* **Present in 1 view:** • Workforce **Used by:** • Editor Time Fraction Left to Work in the Website • Staff Communication Overhead on Main Editor **Feedback loops:** 0

Group	Type	Variable Name and Description
		CurrentRun #Staff Communication Overhead inside Department# 
Work-force	#188 A	**Staff Communication Overhead on Main Editor** (Dimensionless) = MIN (0.54, Staff Communication Overhead among Main Editors+ Staff Communication Overhead inside Department * Main Editors Assigned to Department* Departments / Main Editors) **Description:** *The limit 0.54 is the same limit used in Abdel-Hamid's implementation of Brooks' law.* **Present in 1 view:** • Workforce **Used by:** • Main Editor Time Fraction Left to Work in the Website **Feedback loops:** 0
Work-force	#212 C	**Time to Add New Editor** (Weeks) = 1 **Description:** *Entry level programmer 1-3 months (Madachy, 2008) -- however, it is an internal process in the municipality* **Present in 1 view:** • Workforce **Used by:** • New Editors Adding Rate **Feedback loops:** 0
Work-force	#213 C	**Time to Hire or Fire Main Editor** (Weeks) = 11 **Description:** *Senior tech. person can take from 2-6 months be hired (Madachy 2008). Average of 4 months was assumed for hiring. 1 month notice before firing in general was taken. 2.5 is the average.* **Present in 1 view:** • Workforce **Used by:** • Main Editors Hiring and Firing Rate **Feedback loops:** 0
Work-	#214	**Time to Transfer Editor** (Weeks)

Group	Type	Variable Name and Description
force	C 	= 1 **Present in 1 view:** • Workforce **Used by:** • Editors Leave and Transfer Rate **Feedback loops:** 0
Control	#218 C 	**Unit Main Editor** (Persons) = 1 **Present in 1 view:** • Workforce **Used by:** • Staff Communication Overhead among Main Editors **Feedback loops:** 0
Control	#219 C 	**Unit Person per Department** (Person/Department) = 1 **Present in 1 view:** • Workforce **Used by:** • Staff Communication Overhead inside Department **Feedback loops:** 0
Control	#227 C 	**Weeks per Year** (Weeks/Year) = 52 **Present in 7 views:** • Templates • Workforce • Editors Effective Experience • Main Editors Effective Experience • Training • Consultancies • Costs **Used by:** • Consultancy Schedule • Editors Effective Experience Decay Rate • Editors Leave and Transfer Rate • Editors Training Schedule • Main Editors Effective Experience Decay Rate • Main Editors Effective Experience in Templates Decay Rate • Main Editors Leave Rate • Main Editors Training on Templates Schedule • Main Editors Training Schedule • Required Templates Increase Rate • Sum All Editors Weekly Wages Cost • Sum All Main Editors Weekly Wages Cost **Feedback loops:** 0
Control	#229 C 	**Work Hours per Week per Person** (Hours/(Week*Person)) = 37.5 **Present in 3 views:** • Workforce • Editors Effective Experience • Main Editors Effective Experience

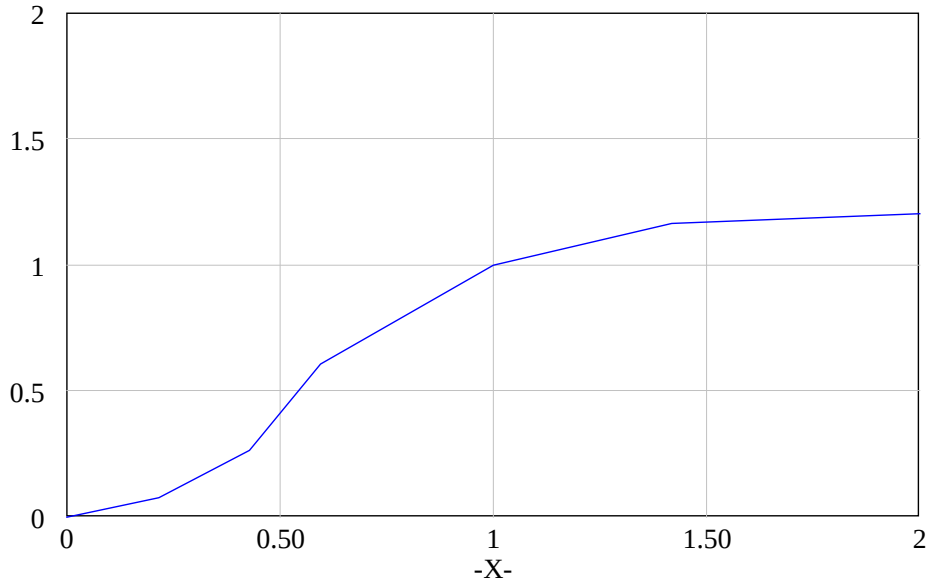
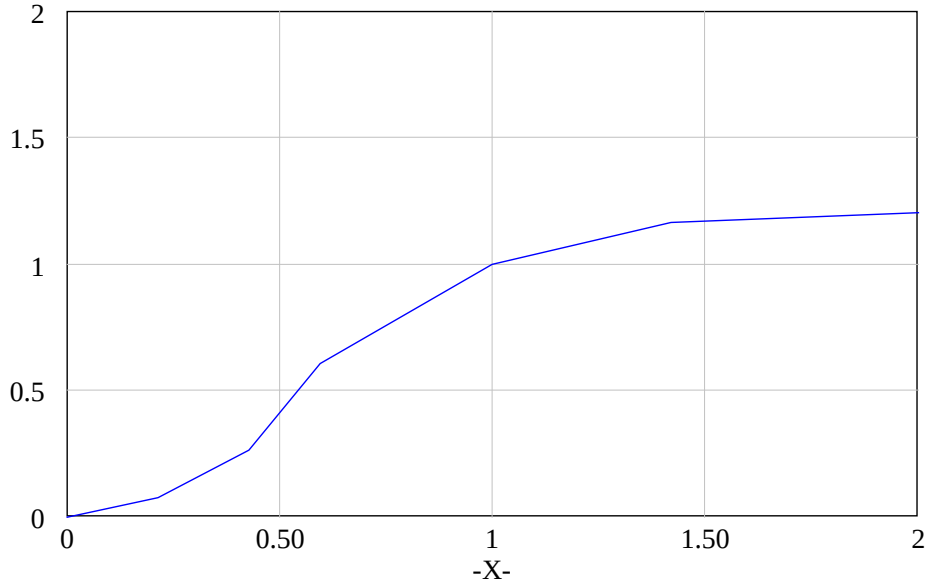
Group	Type	Variable Name and Description
		Used by: • Editors Assimilation Training Overhead • Editors Effective Experience Increase Rate due to Training • Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Effective Experience Increase Rate due to Training • New Editors Assimilation Rate **Feedback loops:** 0

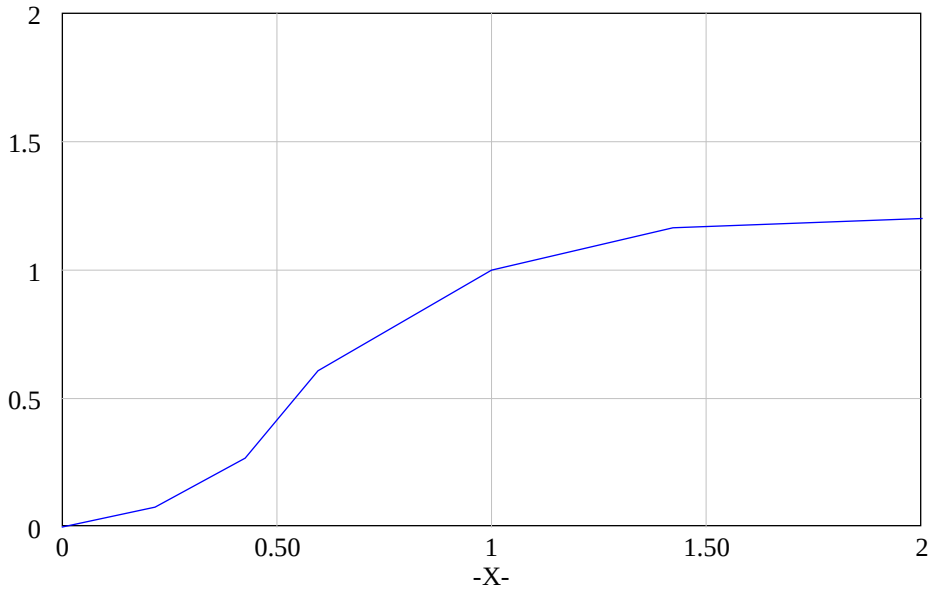
B.6 Productivity and Work Quality (24 variables)

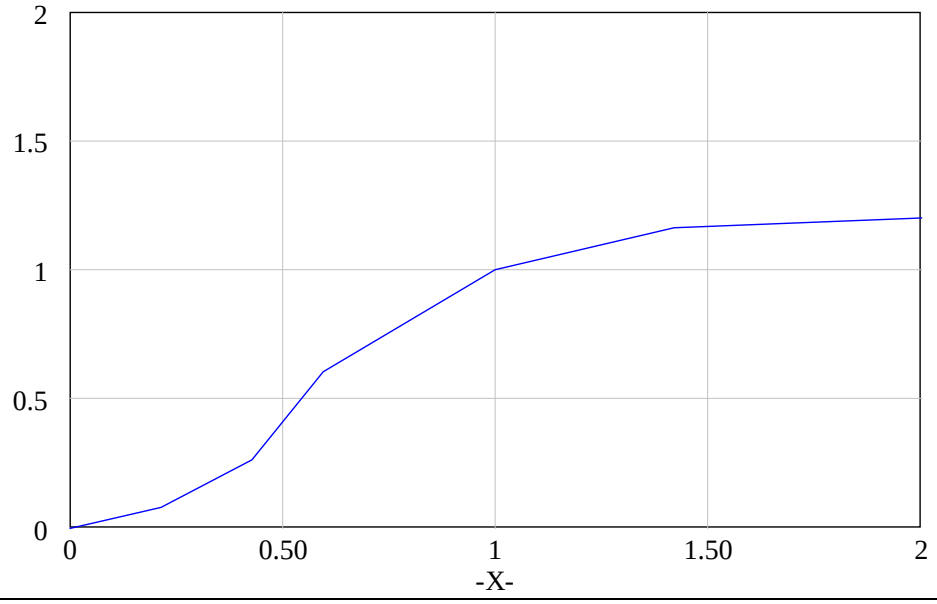
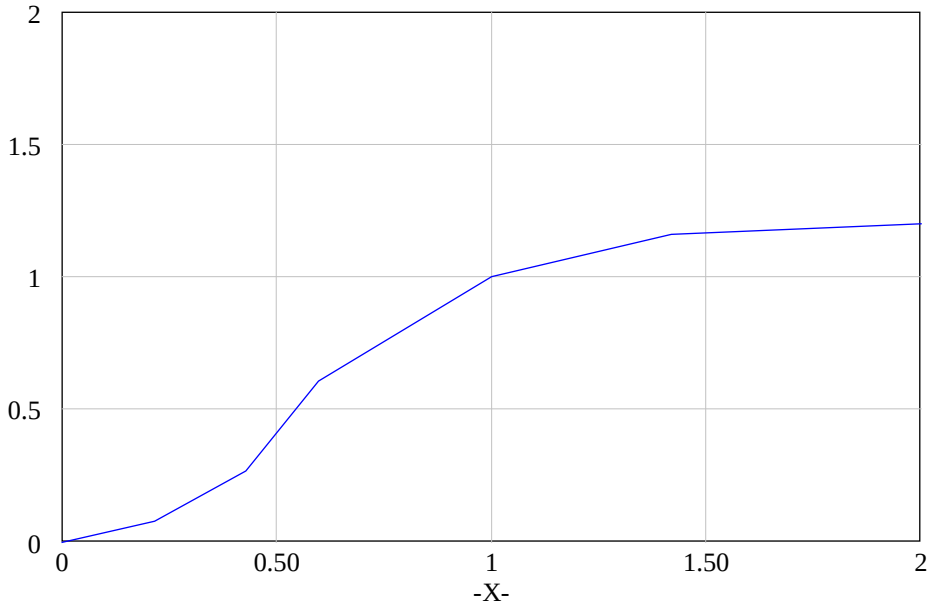


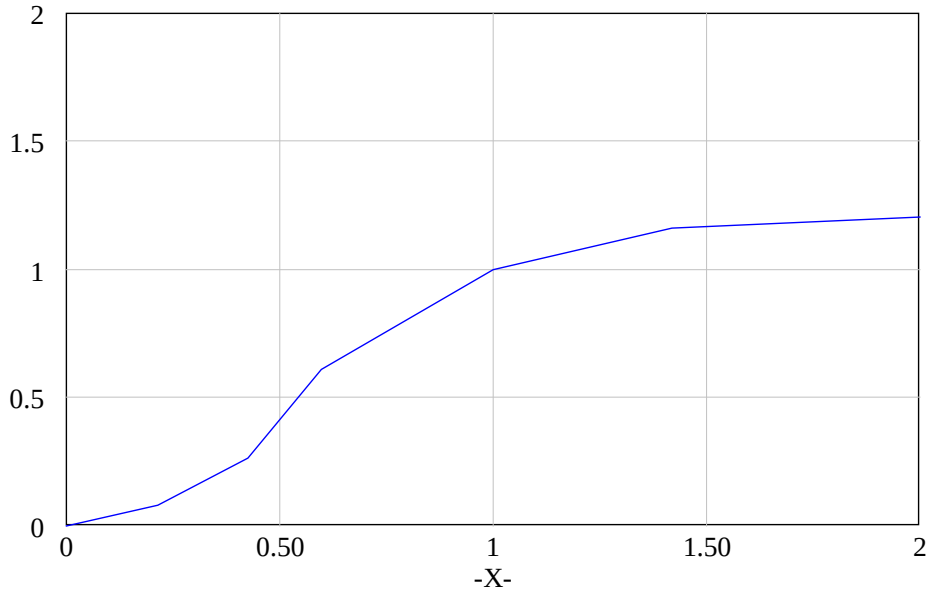
Group	Type	Variable Name and Description
Editors Effective Experience	#37 A 	**Editor Average Effective Experience** (Weeks) = ZIDZ (Total Editors Effective Experience , Editors) **Present in 2 views:** • Productivity and Work Quality • Editors Effective Experience **Used by:** • Editors Effective Experience Decrease Rate due to Attrition • Effect of Editor Average Effective Experience on Editor Article Productivity • Effect of Editor Average Effective Experience on Editor Article Quality **Feedback loops:** 24 (42.1 %)
Productivity	#40 A 	**Editor Nominal Articles Productivity** (Articles/(Person* Week)) = Editor Normal Articles Productivity * Effect of Editor Average Effective Experience on Editor Article Productivity **Present in 2 views:** • Workforce • Productivity and Work Quality **Used by:** • Editors Articles Potential Net Production **Feedback loops:** 23 (40.4 %)
Quality	#41 A 	**Editor Nominal Articles Quality** (Dimensionless) = MIN (1, Editor Normal Articles Quality * Effect of Editor Average Effective Experience on Editor Article Quality) **Present in 2 views:**

Group	Type	Variable Name and Description
		• Articles • Productivity and Work Quality **Used by:** • Failed Tests per Enhanced Article • Failed Tests per New Article **Feedback loops:** 0
Productivity	#42 C 	**Editor Normal Articles Productivity** (Articles/(Person* Week)) = 22.5 **Description:** *According to certain municipalities 1 Article shouldn't take an editor more than 1 Hour. So that 37.5 Hours per Week * 60% (civil servant normally work no more than 60% (Madachy 2008))* **Present in 2 views:** • Productivity and Work Quality • Editors Effective Experience **Used by:** • Editor Effective Experience Gain Rate due to Editing One Article • Editor Nominal Articles Productivity **Feedback loops:** 0
Quality	#43 C 	**Editor Normal Articles Quality** (Dimensionless) = 0.8 **Present in 1 view:** • Productivity and Work Quality **Used by:** • Editor Nominal Articles Quality **Feedback loops:** 0
Quality	#44 C 	**Editor Normal Effective Experience in Articles** (Weeks) = 26 **Description:** *Reference or Normal value to normalise the average effective experience before entering it to graph functions.* **Present in 1 view:** • Productivity and Work Quality **Used by:** • Effect of Editor Average Effective Experience on Editor Article Productivity • Effect of Editor Average Effective Experience on Editor Article Quality **Feedback loops:** 0
Productivity	#73 T,A  	**Effect of Editor Average Effective Experience on Editor Article Productivity** (Dimensionless) = WITH LOOKUP(Editor Average Effective Experience / Editor Normal Effective Experience in Articles, ([(0,0)-(2,1.2)],(0,0),(0.216471,0.0768683),(0.428235,0.264769),(0.597647,0.606406),(1,1),(1.42118,1.16157),(2,1.2))) **Present in 1 view:** • Productivity and Work Quality **Used by:** • Editor Nominal Articles Productivity **Feedback loops:** 23 (40.4 %)

Group	Type	Variable Name and Description
		#Effect of Editor Average Effective Experience on Editor Article Productivity# 
Quality	#74 T,A	**Effect of Editor Average Effective Experience on Editor Article Quality** (Dimensionless) = WITH LOOKUP(Editor Average Effective Experience / Editor Normal Effective Experience in Articles, ([(0,0)-(2,1.2)],(0,0),(0.216471,0.0768683),(0.428235,0.264769),(0.597647,0.606406),(1,1),(1.42118,1.16157),(2,1.2))) **Present in 1 view:** • Productivity and Work Quality **Used by:** • Editor Nominal Articles Quality **Feedback loops:** 0 #Effect of Editor Average Effective Experience on Editor Article Quality# 
Productivity	#75 T,A	**Effect of Main Editor Average Effective Experience on Main Editor Article Productivity** (Dimensionless) = WITH LOOKUP(Main Editor Average Effective Experience / Main Editor Normal Effective Experience in Articles, ([(0,0)-

Group	Type	Variable Name and Description
		(2,1.2)],(0,0),(0.216471,0.0768683),(0.428235,0.264769),(0.597647,0.606406),(1,1),(1.4211 8,1.16157),(2,1.2))) **Present in 1 view:** • Productivity and Work Quality **Used by:** • Main Editor Nominal Articles Productivity **Feedback loops:** 23 (40.4 %) #Effect of Main Editor Average Effective Experience on Main Editor Article Productivity# 
Quality	#76 T,A	**Effect of Main Editor Average Effective Experience on Main Editor Article Quality** (Dimensionless) = WITH LOOKUP(Main Editor Average Effective Experience / Main Editor Normal Effective Experience in Articles, ([(0,0)-(2,1.2)],(0,0),(0.216471,0.0768683),(0.428235,0.264769),(0.597647,0.606406),(1,1),(1.4211 8,1.16157),(2,1.2))) **Present in 1 view:** • Productivity and Work Quality **Used by:** • Main Editor Nominal Articles Quality **Feedback loops:** 0

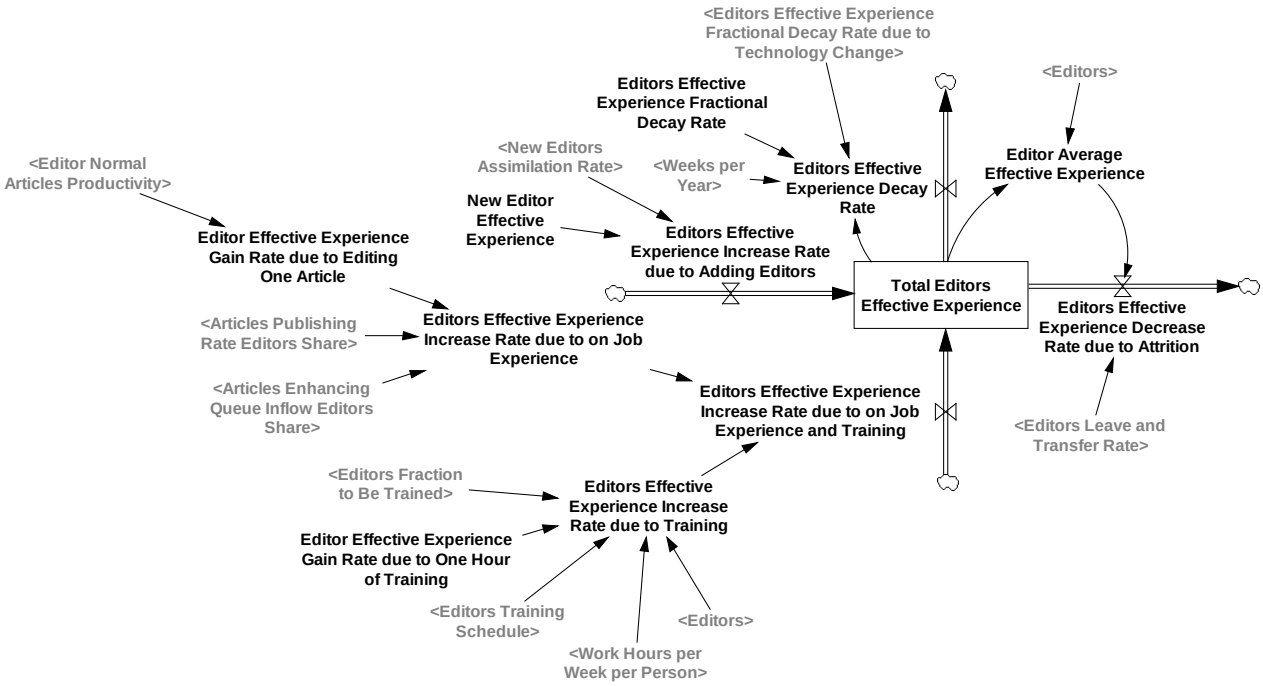
Group	Type	Variable Name and Description
		#Effect of Main Editor Average Effective Experience on Main Editor Article Quality# 
Productivity	#77 T,A	**Effect of Main Editor Average Effective Experience on Main Editor Template Productivity** (Dimensionless) = WITH LOOKUP(Main Editor Average Effective Experience in Templates / Main Editor Normal Effective Experience in Templates, ([(0,0)-(2,1.2)],(0,0),(0.216471,0.0768683),(0.428235,0.264769),(0.597647,0.606406),(1,1),(1.42118,1.16157),(2,1.2))) **Present in 1 view:** • Productivity and Work Quality **Used by:** • Main Editor Nominal Templates Productivity **Feedback loops:** 5 (8.8 %) #Effect of Main Editor Average Effective Experience on Main Editor Template Productivity# 
Quality	#78 T,A	**Effect of Main Editor Average Effective Experience on Main Editor Template Quality** (Dimensionless) = WITH LOOKUP(Main Editor Average Effective Experience in Templates / Main Editor

Group	Type	Variable Name and Description
		Normal Effective Experience in Templates, ([(0,0)-(2,1.2)],(0,0),(0.216471,0.0768683),(0.428235,0.264769),(0.597647,0.606406),(1,1),(1.42118,1.16157),(2,1.2))) **Present in 1 view:** • Productivity and Work Quality **Used by:** • Main Editor Nominal Templates Quality **Feedback loops:** 0 #Effect of Main Editor Average Effective Experience on Main Editor Template Quality# 
Main Editors Effective Experience	#101 A	**Main Editor Average Effective Experience** (Weeks) = ZIDZ (Total Main Editors Effective Experience, Main Editors) **Present in 2 views:** • Productivity and Work Quality • Main Editors Effective Experience **Used by:** • Effect of Main Editor Average Effective Experience on Main Editor Article Productivity • Effect of Main Editor Average Effective Experience on Main Editor Article Quality • Main Editors Effective Experience Decrease Rate due to Attrition **Feedback loops:** 24 (42.1 %)
Main Editors Effective Experience	#102 A	**Main Editor Average Effective Experience in Templates** (Weeks) = ZIDZ (Total Main Editors Effective Experience in Templates, Main Editors) **Present in 2 views:** • Productivity and Work Quality • Main Editors Effective Experience **Used by:** • Effect of Main Editor Average Effective Experience on Main Editor Template Productivity • Effect of Main Editor Average Effective Experience on Main Editor Template Quality • Main Editors Effective Experience in Templates Decrease Rate due to Attrition **Feedback loops:** 6 (10.5 %)
Produc-	#108	**Main Editor Nominal Articles Productivity** (Articles/(Person* Week))

Group	Type	Variable Name and Description
tivity	A	= Main Editor Normal Articles Productivity * Effect of Main Editor Average Effective Experience on Main Editor Article Productivity **Present in 2 views:** • Workforce • Productivity and Work Quality **Used by:** • Main Editors Articles Potential Net Production **Feedback loops:** 23 (40.4 %)
Quality	#109 A	**Main Editor Nominal Articles Quality** (Dimensionless) = MIN (1, Main Editor Normal Articles Quality *Effect of Main Editor Average Effective Experience on Main Editor Article Quality) **Present in 2 views:** • Articles • Productivity and Work Quality **Used by:** • Failed Tests per Enhanced Article • Failed Tests per New Article **Feedback loops:** 0
Productivity	#110 A	**Main Editor Nominal Templates Productivity** (Articles/(Person* Week)) = Main Editor Normal Templates Productivity* Effect of Main Editor Average Effective Experience on Main Editor Template Productivity **Present in 2 views:** • Workforce • Productivity and Work Quality **Used by:** • Main Editors Templates Potential Net Production **Feedback loops:** 5 (8.8 %)
Quality	#111 A	**Main Editor Nominal Templates Quality** (Dimensionless) = MIN (1, Main Editor Normal Templates Quality* Effect of Main Editor Average Effective Experience on Main Editor Template Quality) **Present in 2 views:** • Templates • Productivity and Work Quality **Used by:** • Failed Tests per Enhanced Template • Failed Tests per New Template **Feedback loops:** 0
Productivity	#112 C	**Main Editor Normal Articles Productivity** (Articles/(Person* Week)) = 22.5 **Description:** *According to certain municipalities 1 Article shouldn't take an editor more than 1 Hour. So that 37.5 Hours per Week * 60% (civil servant normally work no more than 60% (Madachy 2008)).* **Present in 2 views:** • Productivity and Work Quality • Main Editors Effective Experience **Used by:** • Main Editor Effective Experience Gain Rate due to Editing One Article • Main Editor Nominal Articles Productivity **Feedback loops:** 0
Quality	#113	**Main Editor Normal Articles Quality** (Dimensionless)

Group	Type	Variable Name and Description
	C 	= 0.8 **Present in 1 view:** • Productivity and Work Quality **Used by:** • Main Editor Nominal Articles Quality **Feedback loops:** 0
Quality	#114 C 	**Main Editor Normal Effective Experience in Articles** (Weeks) = 39 **Description:** *Reference or Normal value to normalise the average effective experience before entering it to graph functions.* **Present in 1 view:** • Productivity and Work Quality **Used by:** • Effect of Main Editor Average Effective Experience on Main Editor Article Productivity • Effect of Main Editor Average Effective Experience on Main Editor Article Quality **Feedback loops:** 0
Quality	#115 C 	**Main Editor Normal Effective Experience in Templates** (Weeks) = 52 **Description:** *Reference or Normal value to normalise the average effective experience before entering it to graph functions.* **Present in 1 view:** • Productivity and Work Quality **Used by:** • Effect of Main Editor Average Effective Experience on Main Editor Template Productivity • Effect of Main Editor Average Effective Experience on Main Editor Template Quality **Feedback loops:** 0
Productivity	#116 C 	**Main Editor Normal Templates Productivity** (Templates/(Person* Week)) = 15 **Description:** *It was assumed that to author a template, a main editor will take one and a half the time an editor will take to publish an article.* **Present in 2 views:** • Productivity and Work Quality • Main Editors Effective Experience **Used by:** • Main Editor Effective Experience in Templates Gain Rate due to Authoring One Template • Main Editor Nominal Templates Productivity **Feedback loops:** 0
Quality	#117 C 	**Main Editor Normal Templates Quality** (Dimensionless) = 0.8 **Present in 1 view:** • Productivity and Work Quality **Used by:** • Main Editor Nominal Templates Quality **Feedback loops:** 0

B.7 Editors Effective Experience Subsystem (24 variables)



Group	Type	Variable Name and Description
Articles	#11 A 	**Articles Enhancing Queue Inflow Editors Share** (Articles/Week) = ZIDZ (Articles Enhancing Queue Inflow* Editors Articles Potential Net Production * Editor Production Fraction for Enhancing Articles,Editors Articles Potential Net Production * Editor Production Fraction for Enhancing Articles+ Main Editors Articles Potential Net Production *Main Editor Production Fraction for Enhancing Articles) **Present in 2 views:** • Articles • Editors Effective Experience **Used by:** • Editors Effective Experience Increase Rate due to on Job Experience • Failed Tests per Enhanced Article **Feedback loops:** 13 (22.8 %)
Articles	#17 A 	**Articles Publishing Rate Editors Share** (Articles/Week) = ZIDZ (Articles Publishing Rate * (1 - Editor Production Fraction for Enhancing Articles) * Editors Articles Potential Net Production , (1 -Editor Production Fraction for Enhancing Articles) * Editors Articles Potential Net Production + (1 - Main Editor Production Fraction for Enhancing Articles) * Main Editors Articles Potential Net Production) **Present in 2 views:** • Articles • Editors Effective Experience **Used by:** • Editors Effective Experience Increase Rate due to on Job Experience • Failed Tests per New Article **Feedback loops:** 10 (17.5 %)
Editors Effective Experience	#37 A 	**Editor Average Effective Experience** (Weeks) = ZIDZ (Total Editors Effective Experience , Editors) **Present in 2 views:** • Productivity and Work Quality

Group	Type	Variable Name and Description
		• Editors Effective Experience **Used by:** • Editors Effective Experience Decrease Rate due to Attrition • Effect of Editor Average Effective Experience on Editor Article Productivity • Effect of Editor Average Effective Experience on Editor Article Quality **Feedback loops:** 24 (42.1 %)
Editors Effective Experience	#38 A 	**Editor Effective Experience Gain Rate due to Editing One Article** (Weeks*Person /Article) = 1 / Editor Normal Articles Productivity **Description:** *The Effective Experience gained per editing one article. This is the reciprocal of Editor nominal productivity (1/22.5), because if editor nominal productivity is the articles that an editor produces per week, then the experience he/she gets because of editing one article is 1/editor nominal productivity. 0.0444444* **Present in 1 view:** • Editors Effective Experience **Used by:** • Editors Effective Experience Increase Rate due to on Job Experience **Feedback loops:** 0
Editors Effective Experience	#39 C 	**Editor Effective Experience Gain Rate due to One Hour of Training** (Weeks*Person /Hour) = 1.5 **Description:** *The Effective Experience gained through one hour of training* **Present in 1 view:** • Editors Effective Experience **Used by:** • Editors Effective Experience Increase Rate due to Training **Feedback loops:** 0
Productivity	#42 C 	**Editor Normal Articles Productivity** (Articles/(Person* Week)) = 22.5 **Description:** *According to certain municipalities 1 Article shouldn't take an editor more than 1 Hour. So that 37.5 Hours per Week * 60% (civil servant normally work no more than 60% (Madachy 2008))* **Present in 2 views:** • Productivity and Work Quality • Editors Effective Experience **Used by:** • Editor Effective Experience Gain Rate due to Editing One Article • Editor Nominal Articles Productivity **Feedback loops:** 0
Workforce	#49 L,LI  	**Editors** (Persons) = $\int$ (New Editors Assimilation Rate - Editors Leave and Transfer Rate) $\cdot dt$ + [INITIAL Editors] **Present in 3 views:** • Workforce • Editors Effective Experience • Costs **Used by:** • Editor Average Effective Experience • Editors Articles Potential Net Production

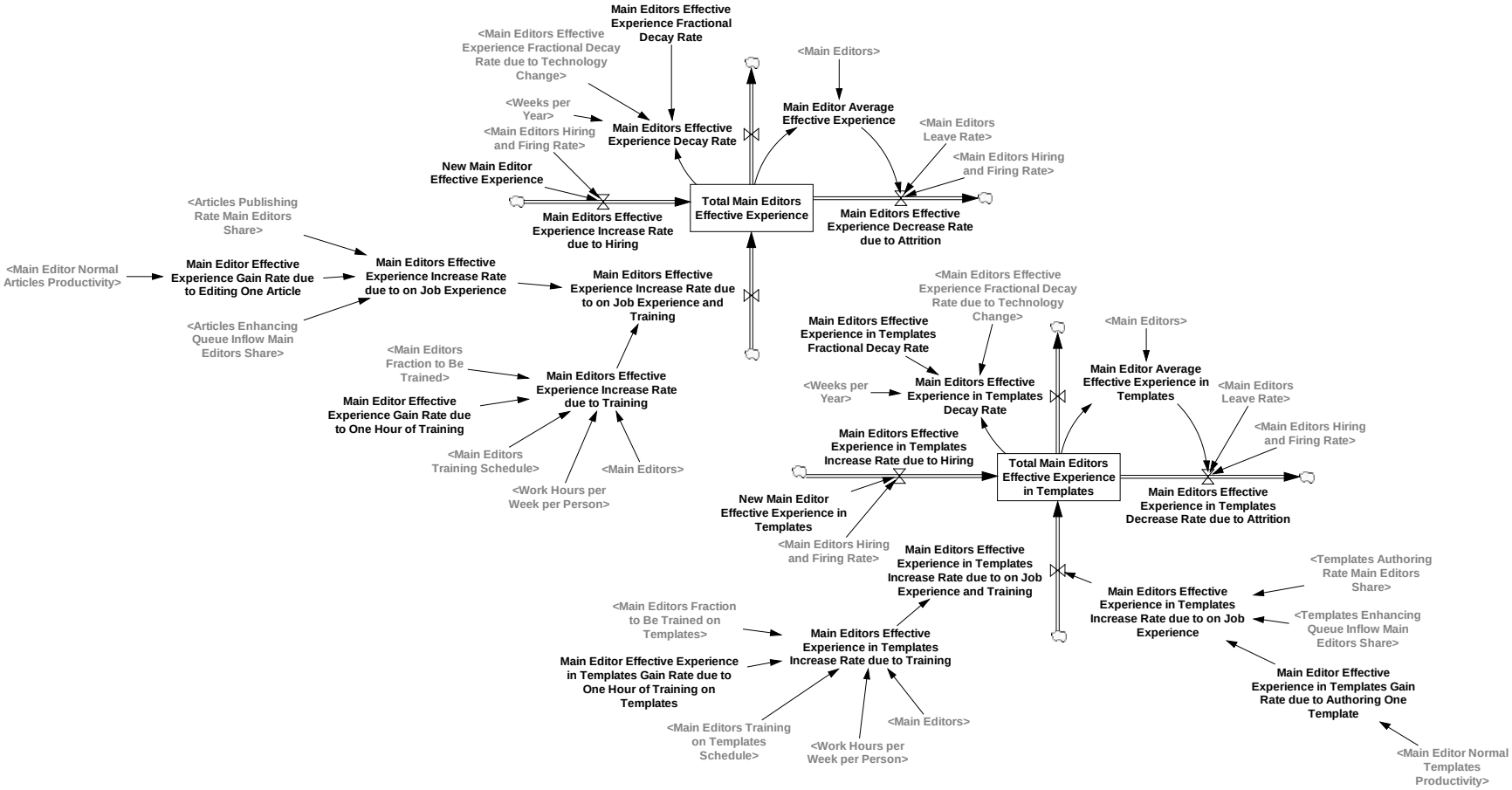
Group	Type	Variable Name and Description
		• Editors Effective Experience Increase Rate due to Training • Editors Gap • Editors Leave and Transfer Rate • Editors Training Cost • Staff Communication Overhead inside Department • Sum All Editors Weekly Wages Cost • Total Editors Effective Experience **Feedback loops:** 3 (5.3 %)
Editors Effective Experi-ence	#52 F,A 	**Editors Effective Experience Decay Rate** (Weeks*Person/Week) = Total Editors Effective Experience * (Editors Effective Experience Fractional Decay Rate / Weeks per Year + Editors Effective Experience Fractional Decay Rate due to Technology Change) **Present in 1 view:** • Editors Effective Experience **Used by:** • Total Editors Effective Experience **Feedback loops:** 1 (1.8 %)
Editors Effective Experi-ence	#53 F,A 	**Editors Effective Experience Decrease Rate due to Attrition** (Weeks*Person/Week) = Editors Leave and Transfer Rate* Editor Average Effective Experience **Present in 1 view:** • Editors Effective Experience **Used by:** • Total Editors Effective Experience **Feedback loops:** 1 (1.8 %)
Editors Effective Experi-ence	#54 C 	**Editors Effective Experience Fractional Decay Rate** (Dimensionless/Year) = 0.1 **Description:** *10% per year (Sterman 2000)* **Present in 1 view:** • Editors Effective Experience **Used by:** • Editors Effective Experience Decay Rate **Feedback loops:** 0
Editors Effective Experi-ence	#55 A 	**Editors Effective Experience Fractional Decay Rate due to Technology Change** (Dimensionless/Week) = IF THEN ELSE(Technology Update Level Latch - Delayed Technology Update Level <> 0, 0.5, 0) **Present in 1 view:** • Editors Effective Experience **Used by:** • Editors Effective Experience Decay Rate **Feedback loops:** 0
Editors Effective Experi-ence	#56 F,A 	**Editors Effective Experience Increase Rate due to Adding Editors** (Weeks*Person /Week) = New Editors Assimilation Rate* New Editor Effective Experience **Present in 1 view:** • Editors Effective Experience **Used by:** • Total Editors Effective Experience **Feedback loops:** 0

Group	Type	Variable Name and Description
Editors Effective Experience	#57 A 	**Editors Effective Experience Increase Rate due to on Job Experience** (Weeks*Person/Week) = (Articles Publishing Rate Editors Share+ Articles Enhancing Queue Inflow Editors Share) * Editor Effective Experience Gain Rate due to Editing One Article **Present in 1 view:** • Editors Effective Experience **Used by:** • Editors Effective Experience Increase Rate due to on Job Experience and Training **Feedback loops:** 23 (40.4 %)
Editors Effective Experience	#58 F,A 	**Editors Effective Experience Increase Rate due to on Job Experience and Training** (Weeks*Person/Week) = Editors Effective Experience Increase Rate due to on Job Experience+ Editors Effective Experience Increase Rate due to Training **Present in 1 view:** • Editors Effective Experience **Used by:** • Total Editors Effective Experience **Feedback loops:** 23 (40.4 %)
Editors Effective Experience	#59 A 	**Editors Effective Experience Increase Rate due to Training** (Weeks*Person/Week) = Editors Training Schedule* Editors * Editors Fraction to Be Trained * Editor Effective Experience Gain Rate due to One Hour of Training*Work Hours per Week per Person **Description:** *Bartel (1995) finds evidence that returns to training investments increase productivity on the order of 9% percent.* **Present in 1 view:** • Editors Effective Experience **Used by:** • Editors Effective Experience Increase Rate due to on Job Experience and Training **Feedback loops:** 0
Control	#60 G 	**Editors Fraction to Be Trained** (Dimensionless [0,1,0.05]) = GAME(0.2) **Present in 2 views:** • Editors Effective Experience • Costs **Used by:** • Editors Effective Experience Increase Rate due to Training • Editors Time Fraction Lost in Training • Editors Training Cost **Feedback loops:** 0
Workforce	#63 F,A 	**Editors Leave and Transfer Rate** (Persons/Week) = Editors * Editors Fractional Leave Rate / Weeks per Year+ IF THEN ELSE (Editors Gap < 0, - Editors Gap / Time to Transfer Editor , 0) **Present in 2 views:** • Workforce • Editors Effective Experience **Used by:** • Editors • Editors Effective Experience Decrease Rate due to Attrition **Feedback loops:** 2 (3.5 %)
Training	#69 A	**Editors Training Schedule** (Dimensionless) = Editors Training Switch * IF THEN ELSE (Editors Training Frequency per Year> 0,

Group	Type	Variable Name and Description
		PULSE TRAIN (Editors Training Start Time , Editors Training Duration in Weeks, Weeks per Year / Editors Training Frequency per Year , FINAL TIME) , PULSE (Editors Training Start Time,Editors Training Duration in Weeks)) **Description:** *external trainers* **Present in 3 views:** • Editors Effective Experience • Training • Costs **Used by:** • Editors Effective Experience Increase Rate due to Training • Editors Time Fraction Lost in Training • Editors Training Cost **Feedback loops:** 0
Editors Effective Experience	#163 LI,C	**New Editor Effective Experience** (Weeks) = 13 **Present in 1 view:** • Editors Effective Experience **Used by:** • Editors Effective Experience Increase Rate due to Adding Editors • Total Editors Effective Experience **Feedback loops:** 0
Workforce	#166 F,A	**New Editors Assimilation Rate** (Persons/Week) = IF THEN ELSE (Main Editors * Main Editor Time Fraction Dedicated to Website* MAX (0, 1 - Main Editors Time Fraction Lost in Training) > 0, MIN (New Editors/ Shortest Assimilation Period , Main Editor Maximum Time Fraction Dedicated to Assimilate New Editors* Main Editors* Main Editor Time Fraction Dedicated to Website * (1 - Main Editors Time Fraction Lost in Training) * Work Hours per Week per Person *New Editors per Training Session / New Editors Assimilation Session Duration in Hours) , 0) **Present in 2 views:** • Workforce • Editors Effective Experience **Used by:** • Editors • Editors Assimilation Training Overhead • Editors Effective Experience Increase Rate due to Adding Editors • New Editors **Feedback loops:** 2 (3.5 %)
Editors Effective Experience	#215 L	**Total Editors Effective Experience** (Weeks*Person) = $\int$ (Editors Effective Experience Increase Rate due to on Job Experience and Training+ Editors Effective Experience Increase Rate due to Adding Editors - Editors Effective Experience Decay Rate- Editors Effective Experience Decrease Rate due to Attrition) $\cdot dt$ + [Editors * New Editor Effective Experience] **Present in 1 view:** • Editors Effective Experience **Used by:** • Editor Average Effective Experience • Editors Effective Experience Decay Rate **Feedback loops:** 25 (43.9 %)
Control	#227	**Weeks per Year** (Weeks/Year)

Group	Type	Variable Name and Description
	C 	= 52 **Present in 7 views:** • Templates • Workforce • Editors Effective Experience • Main Editors Effective Experience • Training • Consultancies • Costs **Used by:** • Consultancy Schedule • Editors Effective Experience Decay Rate • Editors Leave and Transfer Rate • Editors Training Schedule • Main Editors Effective Experience Decay Rate • Main Editors Effective Experience in Templates Decay Rate • Main Editors Leave Rate • Main Editors Training on Templates Schedule • Main Editors Training Schedule • Required Templates Increase Rate • Sum All Editors Weekly Wages Cost • Sum All Main Editors Weekly Wages Cost **Feedback loops:** 0
Control	#229 C 	**Work Hours per Week per Person** (Hours/(Week*Person)) = 37.5 **Present in 3 views:** • Workforce • Editors Effective Experience • Main Editors Effective Experience **Used by:** • Editors Assimilation Training Overhead • Editors Effective Experience Increase Rate due to Training • Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Effective Experience Increase Rate due to Training • New Editors Assimilation Rate **Feedback loops:** 0

B.8 Main Editors Effective Experience Subsystem (50 variables)



Group	Type	Variable Name and Description
Articles	#12 A 	**Articles Enhancing Queue Inflow Main Editors Share** (Articles/Week) = ZIDZ (Articles Enhancing Queue Inflow* Main Editors Articles Potential Net Production * Main Editor Production Fraction for Enhancing Articles, Editors Articles Potential Net Production * Editor Production Fraction for Enhancing Articles+ Main Editors Articles Potential Net Production * Main Editor Production Fraction for Enhancing Articles) **Present in 2 views:** • Articles • Main Editors Effective Experience **Used by:** • Failed Tests per Enhanced Article • Main Editors Effective Experience Increase Rate due to on Job Experience **Feedback loops:** 13 (22.8 %)
Articles	#18 A 	**Articles Publishing Rate Main Editors Share** (Articles/Week) = ZIDZ (Articles Publishing Rate * (1 -Main Editor Production Fraction for Enhancing Articles) * Main Editors Articles Potential Net Production, (1 - Editor Production Fraction for Enhancing Articles) * Editors Articles Potential Net Production+ (1 - Main Editor Production Fraction for Enhancing Articles) * Main Editors Articles Potential Net Production) **Present in 2 views:** • Articles • Main Editors Effective Experience **Used by:** • Failed Tests per New Article • Main Editors Effective Experience Increase Rate due to on Job Experience **Feedback loops:** 10 (17.5 %)
Main Editors Effective Experience	#101 A 	**Main Editor Average Effective Experience** (Weeks) = ZIDZ (Total Main Editors Effective Experience, Main Editors) **Present in 2 views:** • Productivity and Work Quality • Main Editors Effective Experience **Used by:** • Effect of Main Editor Average Effective Experience on Main Editor Article Productivity • Effect of Main Editor Average Effective Experience on Main Editor Article Quality • Main Editors Effective Experience Decrease Rate due to Attrition **Feedback loops:** 24 (42.1 %)
Main Editors Effective Experience	#102 A 	**Main Editor Average Effective Experience in Templates** (Weeks) = ZIDZ (Total Main Editors Effective Experience in Templates, Main Editors) **Present in 2 views:** • Productivity and Work Quality • Main Editors Effective Experience **Used by:** • Effect of Main Editor Average Effective Experience on Main Editor Template Productivity • Effect of Main Editor Average Effective Experience on Main Editor Template Quality • Main Editors Effective Experience in Templates Decrease Rate due to Attrition **Feedback loops:** 6 (10.5 %)
Main Editors Effective	#103 A	**Main Editor Effective Experience Gain Rate due to Editing One Article** (Weeks*Person/Article) = 1 / Main Editor Normal Articles Productivity

Group	Type	Variable Name and Description
Experience		**Description:** *The Effective Experience gained through editing one article. This is the reciprocal of Main editor nominal productivity (1/22.5), because if main editor nominal productivity is the articles that an editor produces per week, then the experience he/she gets because of editing one article is 1/main editor nominal productivity. 0.0444444* **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience Increase Rate due to on Job Experience **Feedback loops:** 0
Main Editors Effective Experience	#104 C 	**Main Editor Effective Experience Gain Rate due to One Hour of Training** (Weeks*Person/Hour) = 1.5 **Description:** *Bartel 1995 found evidence that returns to training investments (1 day) increase productivity growth on the order of 9%. We kept the same value as for the editors.* **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience Increase Rate due to Training **Feedback loops:** 0
Main Editors Effective Experience	#105 A 	**Main Editor Effective Experience in Templates Gain Rate due to Authoring One Template** (Weeks*Person/Template) = 1 / Main Editor Normal Templates Productivity **Description:** *The Effective Experience gained through authoring one template.* **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience in Templates Increase Rate due to on Job Experience **Feedback loops:** 0
Main Editors Effective Experience	#106 C 	**Main Editor Effective Experience in Templates Gain Rate due to One Hour of Training on Templates** (Weeks*Person/Hour) = 0.156 **Description:** *Bartel 1995 found evidence that returns to training investments (1 day) increase productivity growth on the order of 9%. However, it is assumes no prior experience in templates at all. What we done here is to assume that the training of the all main editor for 160 hours (computed using courses from Microsoft and EPiSever) will give the main editors the same results as what is gained from consultancy over the whole period.* **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience in Templates Increase Rate due to Training **Feedback loops:** 0
Productivity	#112 C 	**Main Editor Normal Articles Productivity** (Articles/(Person* Week)) = 22.5 **Description:** *According to certain municipalities 1 Article shouldn't take an editor more than 1 Hour. So that 37.5 Hours per Week * 60% (civil servant normally work no more than 60% (Madachy 2008)).* **Present in 2 views:** • Productivity and Work Quality • Main Editors Effective Experience

Group	Type	Variable Name and Description
		Used by: • Main Editor Effective Experience Gain Rate due to Editing One Article • Main Editor Nominal Articles Productivity **Feedback loops:** 0
Productivity	#116 C 	**Main Editor Normal Templates Productivity** (Templates/(Person* Week)) = 15 **Description:** *It was assumed that to author a template, a main editor will take one and a half the time an editor will take to publish an article.* **Present in 2 views:** • Productivity and Work Quality • Main Editors Effective Experience **Used by:** • Main Editor Effective Experience in Templates Gain Rate due to Authoring One Template • Main Editor Nominal Templates Productivity **Feedback loops:** 0
Workforce	#125 L,LI  	**Main Editors** (Persons) = $\int$ (Main Editors Hiring and Firing Rate - Main Editors Leave Rate) $\cdot dt$ + [INITIAL Main Editors] **Present in 3 views:** • Workforce • Main Editors Effective Experience • Costs **Used by:** • Editors Assimilation Training Overhead • Main Editor Average Effective Experience • Main Editor Average Effective Experience in Templates • Main Editors Articles Potential Net Production • Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Effective Experience Increase Rate due to Training • Main Editors Hiring and Firing Rate • Main Editors Leave Rate • Main Editors Templates Potential Net Production • Main Editors Training Cost • New Editors Assimilation Rate • Staff Communication Overhead among Main Editors • Staff Communication Overhead on Main Editor • Sum All Main Editors Weekly Wages Cost • Total Main Editors Effective Experience • Total Main Editors Effective Experience in Templates **Feedback loops:** 3 (5.3 %)
Main Editors Effective Experience	#128 F,A  	**Main Editors Effective Experience Decay Rate** (Weeks*Person/Week) = Total Main Editors Effective Experience* (Main Editors Effective Experience Fractional Decay Rate / Weeks per Year + Main Editors Effective Experience Fractional Decay Rate due to Technology Change) **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Total Main Editors Effective Experience

Group	Type	Variable Name and Description
		Feedback loops: 1 (1.8 %)
Main Editors Effective Experience	#129 F,A 	**Main Editors Effective Experience Decrease Rate due to Attrition** (Weeks*Person/Week) = (IF THEN ELSE (Main Editors Hiring and Firing Rate< 0, Main Editors Hiring and Firing Rate , 0) + Main Editors Leave Rate) * Main Editor Average Effective Experience **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Total Main Editors Effective Experience **Feedback loops:** 1 (1.8 %)
Main Editors Effective Experience	#130 C 	**Main Editors Effective Experience Fractional Decay Rate** (Dimensionless/Year) = 0.1 **Description:** *10% per year (Sterman 2000)* **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience Decay Rate **Feedback loops:** 0
Main Editors Effective Experience	#131 A 	**Main Editors Effective Experience Fractional Decay Rate due to Technology Change** (Dimensionless/Week) = IF THEN ELSE(Technology Update Level Latch - Delayed Technology Update Level <> 0, 0.3, 0) **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience Decay Rate • Main Editors Effective Experience in Templates Decay Rate **Feedback loops:** 0
Main Editors Effective Experience	#132 F,A 	**Main Editors Effective Experience in Templates Decay Rate** (Weeks*Person/Week) = Total Main Editors Effective Experience in Templates* (Main Editors Effective Experience in Templates Fractional Decay Rate / Weeks per Year+ Main Editors Effective Experience Fractional Decay Rate due to Technology Change) **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Total Main Editors Effective Experience in Templates **Feedback loops:** 1 (1.8 %)
Main Editors Effective Experience	#133 F,A 	**Main Editors Effective Experience in Templates Decrease Rate due to Attrition** (Weeks*Person/Week) = (IF THEN ELSE(Main Editors Hiring and Firing Rate < 0, Main Editors Hiring and Firing Rate , 0) + Main Editors Leave Rate) * Main Editor Average Effective Experience in Templates **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Total Main Editors Effective Experience in Templates **Feedback loops:** 1 (1.8 %)
Main Editors	#134 C	**Main Editors Effective Experience in Templates Fractional Decay Rate** (Dimensionless/Year)

Group	Type	Variable Name and Description
Effective Experience		= 0.1 **Description:** *10% per year (Sterman 2000)* **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience in Templates Decay Rate **Feedback loops:** 0
Main Editors Effective Experience	#135 F,A 	**Main Editors Effective Experience in Templates Increase Rate due to Hiring** (Weeks*Person/Week) = IF THEN ELSE(Main Editors Hiring and Firing Rate > 0, Main Editors Hiring and Firing Rate * New Main Editor Effective Experience in Templates, 0) **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Total Main Editors Effective Experience in Templates **Feedback loops:** 0
Main Editors Effective Experience	#136 A 	**Main Editors Effective Experience in Templates Increase Rate due to on Job Experience** (Weeks*Person/Week) = (Templates Authoring Rate Main Editors Share + Templates Enhancing Queue Inflow Main Editors Share) * Main Editor Effective Experience in Templates Gain Rate due to Authoring One Template **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience in Templates Increase Rate due to on Job Experience and Training **Feedback loops:** 5 (8.8 %)
Main Editors Effective Experience	#137 F,A 	**Main Editors Effective Experience in Templates Increase Rate due to on Job Experience and Training** (Weeks*Person/Week) = Main Editors Effective Experience in Templates Increase Rate due to on Job Experience+ Main Editors Effective Experience in Templates Increase Rate due to Training **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Total Main Editors Effective Experience in Templates **Feedback loops:** 5 (8.8 %)
Main Editors Effective Experience	#138 A 	**Main Editors Effective Experience in Templates Increase Rate due to Training** (Weeks*Person/Week) = Main Editors Training on Templates Schedule* Main Editors * Main Editors Fraction to Be Trained on Templates * Main Editor Effective Experience in Templates Gain Rate due to One Hour of Training on Templates* Work Hours per Week per Person **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience in Templates Increase Rate due to on Job Experience and Training **Feedback loops:** 0
Main Editors	#139 F,A	**Main Editors Effective Experience Increase Rate due to Hiring** (Weeks*Person/Week) = IF THEN ELSE (Main Editors Hiring and Firing Rate> 0, Main Editors Hiring and Firing

Group	Type	Variable Name and Description
Effective Experience		Rate * New Main Editor Effective Experience , 0) **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Total Main Editors Effective Experience **Feedback loops:** 0
Main Editors Effective Experience	#140 A	**Main Editors Effective Experience Increase Rate due to on Job Experience** (Weeks*Person/Week) = (Articles Publishing Rate Main Editors Share+ Articles Enhancing Queue Inflow Main Editors Share) * Main Editor Effective Experience Gain Rate due to Editing One Article **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience Increase Rate due to on Job Experience and Training **Feedback loops:** 23 (40.4 %)
Main Editors Effective Experience	#141 F,A	**Main Editors Effective Experience Increase Rate due to on Job Experience and Training** (Weeks*Person/Week) = Main Editors Effective Experience Increase Rate due to on Job Experience + Main Editors Effective Experience Increase Rate due to Training **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Total Main Editors Effective Experience **Feedback loops:** 23 (40.4 %)
Main Editors Effective Experience	#142 A	**Main Editors Effective Experience Increase Rate due to Training** (Weeks*Person /Week) = Main Editors Training Schedule* Main Editors * Main Editors Fraction to Be Trained * Main Editor Effective Experience Gain Rate due to One Hour of Training* Work Hours per Week per Person **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience Increase Rate due to on Job Experience and Training **Feedback loops:** 0
Control	#143 G	**Main Editors Fraction to Be Trained** (Dimensionless [0,1,0.05]) = GAME(0.5) **Present in 2 views:** • Main Editors Effective Experience • Costs **Used by:** • Main Editors Effective Experience Increase Rate due to Training • Main Editors Time Fraction Lost in Training • Main Editors Training Cost **Feedback loops:** 0
Control	#144 G	**Main Editors Fraction to Be Trained on Templates** (Dimensionless [0,1,0.05]) = GAME(0.5) **Present in 2 views:**

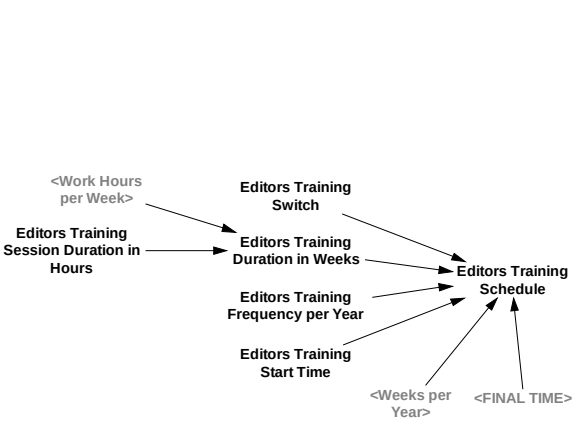
Group	Type	Variable Name and Description
		• Main Editors Effective Experience • Costs **Used by:** • Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Time Fraction Lost in Training • Main Editors Training Cost **Feedback loops:** 0
Work-force	#146 F,A 	**Main Editors Hiring and Firing Rate** (Persons/Week) = Main Editors Leave Rate + (Required Main Editors- Main Editors) / Time to Hire or Fire Main Editor **Present in 2 views:** • Workforce • Main Editors Effective Experience **Used by:** • Main Editors • Main Editors Effective Experience Decrease Rate due to Attrition • Main Editors Effective Experience in Templates Decrease Rate due to Attrition • Main Editors Effective Experience in Templates Increase Rate due to Hiring • Main Editors Effective Experience Increase Rate due to Hiring **Feedback loops:** 2 (3.5 %)
Work-force	#147 F,A 	**Main Editors Leave Rate** (Persons/Week) = Main Editors * Main Editors Fractional Leave Rate / Weeks per Year **Present in 2 views:** • Workforce • Main Editors Effective Experience **Used by:** • Main Editors • Main Editors Effective Experience Decrease Rate due to Attrition • Main Editors Effective Experience in Templates Decrease Rate due to Attrition • Main Editors Hiring and Firing Rate **Feedback loops:** 2 (3.5 %)
Training	#155 A 	**Main Editors Training on Templates Schedule** (Dimensionless) = Main Editors Training on Templates Switch* IF THEN ELSE (Main Editors Training on Templates Frequency per Year > 0, PULSE TRAIN(Main Editors Training on Templates Start Time , Main Editors Training on Templates Duration in Weeks, Weeks per Year / Main Editors Training on Templates Frequency per Year , FINAL TIME) , PULSE (Main Editors Training on Templates Start Time , Main Editors Training on Templates Duration in Weeks)) **Description:** *external trainers* **Present in 3 views:** • Main Editors Effective Experience • Training • Costs **Used by:** • Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Time Fraction Lost in Training • Main Editors Training Cost **Feedback loops:** 0
Training	#158 A	**Main Editors Training Schedule** (Dimensionless) = Main Editors Training Switch * IF THEN ELSE (Main Editors Training Frequency per

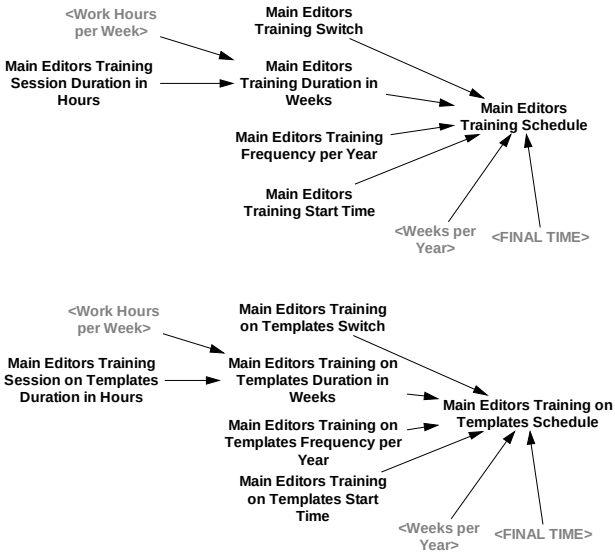
Group	Type	Variable Name and Description
		Year> 0, PULSE TRAIN (Main Editors Training Start Time , Main Editors Training Duration in Weeks, Weeks per Year / Main Editors Training Frequency per Year , FINAL TIME) , PULSE(Main Editors Training Start Time , Main Editors Training Duration in Weeks)) **Description:** *external trainers* **Present in 3 views:** • Main Editors Effective Experience • Training • Costs **Used by:** • Main Editors Effective Experience Increase Rate due to Training • Main Editors Time Fraction Lost in Training • Main Editors Training Cost **Feedback loops:** 0
Main Editors Effective Experience	#169 LI,C	**New Main Editor Effective Experience** (Weeks) = 122 **Description:** *Main editors, one has 10 last years with the web, 2 others 3 years. One was teacher the other studied media master in media. When they were recruited 7/3=2.333 years* **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience Increase Rate due to Hiring • Total Main Editors Effective Experience **Feedback loops:** 0
Main Editors Effective Experience	#170 LI,C	**New Main Editor Effective Experience in Templates** (Weeks) = 0 **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editors Effective Experience in Templates Increase Rate due to Hiring • Total Main Editors Effective Experience in Templates **Feedback loops:** 0
Templates	#201 A	**Templates Authoring Rate Main Editors Share** (Templates/Week) = ZIDZ (Templates Authoring Rate * (1 -Main Editor Production Fraction for Enhancing Templates) * Main Editors Templates Potential Net Production, (1 - Vendor Templates Production Fraction for Enhancing Templates) * Vendor Templates Potential Production+ (1 - Main Editor Production Fraction for Enhancing Templates) * Main Editors Templates Potential Net Production) **Present in 2 views:** • Templates • Main Editors Effective Experience **Used by:** • Failed Tests per New Template • Main Editors Effective Experience in Templates Increase Rate due to on Job Experience **Feedback loops:** 2 (3.5 %)
Templates	#206 A	**Templates Enhancing Queue Inflow Main Editors Share** (Templates/Week) = ZIDZ (Templates Enhancing Queue Inflow* Main Editors Templates Potential Net Production * Main Editor Production Fraction for Enhancing Templates, Vendor Templates Potential Production * Vendor Templates Production Fraction for Enhancing Tem-

Group	Type	Variable Name and Description
		plates+ Main Editors Templates Potential Net Production * Main Editor Production Fraction for Enhancing Templates) **Present in 2 views:** • Templates • Main Editors Effective Experience **Used by:** • Failed Tests per Enhanced Template • Main Editors Effective Experience in Templates Increase Rate due to on Job Experience **Feedback loops:** 3 (5.3 %)
Main Editors Effective Experience	#216 L	**Total Main Editors Effective Experience** (Weeks*Person) = $\int$ (Main Editors Effective Experience Increase Rate due to Hiring+ Main Editors Effective Experience Increase Rate due to on Job Experience and Training- Main Editors Effective Experience Decrease Rate due to Attrition - Main Editors Effective Experience Decay Rate) $\cdot dt$ + [Main Editors * New Main Editor Effective Experience] **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editor Average Effective Experience • Main Editors Effective Experience Decay Rate **Feedback loops:** 25 (43.9 %)
Main Editors Effective Experience	#217 L	**Total Main Editors Effective Experience in Templates** (Weeks*Person) = $\int$ (Main Editors Effective Experience in Templates Increase Rate due to Hiring+ Main Editors Effective Experience in Templates Increase Rate due to on Job Experience and Training- Main Editors Effective Experience in Templates Decrease Rate due to Attrition - Main Editors Effective Experience in Templates Decay Rate) $\cdot dt$ + [Main Editors * New Main Editor Effective Experience in Templates] **Present in 1 view:** • Main Editors Effective Experience **Used by:** • Main Editor Average Effective Experience in Templates • Main Editors Effective Experience in Templates Decay Rate **Feedback loops:** 7 (12.3 %)
Control	#227 C	**Weeks per Year** (Weeks/Year) = 52 **Present in 7 views:** • Templates • Workforce • Editors Effective Experience • Main Editors Effective Experience • Training • Consultancies • Costs **Used by:** • Consultancy Schedule • Editors Effective Experience Decay Rate • Editors Leave and Transfer Rate • Editors Training Schedule

Group	Type	Variable Name and Description
		• Main Editors Effective Experience Decay Rate • Main Editors Effective Experience in Templates Decay Rate • Main Editors Leave Rate • Main Editors Training on Templates Schedule • Main Editors Training Schedule • Required Templates Increase Rate • Sum All Editors Weekly Wages Cost • Sum All Main Editors Weekly Wages Cost **Feedback loops:** 0
Control	#229 C 	**Work Hours per Week per Person** (Hours/(Week*Person)) = 37.5 **Present in 3 views:** • Workforce • Editors Effective Experience • Main Editors Effective Experience **Used by:** • Editors Assimilation Training Overhead • Editors Effective Experience Increase Rate due to Training • Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Effective Experience Increase Rate due to Training • New Editors Assimilation Rate **Feedback loops:** 0

B.9 Training (27 variables)





Group	Type	Variable Name and Description
Training	#67 A 	**Editors Training Duration in Weeks** (Weeks) = Editors Training Session Duration in Hours / Work Hours per Week **Description:** *5 Hours per training time* **Present in 1 view:** • Training **Used by:** • Editors Training Schedule

Group	Type	Variable Name and Description
		Feedback loops: 0
Training	#68 G	**Editors Training Frequency per Year** (Dimensionless/Year [0,52,0.01]) = GAME(2) **Present in 1 view:** • Training **Used by:** • Editors Training Schedule **Feedback loops:** 0
Training	#69 A	**Editors Training Schedule** (Dimensionless) = Editors Training Switch * IF THEN ELSE (Editors Training Frequency per Year> 0, PULSE TRAIN (Editors Training Start Time , Editors Training Duration in Weeks, Weeks per Year / Editors Training Frequency per Year , FINAL TIME) , PULSE (Editors Training Start Time,Editors Training Duration in Weeks)) **Description:** *external trainers* **Present in 3 views:** • Editors Effective Experience • Training • Costs **Used by:** • Editors Effective Experience Increase Rate due to Training • Editors Time Fraction Lost in Training • Editors Training Cost **Feedback loops:** 0
Training	#70 G	**Editors Training Session Duration in Hours** (Hours [0,480,1]) = GAME(5) **Present in 1 view:** • Training **Used by:** • Editors Training Duration in Weeks **Feedback loops:** 0
Training	#71 G	**Editors Training Start Time** (Week [0,208,1]) = GAME(9) **Present in 1 view:** • Training **Used by:** • Editors Training Schedule **Feedback loops:** 0
Control	#72 G	**Editors Training Switch** (Dimensionless [0,1,1]) = GAME(1) **Present in 1 view:** • Training **Used by:** • Editors Training Schedule **Feedback loops:** 0
Control	#85 C	**FINAL TIME** (Week) = 208 **Description:** *The final time for the simulation.* **Present in 2 views:** • Training

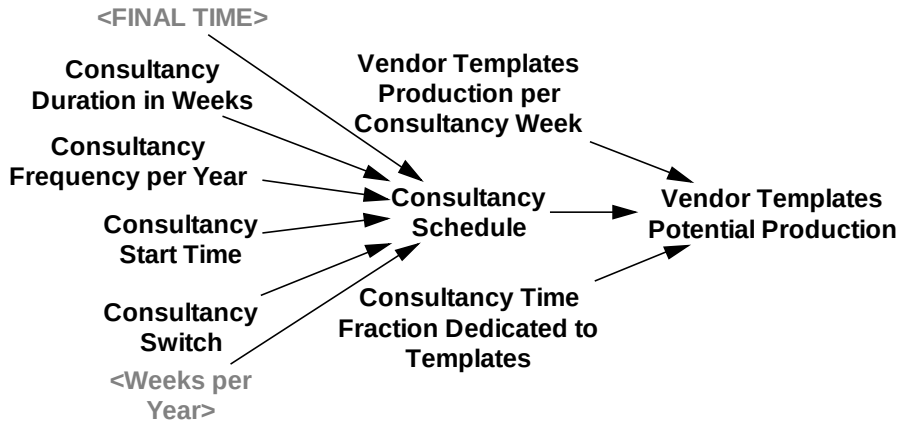
Group	Type	Variable Name and Description
		• Consultancies **Used by:** • Consultancy Schedule • Editors Training Schedule • Main Editors Training on Templates Schedule • Main Editors Training Schedule **Feedback loops:** 0
Training	#151 A 	**Main Editors Training Duration in Weeks** (Weeks) = Main Editors Training Session Duration in Hours/ Work Hours per Week **Present in 1 view:** • Training **Used by:** • Main Editors Training Schedule **Feedback loops:** 0
Training	#152 G 	**Main Editors Training Frequency per Year** (Dimensionless/Year [0,52,0.1]) = GAME(1) **Present in 1 view:** • Training **Used by:** • Main Editors Training Schedule **Feedback loops:** 0
Training	#153 A 	**Main Editors Training on Templates Duration in Weeks** (Weeks) = Main Editors Training Session on Templates Duration in Hours/ Work Hours per Week **Present in 1 view:** • Training **Used by:** • Main Editors Training on Templates Schedule **Feedback loops:** 0
Training	#154 G 	**Main Editors Training on Templates Frequency per Year** (Dimensionless/Year [0,52,0.1]) = GAME(0) **Present in 1 view:** • Training **Used by:** • Main Editors Training on Templates Schedule **Feedback loops:** 0
Training	#155 A 	**Main Editors Training on Templates Schedule** (Dimensionless) = Main Editors Training on Templates Switch* IF THEN ELSE (Main Editors Training on Templates Frequency per Year > 0, PULSE TRAIN(Main Editors Training on Templates Start Time , Main Editors Training on Templates Duration in Weeks, Weeks per Year / Main Editors Training on Templates Frequency per Year , FINAL TIME) , PULSE (Main Editors Training on Templates Start Time , Main Editors Training on Templates Duration in Weeks)) **Description:** *external trainers* **Present in 3 views:** • Main Editors Effective Experience • Training • Costs **Used by:**

Group	Type	Variable Name and Description
		• Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Time Fraction Lost in Training • Main Editors Training Cost **Feedback loops:** 0
Training	#156 G	**Main Editors Training on Templates Start Time** (Week [0,208,1]) = GAME(1) **Present in 1 view:** • Training **Used by:** • Main Editors Training on Templates Schedule **Feedback loops:** 0
Control	#157 G	**Main Editors Training on Templates Switch** (Dimensionless [0,1,1]) = GAME(0) **Present in 1 view:** • Training **Used by:** • Main Editors Training on Templates Schedule **Feedback loops:** 0
Training	#158 A	**Main Editors Training Schedule** (Dimensionless) = Main Editors Training Switch * IF THEN ELSE (Main Editors Training Frequency per Year> 0, PULSE TRAIN (Main Editors Training Start Time , Main Editors Training Duration in Weeks, Weeks per Year / Main Editors Training Frequency per Year , FINAL TIME) , PULSE(Main Editors Training Start Time , Main Editors Training Duration in Weeks)) **Description:** *external trainers* **Present in 3 views:** • Main Editors Effective Experience • Training • Costs **Used by:** • Main Editors Effective Experience Increase Rate due to Training • Main Editors Time Fraction Lost in Training • Main Editors Training Cost **Feedback loops:** 0
Training	#159 G	**Main Editors Training Session Duration in Hours** (Hours [0,480,1]) = GAME(5) **Present in 1 view:** • Training **Used by:** • Main Editors Training Duration in Weeks **Feedback loops:** 0
Training	#160 G	**Main Editors Training Session on Templates Duration in Hours** (Hours [0,480,1]) = GAME(320) **Description:** *160 hours of training should be enough as stated before. However since that we are only training half of the staff we doubled the number of hour to cover them all.* **Present in 1 view:** • Training **Used by:** • Main Editors Training on Templates Duration in Weeks **Feedback loops:** 0

Group	Type	Variable Name and Description
Training	#161 G	**Main Editors Training Start Time** (Week [0,208,1]) = GAME(1) **Present in 1 view:** • Training **Used by:** • Main Editors Training Schedule **Feedback loops:** 0
Control	#162 G	**Main Editors Training Switch** (Dimensionless [0,1,1]) = GAME(1) **Present in 1 view:** • Training **Used by:** • Main Editors Training Schedule **Feedback loops:** 0
Control	#227 C	**Weeks per Year** (Weeks/Year) = 52 **Present in 7 views:** • Templates • Workforce • Editors Effective Experience • Main Editors Effective Experience • Training • Consultancies • Costs **Used by:** • Consultancy Schedule • Editors Effective Experience Decay Rate • Editors Leave and Transfer Rate • Editors Training Schedule • Main Editors Effective Experience Decay Rate • Main Editors Effective Experience in Templates Decay Rate • Main Editors Leave Rate • Main Editors Training on Templates Schedule • Main Editors Training Schedule • Required Templates Increase Rate • Sum All Editors Weekly Wages Cost • Sum All Main Editors Weekly Wages Cost **Feedback loops:** 0
Control	#228 C	**Work Hours per Week** (Hours/Week) = 40 **Present in 2 views:** • Training • Costs **Used by:** • Consultancy Dedicated to Templates Cost • Editors Training Cost • Editors Training Duration in Weeks • Main Editors Training Cost • Main Editors Training Duration in Weeks • Main Editors Training on Templates Duration in Weeks

Group	Type	Variable Name and Description
		Feedback loops: 0

B.10 Consultancies (10 variables)

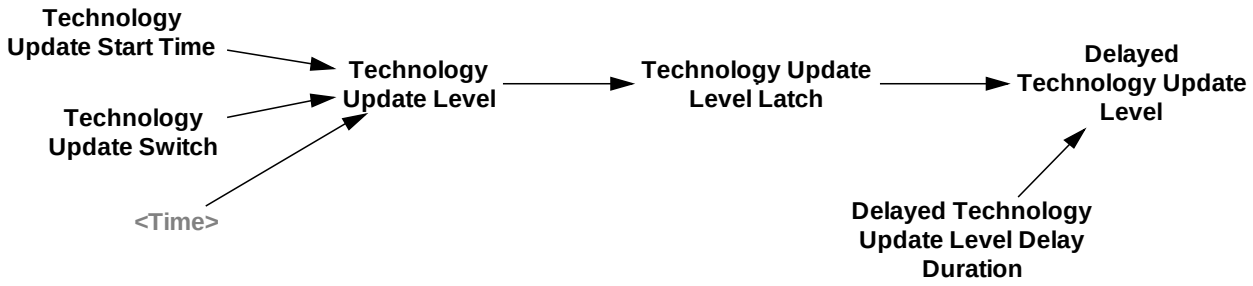


Group	Type	Variable Name and Description
Consul-tancies	#26 G	**Consultancy Duration in Weeks** (Weeks [0,52,1]) = GAME(2) **Present in 1 view:** • Consultancies **Used by:** • Consultancy Schedule **Feedback loops:** 0
Consul-tancies	#27 G	**Consultancy Frequency per Year** (Dimensionless/Year [0,52,0.1]) = GAME(1) **Present in 1 view:** • Consultancies **Used by:** • Consultancy Schedule **Feedback loops:** 0
Consul-tancies	#28 A	**Consultancy Schedule** (Dimensionless) = Consultancy Switch * IF THEN ELSE (Consultancy Frequency per Year> 0, PULSE TRAIN (Consultancy Start Time , Consultancy Duration in Weeks , Weeks per Year / Consultancy Frequency per Year , FINAL TIME) , PULSE (Consultancy Start Time ,Consultancy Duration in Weeks)) **Present in 2 views:** • Consultancies • Costs **Used by:** • Consultancy Dedicated to Templates Cost • Vendor Templates Potential Production **Feedback loops:** 0
Consul-tancies	#29 G	**Consultancy Start Time** (Week [0,208,1]) = GAME(40) **Present in 1 view:** • Consultancies **Used by:** • Consultancy Schedule

Group	Type	Variable Name and Description
		Feedback loops: 0
Control	#30 G	**Consultancy Switch** (Dimensionless [0,1,1]) = GAME(1) **Present in 1 view:** • Consultancies **Used by:** • Consultancy Schedule **Feedback loops:** 0
Consul-tancies	#31 G	**Consultancy Time Fraction Dedicated to Templates** (Dimensionless [0,1,0.05]) = GAME(1) **Present in 2 views:** • Consultancies • Costs **Used by:** • Consultancy Dedicated to Templates Cost • Vendor Templates Potential Production **Feedback loops:** 0
Control	#85 C	**FINAL TIME** (Week) = 208 **Description:** *The final time for the simulation.* **Present in 2 views:** • Training • Consultancies **Used by:** • Consultancy Schedule • Editors Training Schedule • Main Editors Training on Templates Schedule • Main Editors Training Schedule **Feedback loops:** 0
Consul-tancies	#221 A	**Vendor Templates Potential Production** (Templates/Week) = Vendor Templates Production per Consultancy Week* Consultancy Time Fraction Dedicated to Templates * Consultancy Schedule **Present in 2 views:** • Templates • Consultancies **Used by:** • Templates Authoring Rate • Templates Authoring Rate Main Editors Share • Templates Authoring Rate Vendor Share • Templates Enhancing Queue Inflow • Templates Enhancing Queue Inflow Main Editors Share • Templates Enhancing Queue Inflow Vendor Share **Feedback loops:** 0
Consul-tancies	#223 C	**Vendor Templates Production per Consultancy Week** (Templates/Week) = 22.5 **Description:** *The average number of templates produced or enhanced per consultancy week.* **Present in 1 view:** • Consultancies **Used by:**

Group	Type	Variable Name and Description
		• Vendor Templates Potential Production **Feedback loops:** 0
Control	#227 C 	**Weeks per Year** (Weeks/Year) = 52 **Present in 7 views:** • Templates • Workforce • Editors Effective Experience • Main Editors Effective Experience • Training • Consultancies • Costs **Used by:** • Consultancy Schedule • Editors Effective Experience Decay Rate • Editors Leave and Transfer Rate • Editors Training Schedule • Main Editors Effective Experience Decay Rate • Main Editors Effective Experience in Templates Decay Rate • Main Editors Leave Rate • Main Editors Training on Templates Schedule • Main Editors Training Schedule • Required Templates Increase Rate • Sum All Editors Weekly Wages Cost • Sum All Main Editors Weekly Wages Cost **Feedback loops:** 0

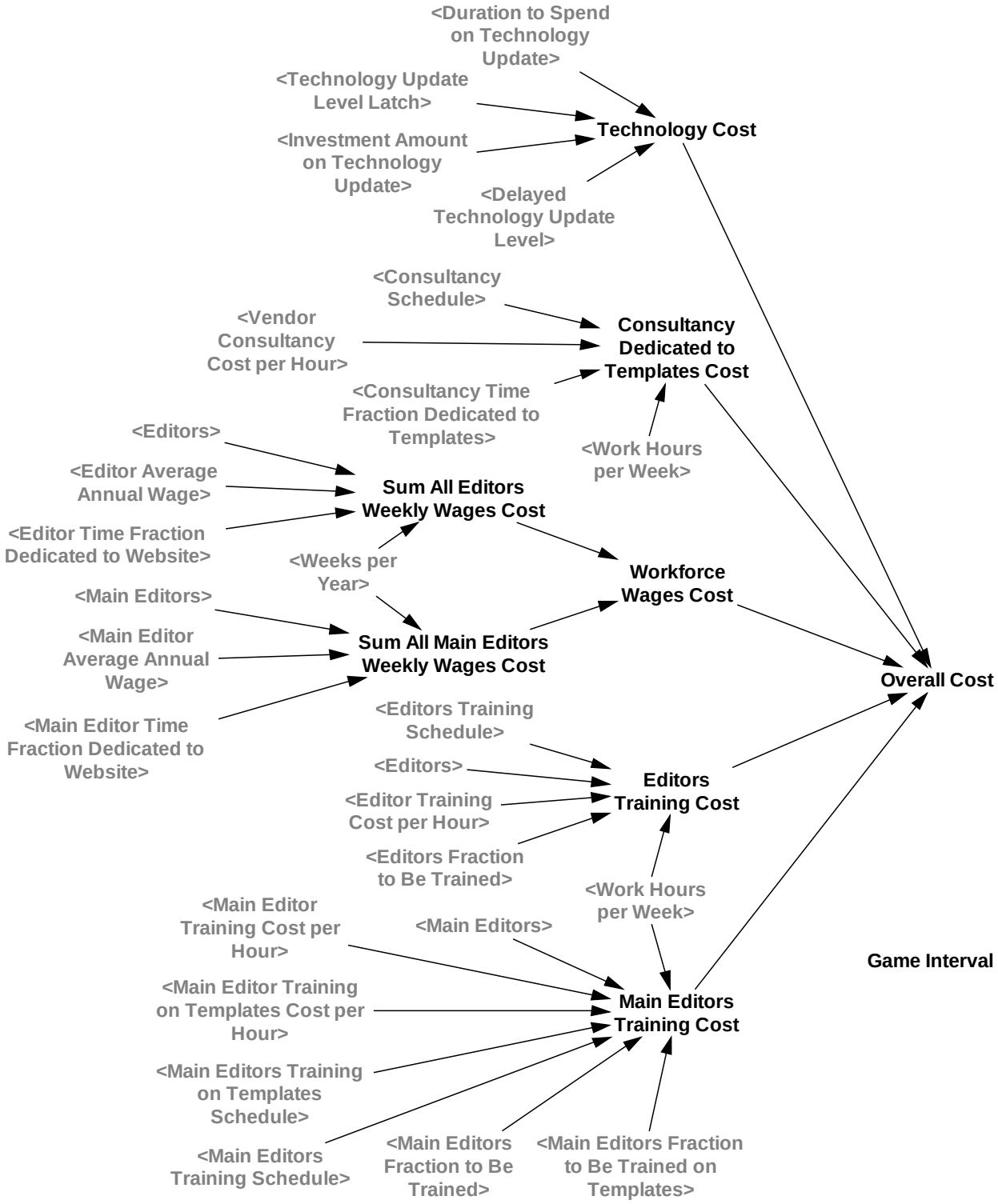
B.11 Technology Subsystem (6 variables)



Group	Type	Variable Name and Description
Technol-ogy	#32 DE	**Delayed Technology Update Level** (Dimensionless) = DELAY FIXED (Technology Update Level Latch ,Delayed Technology Update Level Delay Duration, Technology Update Level Latch) **Present in 2 views:** • Technology • Costs **Used by:** • Editors Effective Experience Fractional Decay Rate due to Technology Change • Main Editors Effective Experience Fractional Decay Rate due to Technology Change • Technology Cost

Group	Type	Variable Name and Description
		Feedback loops: 0
Technol-ogy	#33 C 	**Delayed Technology Update Level Delay Duration** (Weeks) = 1 **Present in 1 view:** • Technology **Used by:** • Delayed Technology Update Level **Feedback loops:** 0
Technol-ogy	#192 A 	**Technology Update Level** (Dimensionless) = IF THEN ELSE (Technology Update Switch = 1 :AND: Technology Update Start Time<= Time , 1, 0) **Present in 1 view:** • Technology **Used by:** • Technology Update Level Latch **Feedback loops:** 0
Technol-ogy	#193 A 	**Technology Update Level Latch** (Dimensionless) = SAMPLE IF TRUE(Technology Update Level = 1, 1, 0) **Present in 3 views:** • Website Accessibility Score • Technology • Costs **Used by:** • Average Failed Tests Applied per Webpage due to Technology • Delayed Technology Update Level • Editors Effective Experience Fractional Decay Rate due to Technology Change • Main Editors Effective Experience Fractional Decay Rate due to Technology Change • Technology Cost **Feedback loops:** 0
Technol-ogy	#194 G 	**Technology Update Start Time** (Week [0,13,1]) = GAME(0) **Present in 1 view:** • Technology **Used by:** • Technology Update Level **Feedback loops:** 0
Control	#195 G 	**Technology Update Switch** (Dimensionless [0,1,1]) = GAME(0) **Present in 1 view:** • Technology **Used by:** • Technology Update Level **Feedback loops:** 0

B.12 Costs Subsystem (36 variables)



Group	Type	Variable Name and Description
Costs Compu-tations	#25 A VAB	**Consultancy Dedicated to Templates Cost** (NOK/Week) = Consultancy Schedule * Consultancy Time Fraction Dedicated to Templates* Vendor Consultancy Cost per Hour * Work Hours per Week **Present in 1 view:** • Costs

Group	Type	Variable Name and Description
		Used by: • Overall Cost **Feedback loops:** 0
Consul-tancies	#28 A 	**Consultancy Schedule** (Dimensionless) = Consultancy Switch * IF THEN ELSE (Consultancy Frequency per Year> 0, PULSE TRAIN (Consultancy Start Time , Consultancy Duration in Weeks , Weeks per Year / Consultancy Frequency per Year , FINAL TIME) , PULSE (Consultancy Start Time ,Consultancy Duration in Weeks)) **Present in 2 views:** • Consultancies • Costs **Used by:** • Consultancy Dedicated to Templates Cost • Vendor Templates Potential Production **Feedback loops:** 0
Consul-tancies	#31 G 	**Consultancy Time Fraction Dedicated to Templates** (Dimensionless [0,1,0.05]) = GAME(1) **Present in 2 views:** • Consultancies • Costs **Used by:** • Consultancy Dedicated to Templates Cost • Vendor Templates Potential Production **Feedback loops:** 0
Technol-ogy	#32 DE	**Delayed Technology Update Level** (Dimensionless) = DELAY FIXED (Technology Update Level Latch ,Delayed Technology Update Level Delay Duration, Technology Update Level Latch) **Present in 2 views:** • Technology • Costs **Used by:** • Editors Effective Experience Fractional Decay Rate due to Technology Change • Main Editors Effective Experience Fractional Decay Rate due to Technology Change • Technology Cost **Feedback loops:** 0
Costs Compu-tations	#35 C 	**Duration to Spend on Technology Update** (Weeks) = 1 **Present in 1 view:** • Costs **Used by:** • Technology Cost **Feedback loops:** 0
Costs Compu-tations	#36 C 	**Editor Average Annual Wage** (NOK/(Year*Person)) = 406800 **Description:** *Public sector average monthly basic salary * 12 months http://www.ssb.no /lonnansatt_en/tab-2011-03-31-01-en.html* **Present in 1 view:** • Costs **Used by:**

Group	Type	Variable Name and Description
		• Sum All Editors Weekly Wages Cost **Feedback loops:** 0
Control	#46 G	**Editor Time Fraction Dedicated to Website** (Dimensionless [0,1,0.05]) = GAME(0.08) **Description:** *The time fraction dedicated by the editor to the website. The number is based on Trondheim municipality interview (part-time 20%)* **Present in 2 views:** • Workforce • Costs **Used by:** • Editors Articles Potential Net Production • Staff Communication Overhead inside Department • Sum All Editors Weekly Wages Cost **Feedback loops:** 0
Costs Compu-tations	#48 C	**Editor Training Cost per Hour** (NOK/(Hour*Person)) = 260 **Description:** *DIFI's estimates* **Present in 1 view:** • Costs **Used by:** • Editors Training Cost **Feedback loops:** 0
Work-force	#49 L,LI	**Editors** (Persons) = $\int$ (New Editors Assimilation Rate - Editors Leave and Transfer Rate) $\cdot dt$ + [INITIAL Editors] **Present in 3 views:** • Workforce • Editors Effective Experience • Costs **Used by:** • Editor Average Effective Experience • Editors Articles Potential Net Production • Editors Effective Experience Increase Rate due to Training • Editors Gap • Editors Leave and Transfer Rate • Editors Training Cost • Staff Communication Overhead inside Department • Sum All Editors Weekly Wages Cost • Total Editors Effective Experience **Feedback loops:** 3 (5.3 %)
Control	#60 G	**Editors Fraction to Be Trained** (Dimensionless [0,1,0.05]) = GAME(0.2) **Present in 2 views:** • Editors Effective Experience • Costs **Used by:** • Editors Effective Experience Increase Rate due to Training • Editors Time Fraction Lost in Training • Editors Training Cost

Group	Type	Variable Name and Description
		Feedback loops: 0
Costs Computations	#66 A	**Editors Training Cost** (NOK/Week) = Editors Training Schedule * Editors * Editors Fraction to Be Trained* Editor Training Cost per Hour * Work Hours per Week **Present in 1 view:** • Costs **Used by:** • Overall Cost **Feedback loops:** 0
Training	#69 A	**Editors Training Schedule** (Dimensionless) = Editors Training Switch * IF THEN ELSE (Editors Training Frequency per Year> 0, PULSE TRAIN (Editors Training Start Time , Editors Training Duration in Weeks, Weeks per Year / Editors Training Frequency per Year , FINAL TIME) , PULSE (Editors Training Start Time,Editors Training Duration in Weeks)) **Description:** *external trainers* **Present in 3 views:** • Editors Effective Experience • Training • Costs **Used by:** • Editors Effective Experience Increase Rate due to Training • Editors Time Fraction Lost in Training • Editors Training Cost **Feedback loops:** 0
Control	#86 C	**Game Interval** (Weeks) = 13 **Description:** *"Use GAME INTERVAL to specify how far a model should advance during gaming. This value can be changed later using the Gaming Control Dialog or GAME commands." Vensim Reference Manual* **Present in 1 view:** • Costs **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Costs Computations	#99 C	**Investment Amount on Technology Update** (NOK) = 104028 **Present in 1 view:** • Costs **Used by:** • Technology Cost **Feedback loops:** 0
Costs Computations	#100 C	**Main Editor Average Annual Wage** (NOK/(Year*Person)) = 511601 **Description:** *Average computed using salaries from taxes reports for selected main editors.* **Present in 1 view:** • Costs **Used by:** • Sum All Main Editors Weekly Wages Cost **Feedback loops:** 0
Control	#121	**Main Editor Time Fraction Dedicated to Website** (Dimensionless [0,1,0.05])

Group	Type	Variable Name and Description
	G	= GAME(1) **Description:** *The time fraction dedicated by the main editor to the website. The number is based on municipalities interview (full-time)* **Present in 2 views:** • Workforce • Costs **Used by:** • Editors Assimilation Training Overhead • Main Editors Articles Potential Net Production • Main Editors Templates Potential Net Production • New Editors Assimilation Rate • Staff Communication Overhead among Main Editors • Staff Communication Overhead inside Department • Sum All Main Editors Weekly Wages Cost **Feedback loops:** 0
Costs Compu-tations	#123 C	**Main Editor Training Cost per Hour** (NOK/(Hour*Person)) = 260 **Description:** *DIFI's estimates* **Present in 1 view:** • Costs **Used by:** • Main Editors Training Cost **Feedback loops:** 0
Main Editors Effective Experi-ence	#124 C	**Main Editor Training on Templates Cost per Hour** (NOK/(Hour*Person)) = 607.5 **Description:** *EPiServer training cost per hour (www.episerver.com). 16,200 SEK for 3 days --> 16,200*0.9 (NOK per SEK)/(3 days *8 hours per day)* **Present in 1 view:** • Costs **Used by:** • Main Editors Training Cost **Feedback loops:** 0
Work-force	#125 L,LI	**Main Editors** (Persons) = $\int$ (Main Editors Hiring and Firing Rate - Main Editors Leave Rate) $\cdot dt$ + [INITIAL Main Editors] **Present in 3 views:** • Workforce • Main Editors Effective Experience • Costs **Used by:** • Editors Assimilation Training Overhead • Main Editor Average Effective Experience • Main Editor Average Effective Experience in Templates • Main Editors Articles Potential Net Production • Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Effective Experience Increase Rate due to Training • Main Editors Hiring and Firing Rate • Main Editors Leave Rate • Main Editors Templates Potential Net Production

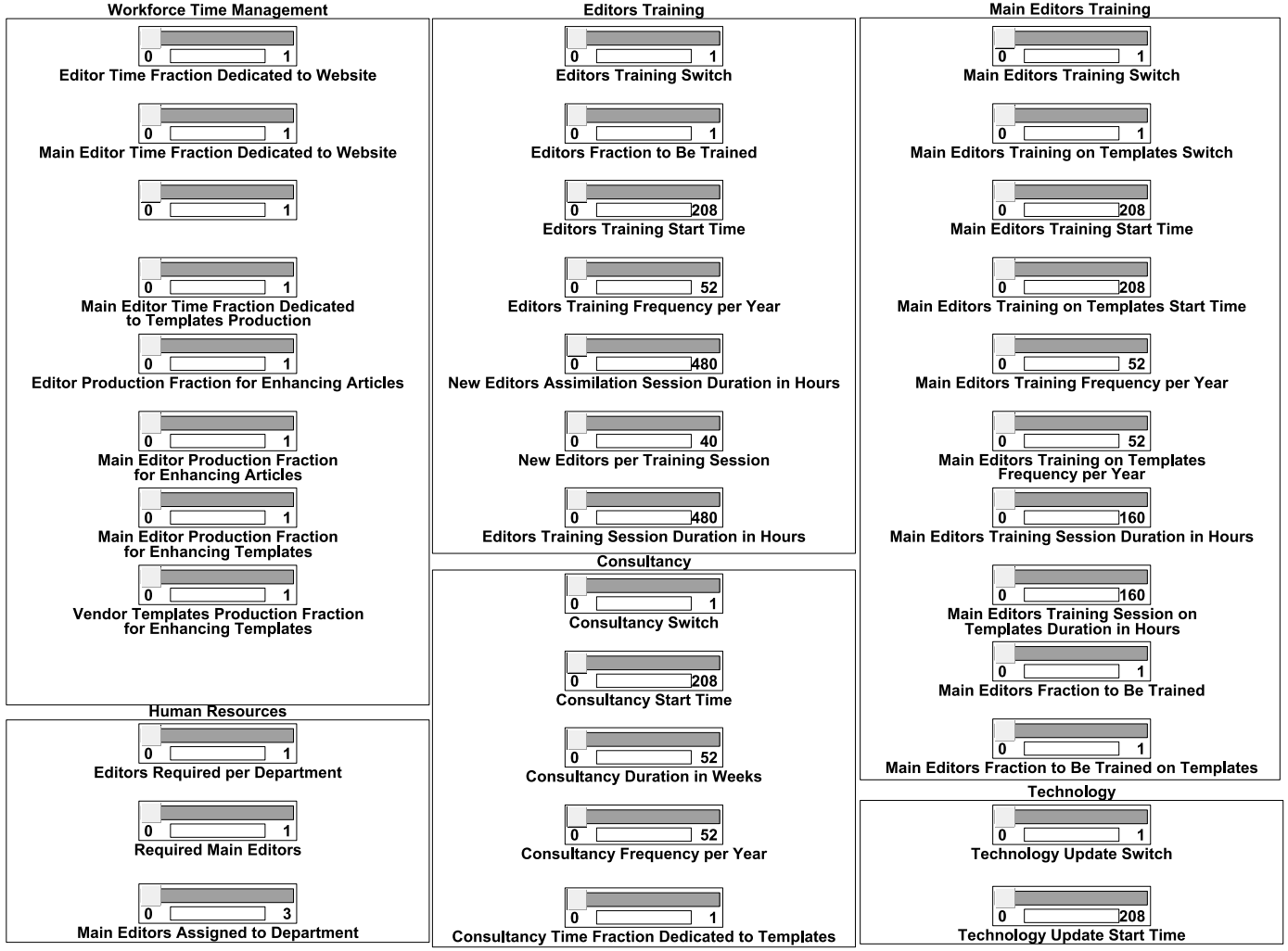
Group	Type	Variable Name and Description
		• Main Editors Training Cost • New Editors Assimilation Rate • Staff Communication Overhead among Main Editors • Staff Communication Overhead on Main Editor • Sum All Main Editors Weekly Wages Cost • Total Main Editors Effective Experience • Total Main Editors Effective Experience in Templates **Feedback loops:** 3 (5.3 %)
Control	#143 G	**Main Editors Fraction to Be Trained** (Dimensionless [0,1,0.05]) = GAME(0.5) **Present in 2 views:** • Main Editors Effective Experience • Costs **Used by:** • Main Editors Effective Experience Increase Rate due to Training • Main Editors Time Fraction Lost in Training • Main Editors Training Cost **Feedback loops:** 0
Control	#144 G	**Main Editors Fraction to Be Trained on Templates** (Dimensionless [0,1,0.05]) = GAME(0.5) **Present in 2 views:** • Main Editors Effective Experience • Costs **Used by:** • Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Time Fraction Lost in Training • Main Editors Training Cost **Feedback loops:** 0
Costs Compu-tations	#150 A	**Main Editors Training Cost** (NOK/Week) = (Main Editors Training Schedule * Main Editors * Main Editors Fraction to Be Trained* Main Editor Training Cost per Hour * Work Hours per Week) + (Main Editors Training on Templates Schedule* Main Editors * Main Editors Fraction to Be Trained on Templates * Main Editor Training on Templates Cost per Hour* Work Hours per Week) **Present in 1 view:** • Costs **Used by:** • Overall Cost **Feedback loops:** 0
Training	#155 A	**Main Editors Training on Templates Schedule** (Dimensionless) = Main Editors Training on Templates Switch* IF THEN ELSE (Main Editors Training on Templates Frequency per Year > 0, PULSE TRAIN(Main Editors Training on Templates Start Time , Main Editors Training on Templates Duration in Weeks, Weeks per Year / Main Editors Training on Templates Frequency per Year , FINAL TIME) , PULSE (Main Editors Training on Templates Start Time , Main Editors Training on Templates Duration in Weeks)) **Description:** *external trainers* **Present in 3 views:** • Main Editors Effective Experience • Training • Costs

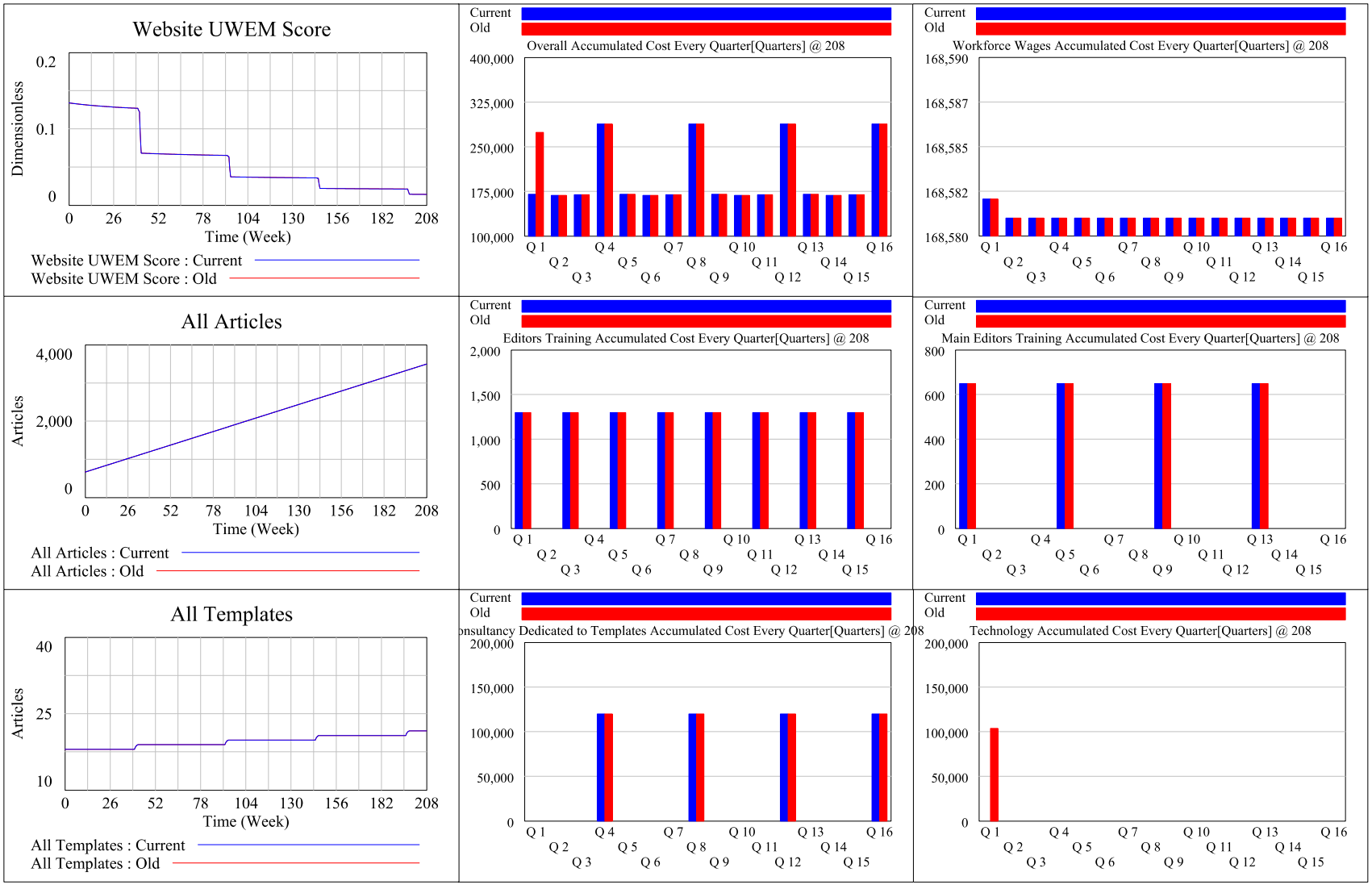
Group	Type	Variable Name and Description
		Used by: • Main Editors Effective Experience in Templates Increase Rate due to Training • Main Editors Time Fraction Lost in Training • Main Editors Training Cost **Feedback loops:** 0
Training	#158 A 	**Main Editors Training Schedule** (Dimensionless) = Main Editors Training Switch * IF THEN ELSE (Main Editors Training Frequency per Year> 0, PULSE TRAIN (Main Editors Training Start Time , Main Editors Training Duration in Weeks, Weeks per Year / Main Editors Training Frequency per Year , FINAL TIME) , PULSE(Main Editors Training Start Time , Main Editors Training Duration in Weeks)) **Description:** *external trainers* **Present in 3 views:** • Main Editors Effective Experience • Training • Costs **Used by:** • Main Editors Effective Experience Increase Rate due to Training • Main Editors Time Fraction Lost in Training • Main Editors Training Cost **Feedback loops:** 0
Costs Computations	#175 A 	**Overall Cost** (NOK/Week) = Consultancy Dedicated to Templates Cost + Editors Training Cost + Main Editors Training Cost+ Technology Cost + Workforce Wages Cost **Present in 1 view:** • Costs **Used by:** **This is a supplementary variable.** **Feedback loops:** 0
Costs Computations	#189 A 	**Sum All Editors Weekly Wages Cost** (NOK/Week) = (Editors * Editor Average Annual Wage * Editor Time Fraction Dedicated to Website) / Weeks per Year **Present in 1 view:** • Costs **Used by:** • Workforce Wages Cost **Feedback loops:** 0
Costs Computations	#190 A 	**Sum All Main Editors Weekly Wages Cost** (NOK/Week) = (Main Editors * Main Editor Average Annual Wage* Main Editor Time Fraction Dedicated to Website) / Weeks per Year **Present in 1 view:** • Costs **Used by:** • Workforce Wages Cost **Feedback loops:** 0
Costs Computations	#191 A 	**Technology Cost** (NOK/Week) = IF THEN ELSE (Technology Update Level Latch - Delayed Technology Update Level<> 0, Investment Amount on Technology Update /Duration to Spend on Technology Update, 0) **Present in 1 view:**

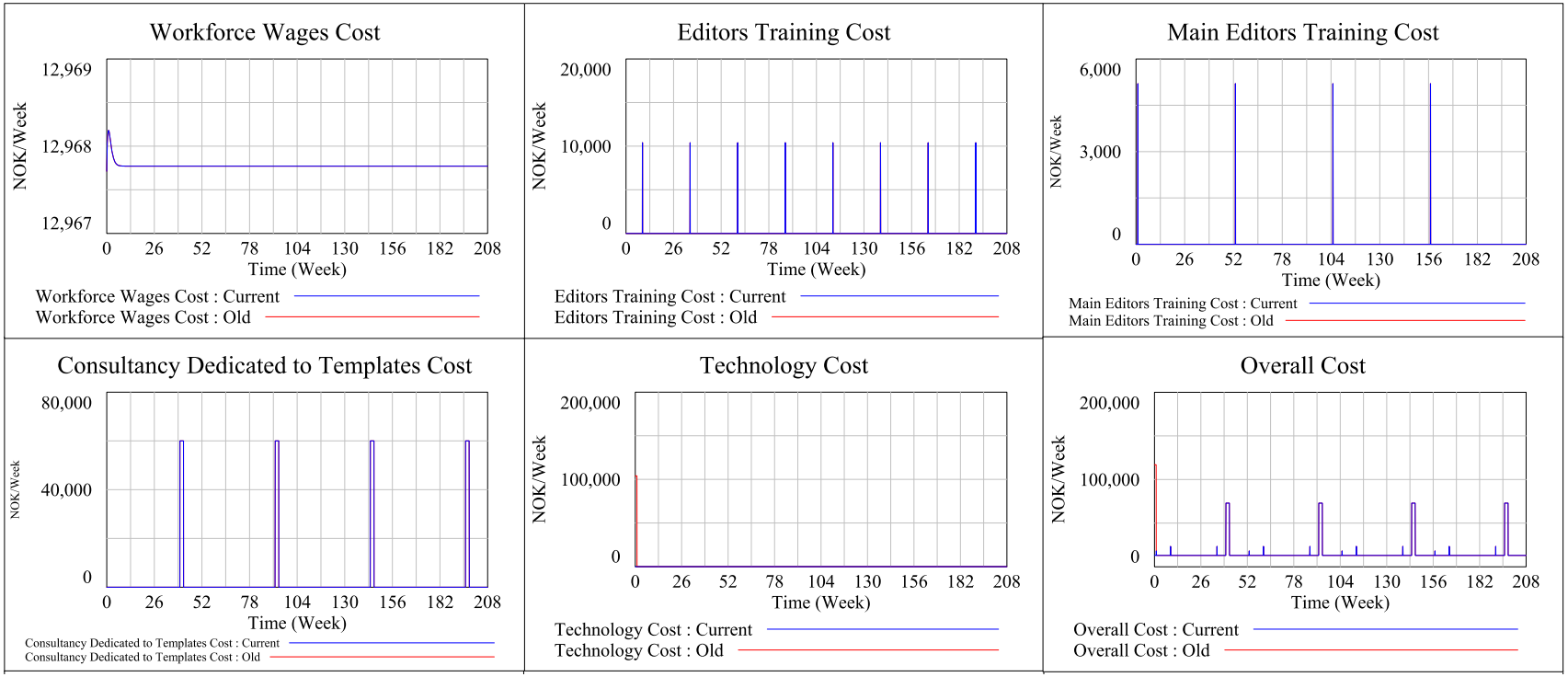
Group	Type	Variable Name and Description
		• Costs **Used by:** • Overall Cost **Feedback loops:** 0
Technol-ogy	#193 A	**Technology Update Level Latch** (Dimensionless) = SAMPLE IF TRUE(Technology Update Level = 1, 1, 0) **Present in 3 views:** • Website Accessibility Score • Technology • Costs **Used by:** • Average Failed Tests Applied per Webpage due to Technology • Delayed Technology Update Level • Editors Effective Experience Fractional Decay Rate due to Technology Change • Main Editors Effective Experience Fractional Decay Rate due to Technology Change • Technology Cost **Feedback loops:** 0
Costs Compu-tations	#220 C	**Vendor Consultancy Cost per Hour** (NOK/Hour) = 1500 **Description:** *DIFI's estimates* **Present in 1 view:** • Costs **Used by:** • Consultancy Dedicated to Templates Cost **Feedback loops:** 0
Control	#227 C	**Weeks per Year** (Weeks/Year) = 52 **Present in 7 views:** • Templates • Workforce • Editors Effective Experience • Main Editors Effective Experience • Training • Consultancies • Costs **Used by:** • Consultancy Schedule • Editors Effective Experience Decay Rate • Editors Leave and Transfer Rate • Editors Training Schedule • Main Editors Effective Experience Decay Rate • Main Editors Effective Experience in Templates Decay Rate • Main Editors Leave Rate • Main Editors Training on Templates Schedule • Main Editors Training Schedule • Required Templates Increase Rate • Sum All Editors Weekly Wages Cost • Sum All Main Editors Weekly Wages Cost **Feedback loops:** 0

Group	Type	Variable Name and Description
Control	#228 C 	**Work Hours per Week** (Hours/Week) = 40 **Present in 2 views:** • Training • Costs **Used by:** • Consultancy Dedicated to Templates Cost • Editors Training Cost • Editors Training Duration in Weeks • Main Editors Training Cost • Main Editors Training Duration in Weeks • Main Editors Training on Templates Duration in Weeks **Feedback loops:** 0
Costs Compu-tations	#230 A 	**Workforce Wages Cost** (NOK/Week) = Sum All Main Editors Weekly Wages Cost + Sum All Editors Weekly Wages Cost **Present in 1 view:** • Costs **Used by:** • Overall Cost **Feedback loops:** 0

B.13 Vensim ILE GUI




Website UWEM Score
Dimensionless
0.2
0.1
0
0 26 52 78 104 130 156 182 208
Time (Week)
Website UWEM Score : Current
Website UWEM Score : Old
Current
Old
Overall Accumulated Cost Every Quarter[Quarters] @ 208
400,000
325,000
250,000
175,000
100,000
Q 1 Q 2 Q 3 Q 4 Q 5 Q 6 Q 7 Q 8 Q 9 Q 10 Q 11 Q 12 Q 13 Q 14 Q 15 Q 16
Current
Old
Workforce Wages Accumulated Cost Every Quarter[Quarters] @ 208
168,590
168,587
168,585
168,582
168,580
Q 1 Q 2 Q 3 Q 4 Q 5 Q 6 Q 7 Q 8 Q 9 Q 10 Q 11 Q 12 Q 13 Q 14 Q 15 Q 16
All Articles
Articles
4,000
2,000
0
0 26 52 78 104 130 156 182 208
Time (Week)
All Articles : Current
All Articles : Old
Current
Old
Editors Training Accumulated Cost Every Quarter[Quarters] @ 208
2,000
1,500
1,000
500
0
Q 1 Q 2 Q 3 Q 4 Q 5 Q 6 Q 7 Q 8 Q 9 Q 10 Q 11 Q 12 Q 13 Q 14 Q 15 Q 16
Current
Old
Main Editors Training Accumulated Cost Every Quarter[Quarters] @ 208
800
600
400
200
0
Q 1 Q 2 Q 3 Q 4 Q 5 Q 6 Q 7 Q 8 Q 9 Q 10 Q 11 Q 12 Q 13 Q 14 Q 15 Q 16
All Templates
Articles
40
25
10
0 26 52 78 104 130 156 182 208
Time (Week)
All Templates : Current
All Templates : Old
Current
Old
nsultancy Dedicated to Templates Accumulated Cost Every Quarter[Quarters] @ 208
200,000
150,000
100,000
50,000
0
Q 1 Q 2 Q 3 Q 4 Q 5 Q 6 Q 7 Q 8 Q 9 Q 10 Q 11 Q 12 Q 13 Q 14 Q 15 Q 16
Current
Old
Technology Accumulated Cost Every Quarter[Quarters] @ 208
200,000
150,000
100,000
50,000
0
Q 1 Q 2 Q 3 Q 4 Q 5 Q 6 Q 7 Q 8 Q 9 Q 10 Q 11 Q 12 Q 13 Q 14 Q 15 Q 16


Workforce Wages Cost
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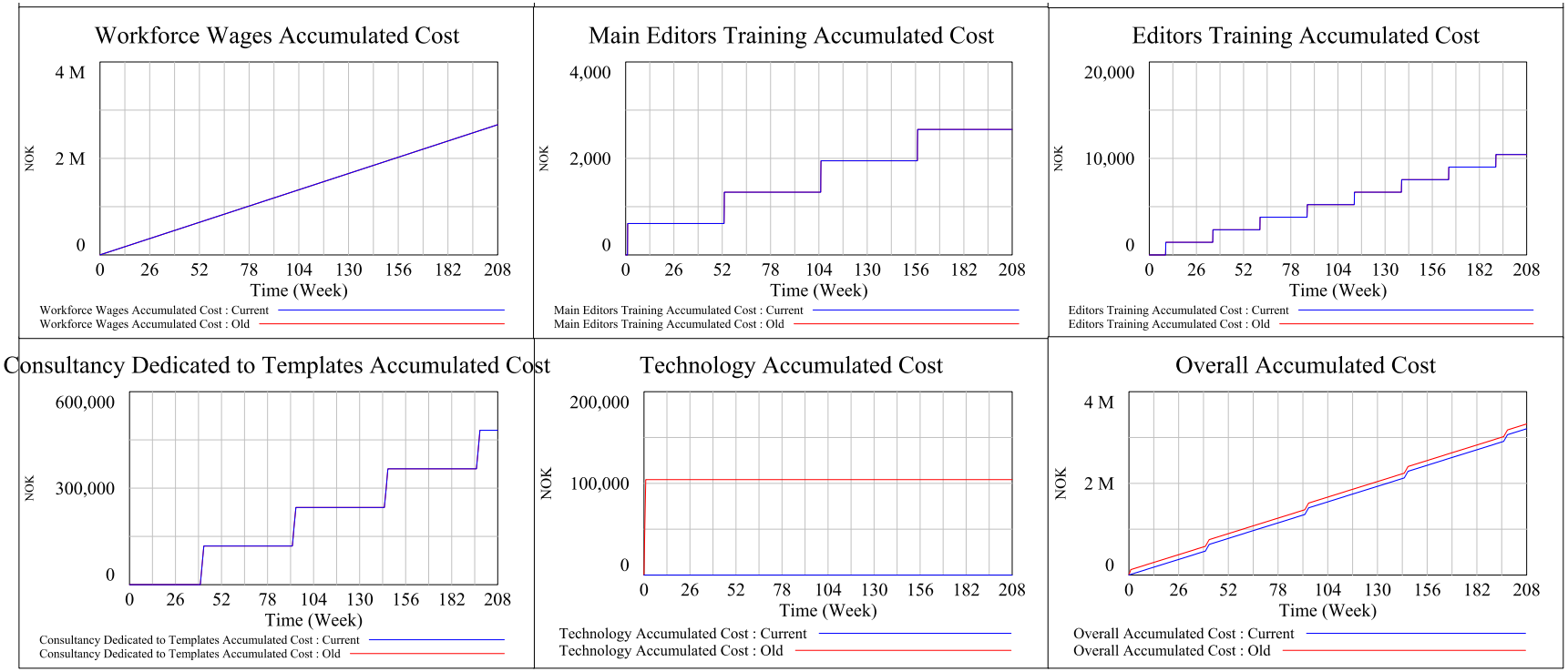
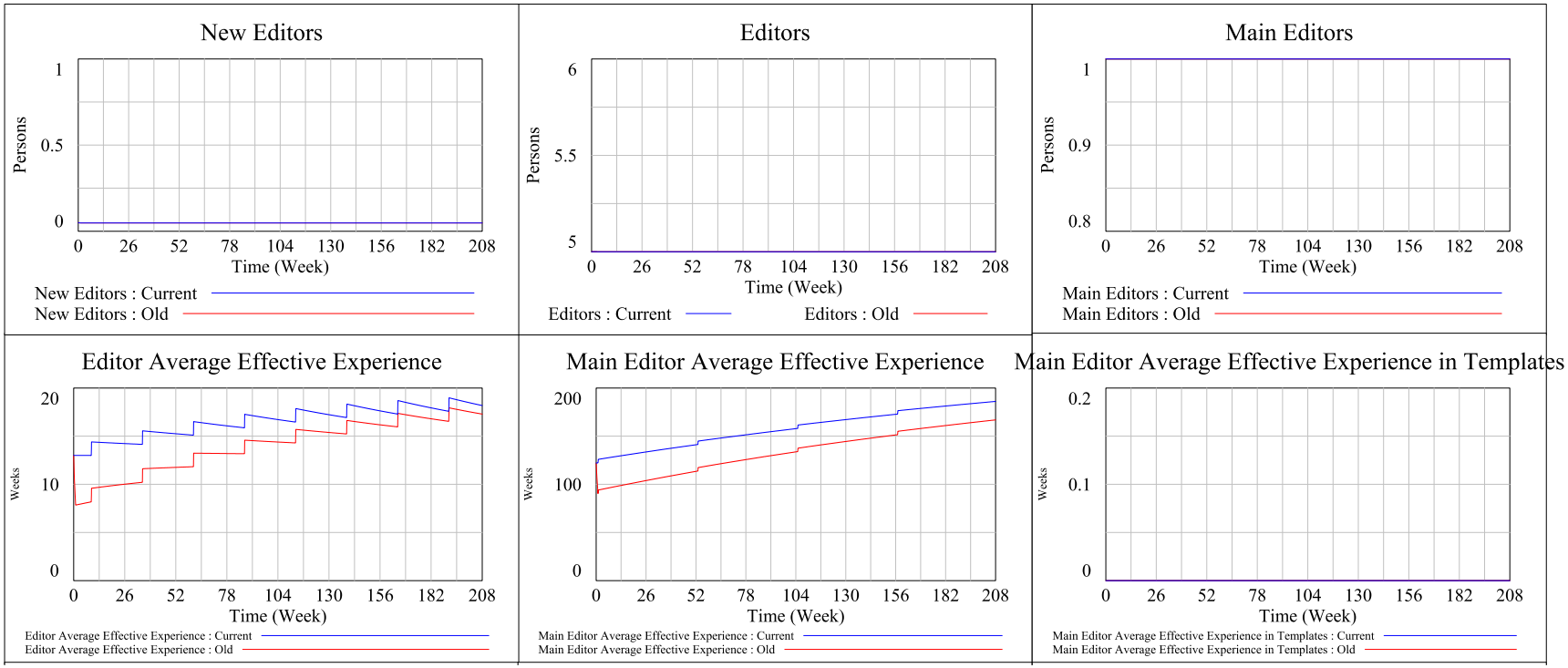
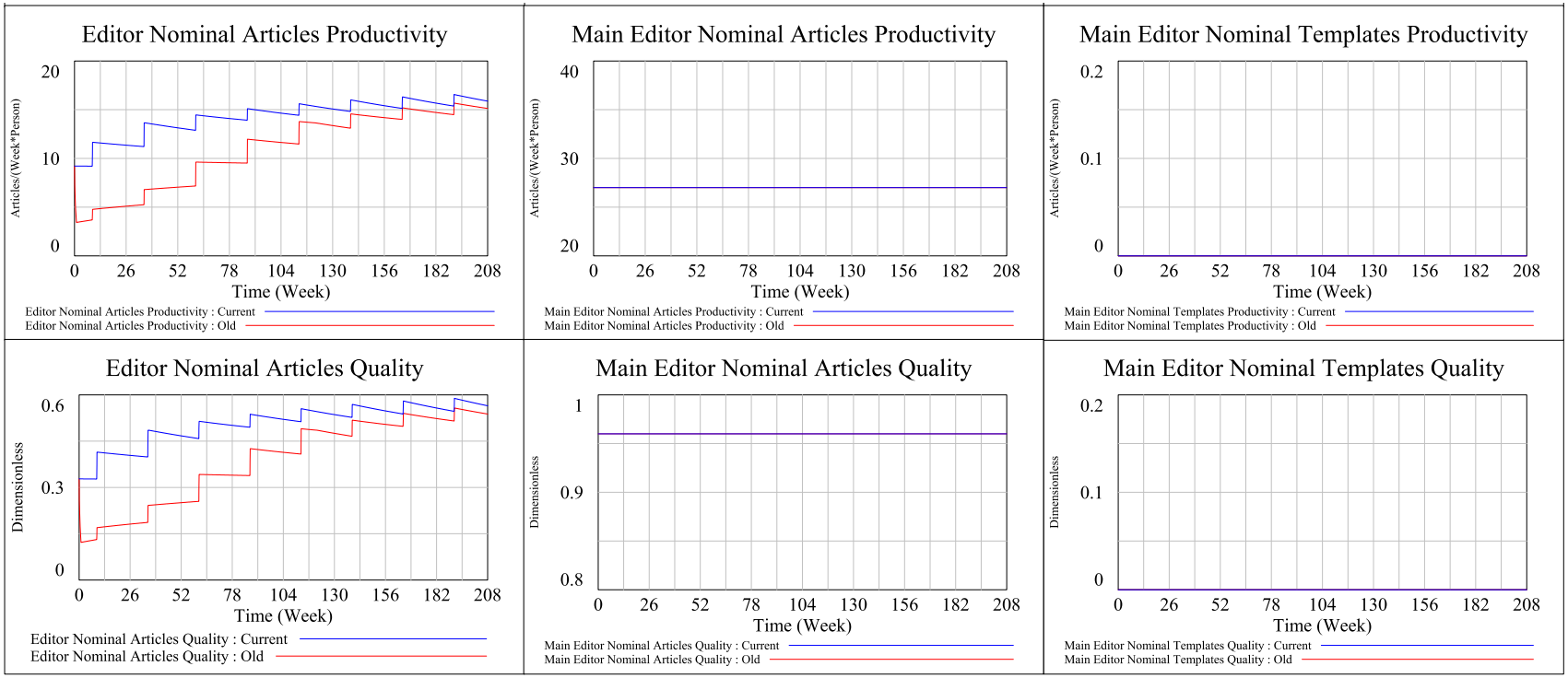
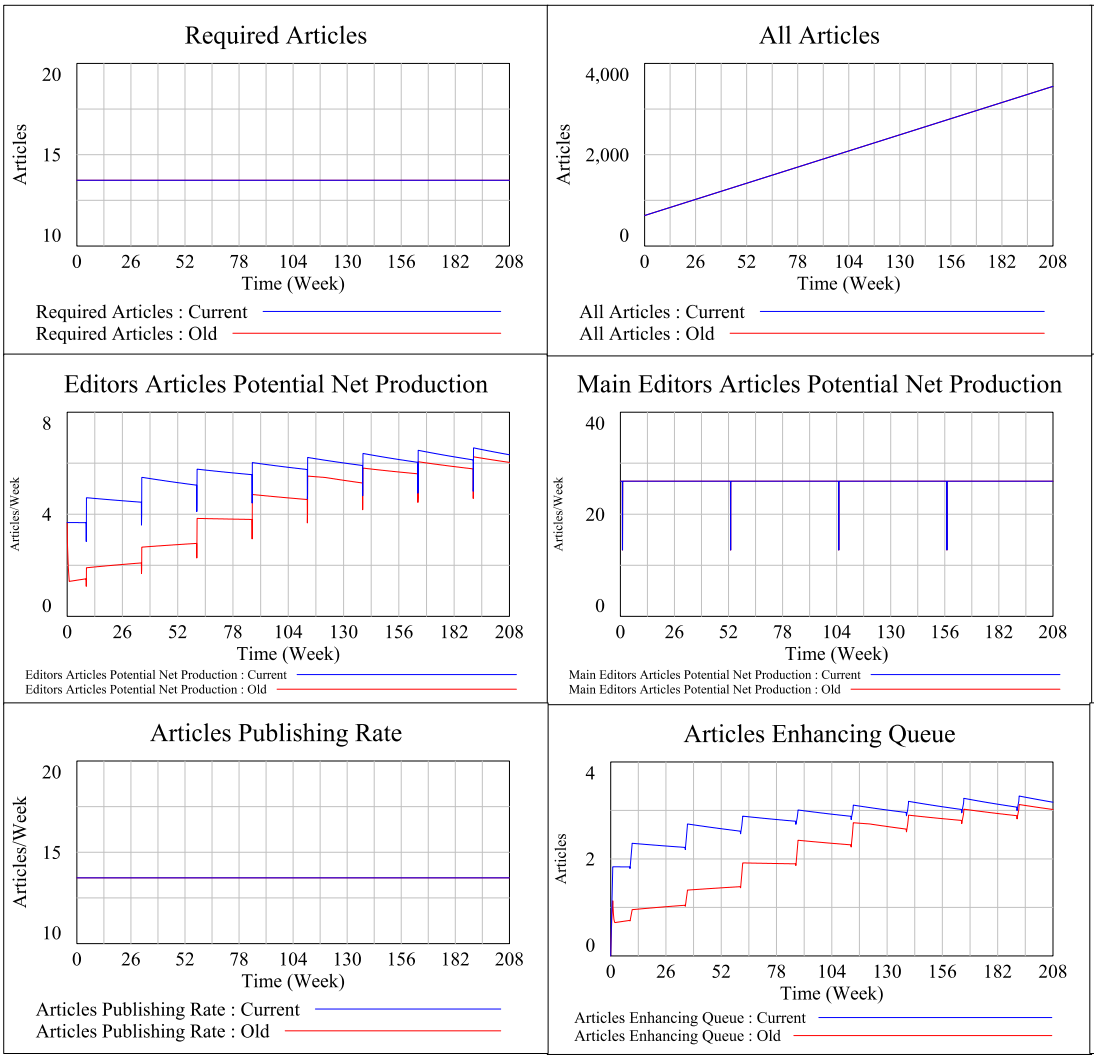
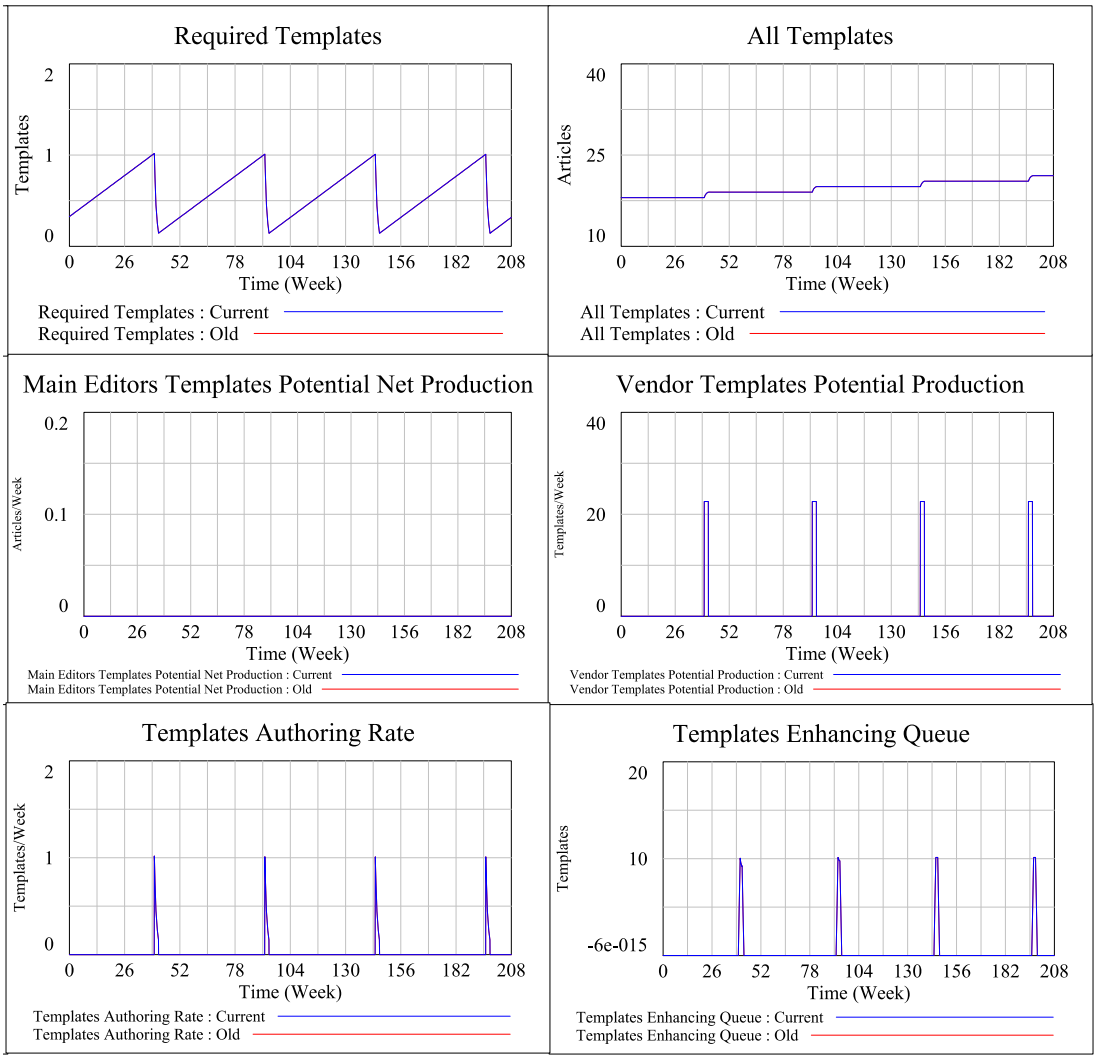
12,968
12,967
NOK/Week
0 26 52 78 104 130 156 182 208
Time (Week)
Workforce Wages Cost : Current
Workforce Wages Cost : Old
Editors Training Cost
20,000
10,000
0
NOK/Week
0 26 52 78 104 130 156 182 208
Time (Week)
Editors Training Cost : Current
Editors Training Cost : Old
Main Editors Training Cost
6,000
3,000
0
NOK/Week
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editors Training Cost : Current
Main Editors Training Cost : Old
Consultancy Dedicated to Templates Cost
80,000
40,000
0
NOK/Week
0 26 52 78 104 130 156 182 208
Time (Week)
Consultancy Dedicated to Templates Cost : Current
Consultancy Dedicated to Templates Cost : Old
Technology Cost
200,000
100,000
0
NOK/Week
0 26 52 78 104 130 156 182 208
Time (Week)
Technology Cost : Current
Technology Cost : Old
Overall Cost
200,000
100,000
0
NOK/Week
0 26 52 78 104 130 156 182 208
Time (Week)
Overall Cost : Current
Overall Cost : Old


Workforce Wages Accumulated Cost
4 M
2 M
0
NOK
0 26 52 78 104 130 156 182 208
Time (Week)
Workforce Wages Accumulated Cost : Current
Workforce Wages Accumulated Cost : Old
Main Editors Training Accumulated Cost
4,000
2,000
0
NOK
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editors Training Accumulated Cost : Current
Main Editors Training Accumulated Cost : Old
Editors Training Accumulated Cost
20,000
10,000
0
NOK
0 26 52 78 104 130 156 182 208
Time (Week)
Editors Training Accumulated Cost : Current
Editors Training Accumulated Cost : Old
Consultancy Dedicated to Templates Accumulated Cost
600,000
300,000
0
NOK
0 26 52 78 104 130 156 182 208
Time (Week)
Consultancy Dedicated to Templates Accumulated Cost : Current
Consultancy Dedicated to Templates Accumulated Cost : Old
Technology Accumulated Cost
200,000
100,000
0
NOK
0 26 52 78 104 130 156 182 208
Time (Week)
Technology Accumulated Cost : Current
Technology Accumulated Cost : Old
Overall Accumulated Cost
4 M
2 M
0
NOK
0 26 52 78 104 130 156 182 208
Time (Week)
Overall Accumulated Cost : Current
Overall Accumulated Cost : Old


New Editors
Persons
1
0.5
0
0 26 52 78 104 130 156 182 208
Time (Week)
New Editors : Current
New Editors : Old
Editors
Persons
6
5.5
5
0 26 52 78 104 130 156 182 208
Time (Week)
Editors : Current
Editors : Old
Main Editors
Persons
1
0.9
0.8
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editors : Current
Main Editors : Old
Editor Average Effective Experience
Weeks
20
10
0
0 26 52 78 104 130 156 182 208
Time (Week)
Editor Average Effective Experience : Current
Editor Average Effective Experience : Old
Main Editor Average Effective Experience
Weeks
200
100
0
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editor Average Effective Experience : Current
Main Editor Average Effective Experience : Old
Main Editor Average Effective Experience in Templates
Weeks
0.2
0.1
0
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editor Average Effective Experience in Templates : Current
Main Editor Average Effective Experience in Templates : Old


Editor Nominal Articles Productivity
Articles/(Week*Person)
20
10
0
0 26 52 78 104 130 156 182 208
Time (Week)
Editor Nominal Articles Productivity : Current
Editor Nominal Articles Productivity : Old
Main Editor Nominal Articles Productivity
Articles/(Week*Person)
40
30
20
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editor Nominal Articles Productivity : Current
Main Editor Nominal Articles Productivity : Old
Main Editor Nominal Templates Productivity
Articles/(Week*Person)
0.2
0.1
0
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editor Nominal Templates Productivity : Current
Main Editor Nominal Templates Productivity : Old
Editor Nominal Articles Quality
Dimensionless
0.6
0.3
0
0 26 52 78 104 130 156 182 208
Time (Week)
Editor Nominal Articles Quality : Current
Editor Nominal Articles Quality : Old
Main Editor Nominal Articles Quality
Dimensionless
1
0.9
0.8
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editor Nominal Articles Quality : Current
Main Editor Nominal Articles Quality : Old
Main Editor Nominal Templates Quality
Dimensionless
0.2
0.1
0
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editor Nominal Templates Quality : Current
Main Editor Nominal Templates Quality : Old


Required Articles
Articles
20
15
10
0 26 52 78 104 130 156 182 208
Time (Week)
Required Articles : Current
Required Articles : Old
All Articles
Articles
4,000
2,000
0
0 26 52 78 104 130 156 182 208
Time (Week)
All Articles : Current
All Articles : Old
Editors Articles Potential Net Production
Articles/Week
8
4
0
0 26 52 78 104 130 156 182 208
Time (Week)
Editors Articles Potential Net Production : Current
Editors Articles Potential Net Production : Old
Main Editors Articles Potential Net Production
Articles/Week
40
20
0
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editors Articles Potential Net Production : Current
Main Editors Articles Potential Net Production : Old
Articles Publishing Rate
Articles/Week
20
15
10
0 26 52 78 104 130 156 182 208
Time (Week)
Articles Publishing Rate : Current
Articles Publishing Rate : Old
Articles Enhancing Queue
Articles
4
2
0
0 26 52 78 104 130 156 182 208
Time (Week)
Articles Enhancing Queue : Current
Articles Enhancing Queue : Old


Required Templates
Templates
2
1
0
0 26 52 78 104 130 156 182 208
Time (Week)
Required Templates : Current
Required Templates : Old
All Templates
Articles
40
25
10
0 26 52 78 104 130 156 182 208
Time (Week)
All Templates : Current
All Templates : Old
Main Editors Templates Potential Net Production
Articles/Week
0.2
0.1
0
0 26 52 78 104 130 156 182 208
Time (Week)
Main Editors Templates Potential Net Production : Current
Main Editors Templates Potential Net Production : Old
Vendor Templates Potential Production
Templates/Week
40
20
0
0 26 52 78 104 130 156 182 208
Time (Week)
Vendor Templates Potential Production : Current
Vendor Templates Potential Production : Old
Templates Authoring Rate
Templates/Week
2
1
0
0 26 52 78 104 130 156 182 208
Time (Week)
Templates Authoring Rate : Current
Templates Authoring Rate : Old
Templates Enhancing Queue
Templates
20
10
-6e-015
0 26 52 78 104 130 156 182 208
Time (Week)
Templates Enhancing Queue : Current
Templates Enhancing Queue : Old

C Sensitivity Analysis Report of PWD from Welfare to Jobs SD Model

C.1 Overview

Sensitivity Analysis [224], [11], aims at testing the robustness of the model under assumed uncertainties in parameters and initial values, was applied to the model using Vensim DSS [226]. To test model sensitivity, Vensim DSS uses Monte-Carlo simulations [229]. We have run 200 Monte-Carlo simulations per parameter. As no further information about the probability distribution of the parameters was available, we opted for Uniform probability distribution for all parameters.

The PWD from Welfare to Jobs SD Model has two different structures, as mentioned in Chapter 4, PWD shift to work (Current situation) shown in Figure 4-2, and a new policy PWD shift to work (Proposed programme) introduced via structural change, shown in Figure 4-4. Because of that, we have conducted the sensitivity analysis for all parameters in both cases separately. In the following sections the sensitivity graph of the (Proposed programme) case will be shown to the right of the sensitivity graph of the (Current situation) case.

As mentioned previously in Chapter 1, our systems exhibit emergence or emergent behaviour, which "refers to the novel and coherent structures, patterns, and properties that arise from the interaction of the parts of a complex system and take place at the system scale rather than at the component's scale" [116]. This was clear in the results of the univariate sampling. Many parameters exhibit no or very subtle effect on the *Employed PWD* variable, which we consider it the principal model output. Accordingly, we have followed the univariate sampling by a multivariate sampling where all the parameters were changed together. The following table shows the minimum and maximum values used in the sensitivity analysis for all parameters.

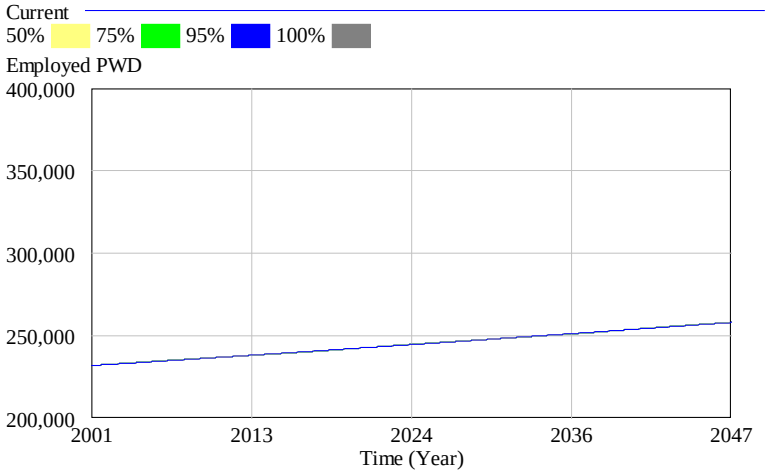
Parameter Name	Min	Max	Value	Units
Advertising Effectiveness	0.00122122	0.00366366	0.00244244	Dimensionless/Year
Advertising Spending Needed per Disabled Person per Year	18.70505	56.11515	37.4101	NOK/Person/Year
Advertising Spending Needed per Employer per Year	18.70505	56.11515	37.4101	NOK/Employer/Year
Average Pension for Disabled Person	44310	132930	88620	NOK/(Year*Person)

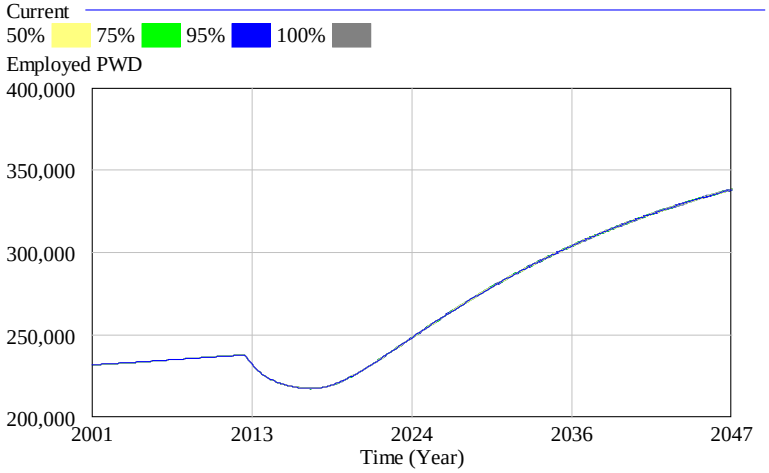
Parameter Name	Min	Max	Value	Units
Average Tax Tariff for Working PWD	0.14	0.42	0.28	Dimensionless
Average Time to Prepare Employer to Recruit PWD	0.505	1.515	1.01	Year
Average Training Cost per Disabled Person	222222	666666	444444	NOK/Person
Average Wage for Working Disabled Person	91950	275850	183900	NOK/(Year*Person)
Employed PWD Work Quitting Fraction	0.0165	0.0495	0.033	Dimensionless/Year
Employers Contact Rate	13.1716	39.5148	26.3432	Dimensionless/Year
Employers Decrease Fraction	0.0059503	0.0178509	0.0119006	Dimensionless/Year
Employers Increase Fraction	0.0071053	0.0213159	0.0142106	Dimensionless/Year
Employers Recruiting PWD Adoption Fraction from Word of Mouth	0.0088	0.0264	0.0176	Dimensionless
Initial All Employers Fraction Having No Disabled Employees but Possible to Have	0	1	1	Dimensionless [0,1,1]
Initial All Employers Fraction Having One or More Disabled Employees	0.242515	0.727545	0.48503	Dimensionless [0,1,1]
Initial All Employers Having Employees	87993.5	263980.5	175987	Employers
Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees with Accommodations or Assistive Aid	0.00755	0.02265	0.0151	Dimensionless [0,1,1]
Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees without Special Arrangements	0.0542635	0.1627905	0.108527	Dimensionless [0,1,1]
Initial Ratio of PWD Able to Work and Interested in Work to All PWD in Working Age Using Welfare	0.125	0.375	0.25	Dimensionless [0,1,1]
Potential Vacancies for PWD per New Employers Recruiting PWD	1.359455	4.078365	2.71891	Persons/Employer
PWD Contact Rate	22.8571	68.5713	45.7142	Dimensionless/Year
PWD Fail Programme Training Fraction	0.0625	0.1875	0.125	Dimensionless/Year
PWD Fraction Recruited in Old Jobs after Disability	0.21	0.63	0.42	Dimensionless [0,1,1]
PWD in Working Age Using Welfare Fastest Draining Time	0.555715	1.667145	1.11143	Year
PWD Wage Percentage Paid by the Government	0	1	0	Dimensionless [0,1,0.5]
PWD Work Adoption Fraction	0.0088	0.0264	0.0176	Dimensionless
Shortest Time to Fill All Available Vacancies	0.62354	1.87062	1.24708	Year
Smoothing Time	2.5	7.5	5	Year
Targeted Employers Fastest Draining Time	0.524115	1.572345	1.04823	Year

We did not have any benchmark for the numerical changes in the *Employed PWD* variable due to the change in any of the tested parameters to test our results against. However, in all sensitivity graphs in the following sections, we did not notice any change in the modes of behaviour, consequently no policy implications change due to the change in the values of the parameters. Accordingly we find the results acceptable.

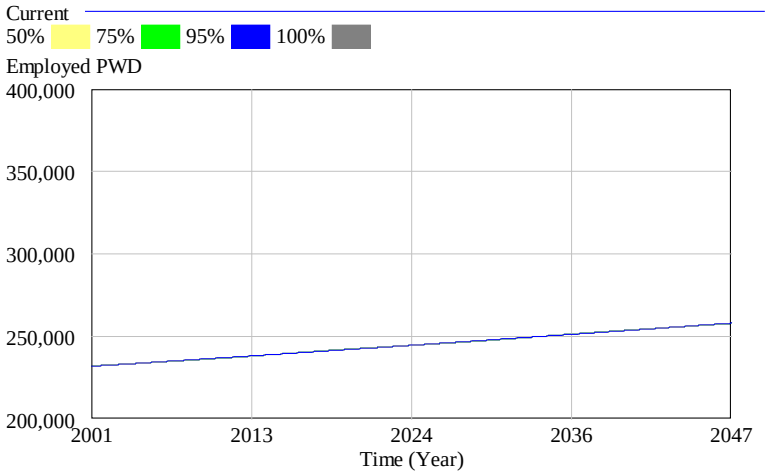
C.2 Univariate Sampling

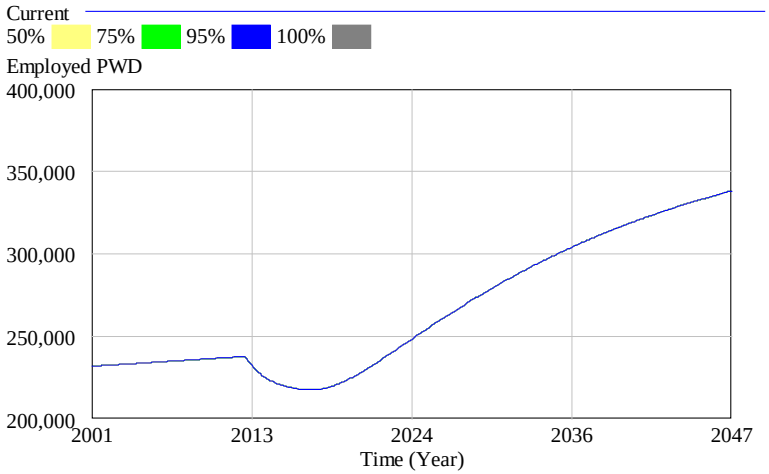
C.2.1 Advertising Effectiveness



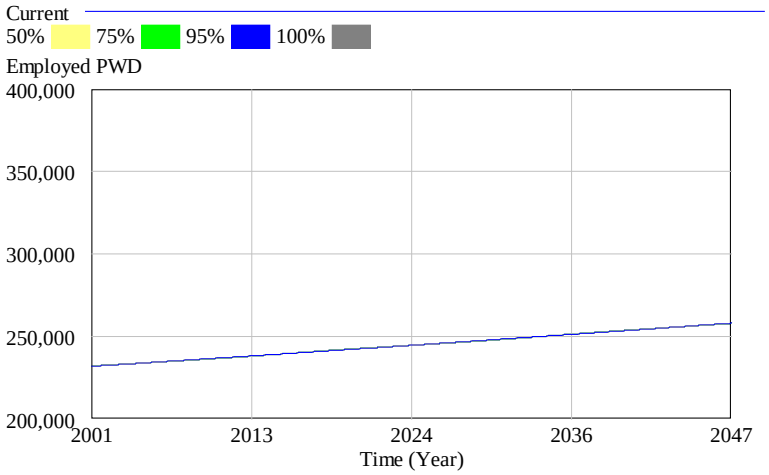


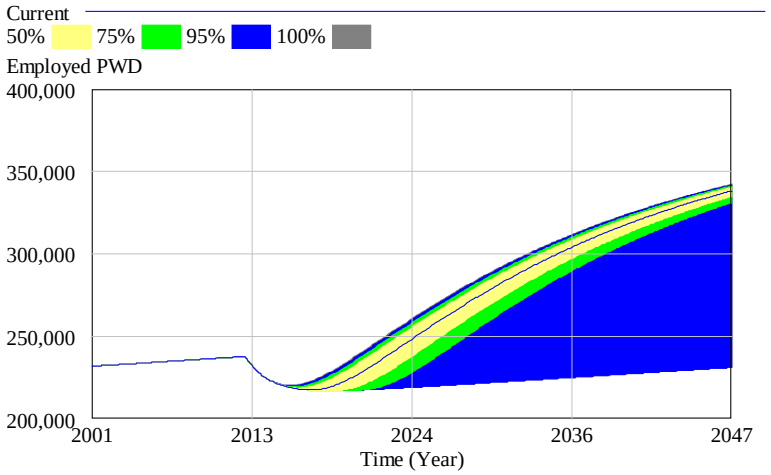
C.2.2 Advertising Spending Needed per Disabled Person per Year



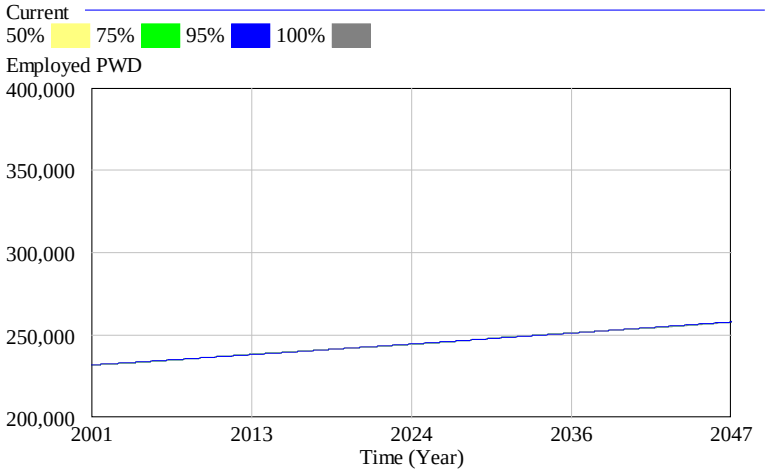


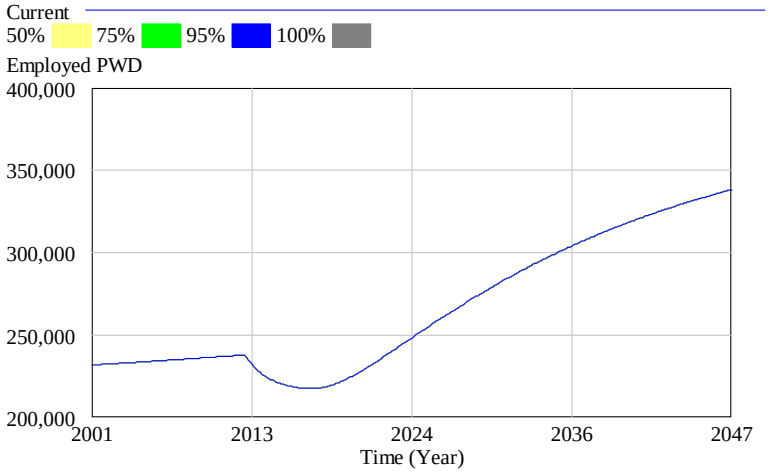
C.2.3 Advertising Spending Needed per Employer per Year



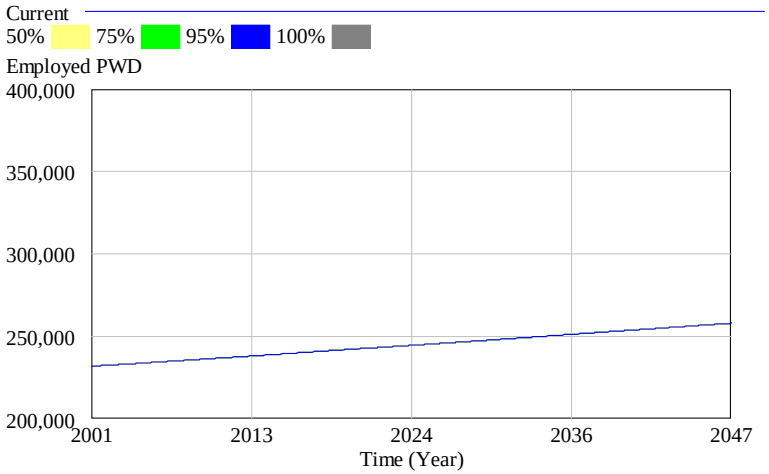


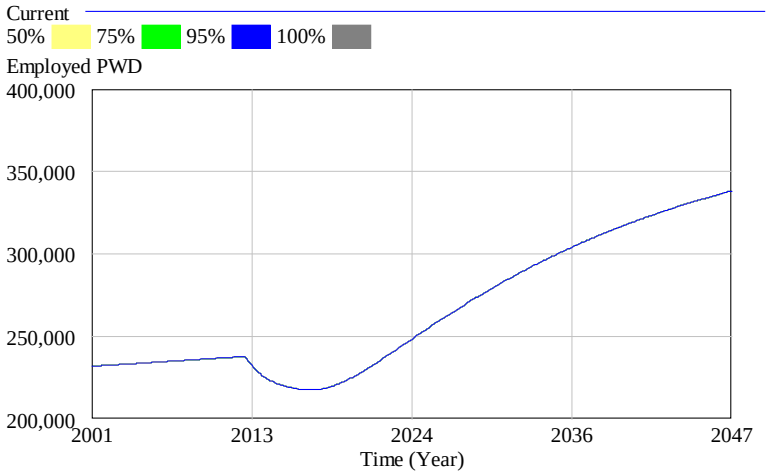
C.2.4 Average Pension for Disabled Person



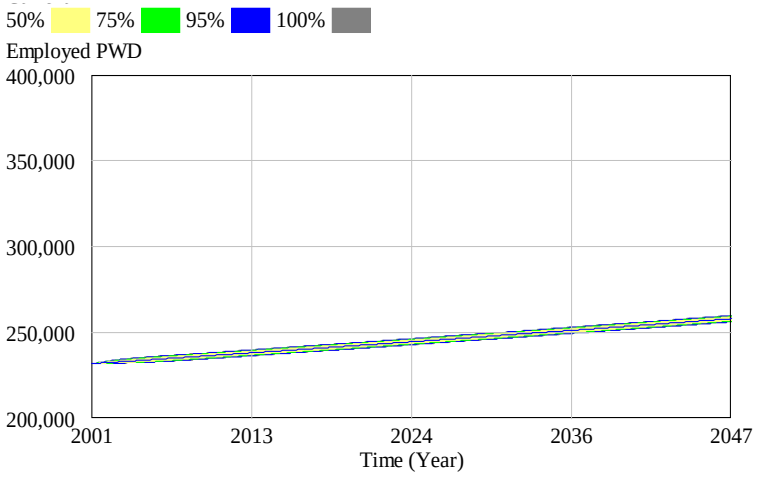


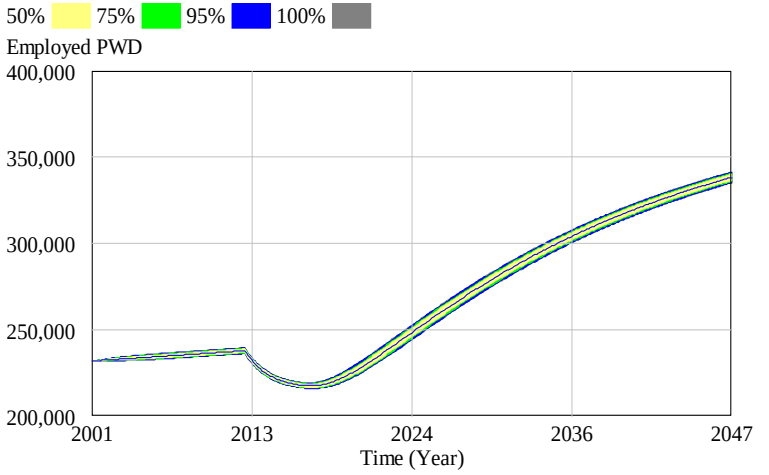
C.2.5 Average Tax Tariff for Working PWD



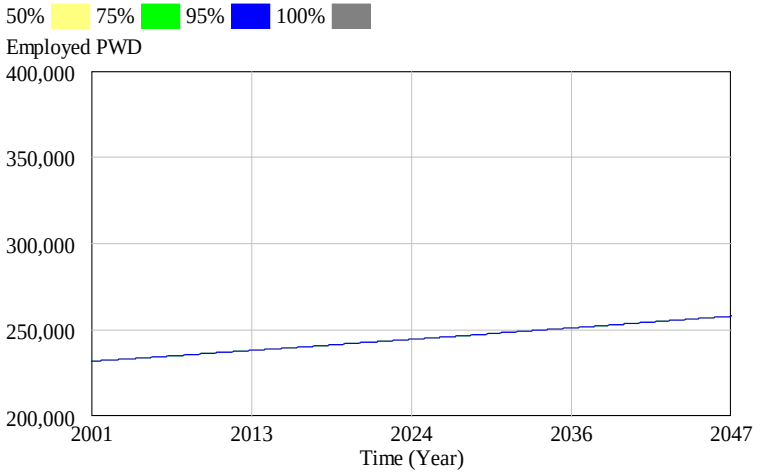


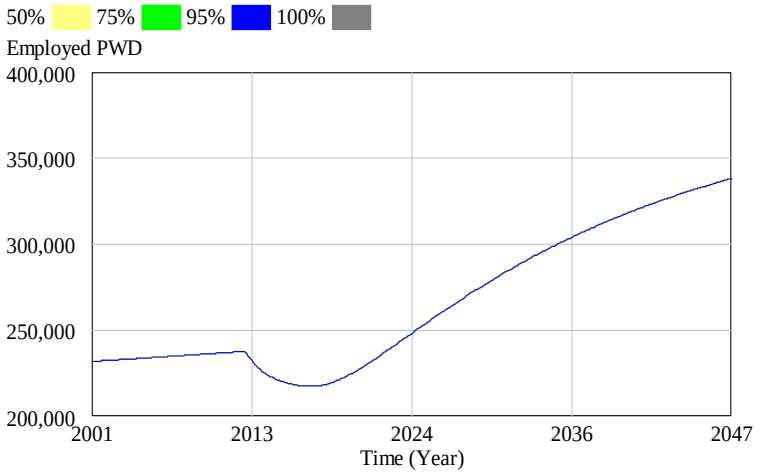
C.2.6 Average Time to Prepare Employer to Recruit PWD



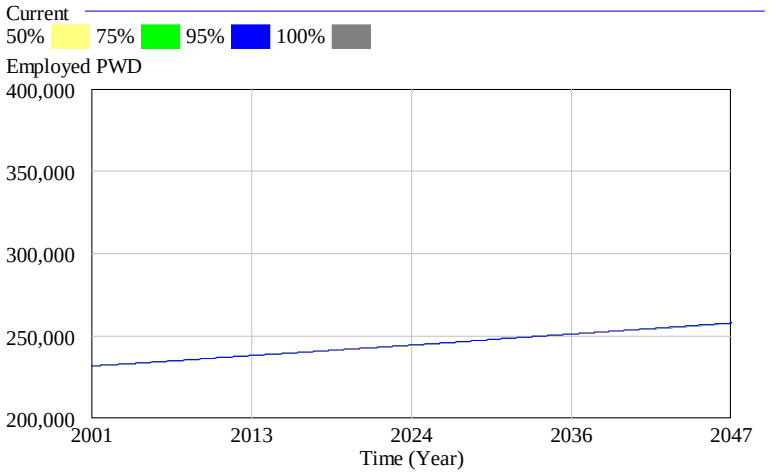


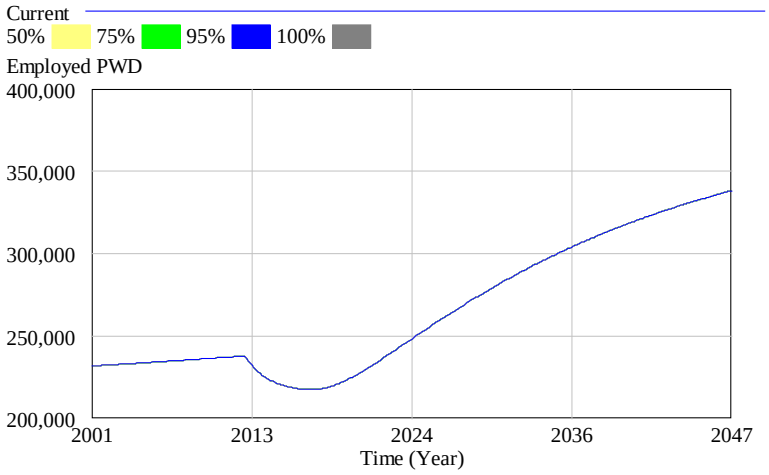
C.2.7 Average Training Cost per Disabled Person



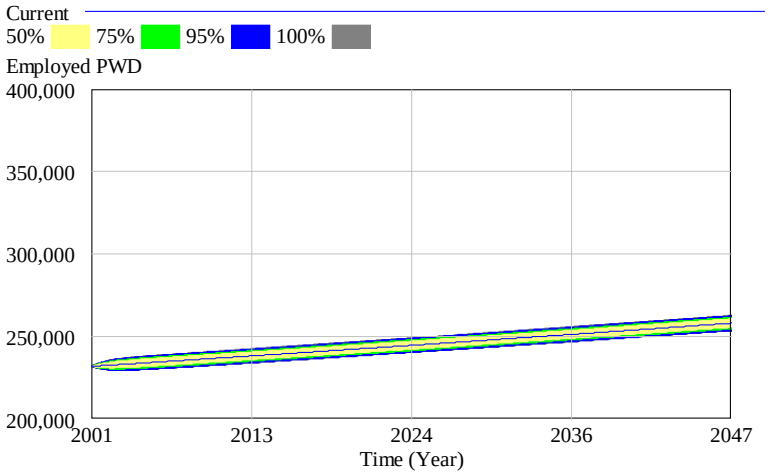


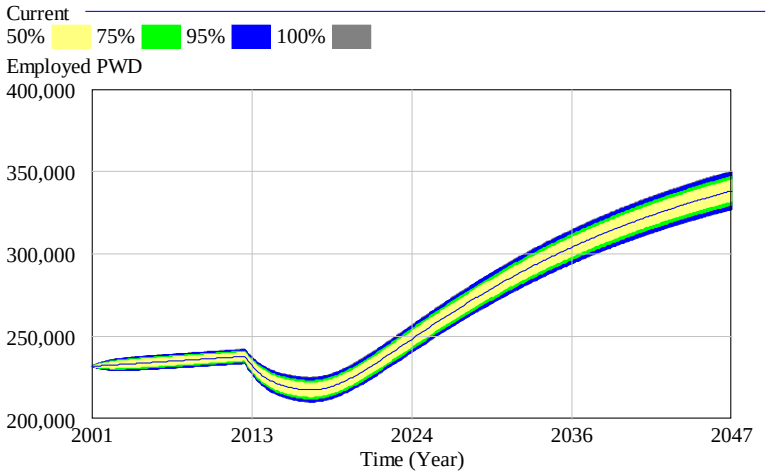
C.2.8 Average Wage for Working Disabled Person



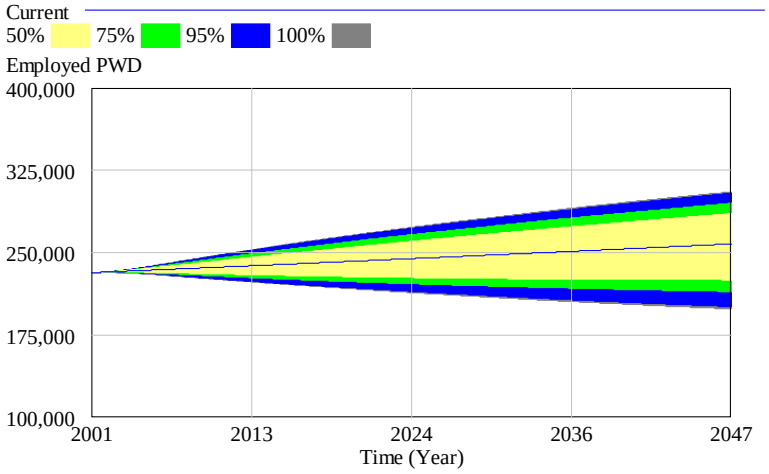


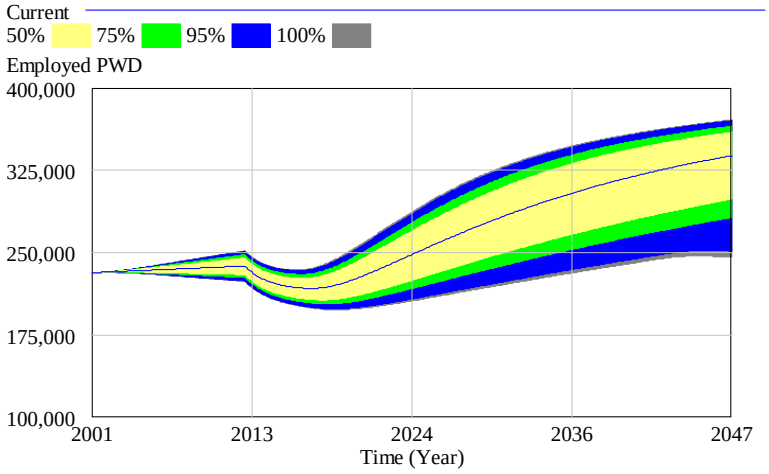
C.2.9 Employed PWD Work Quitting Fraction



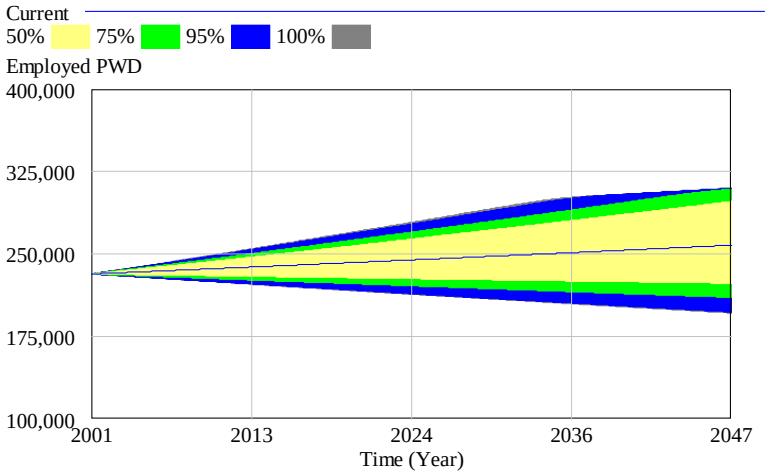


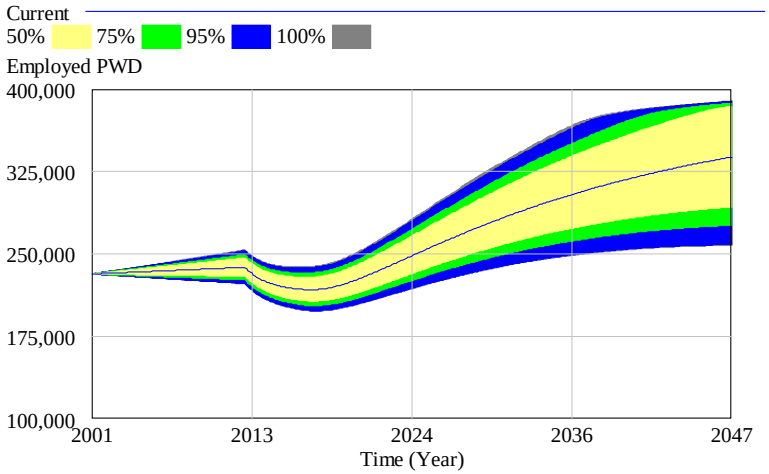
C.2.10 Employers Contact Rate



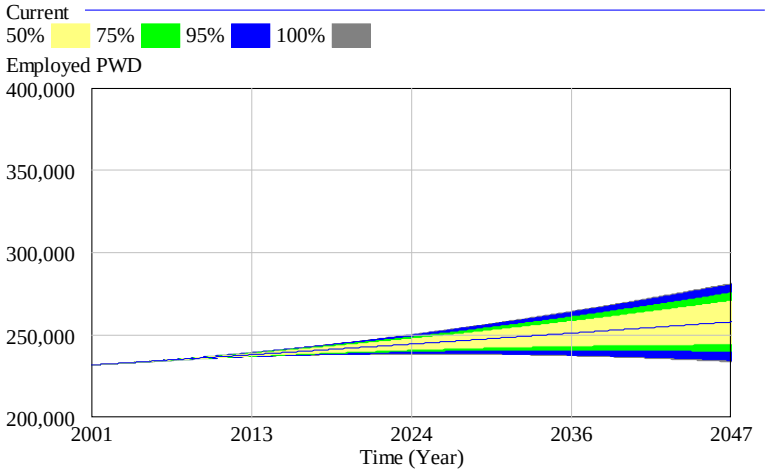


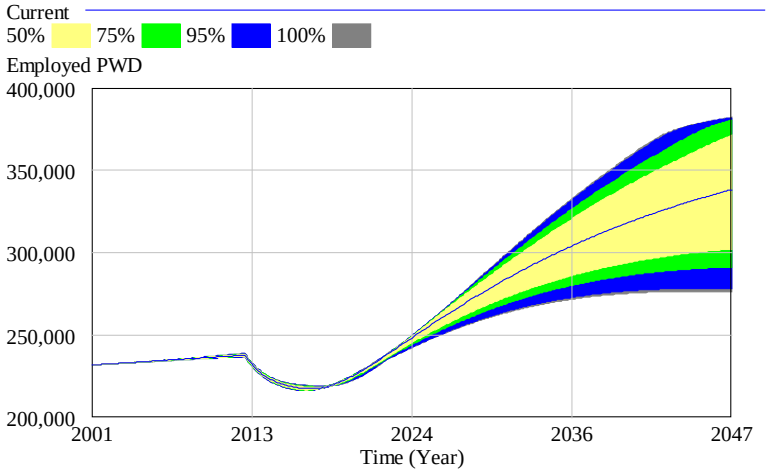
C.2.11 Employers Decrease Fraction



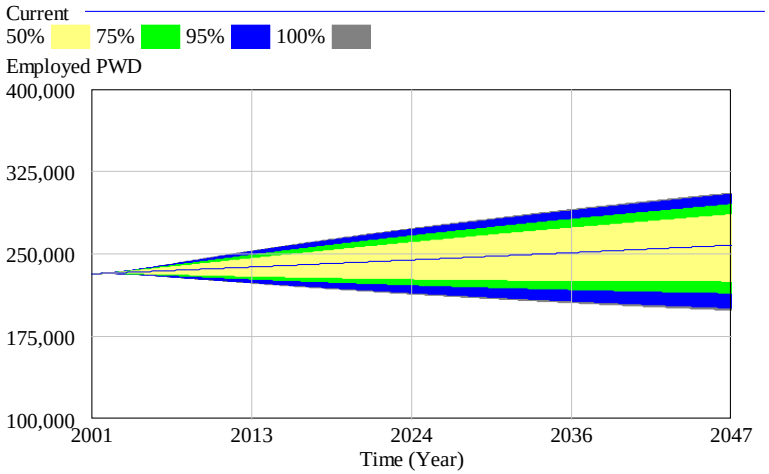


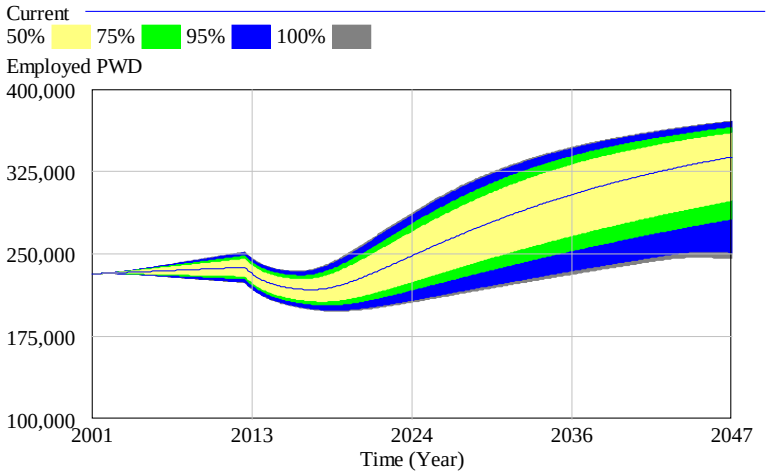
C.2.12 Employers Increase Fraction



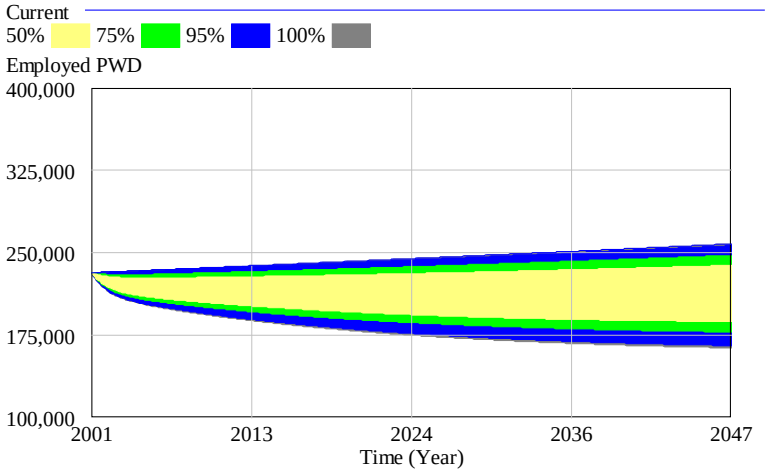


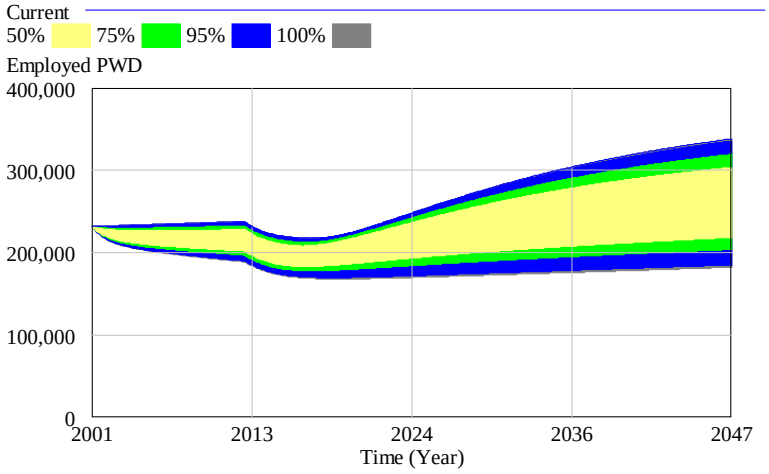
C.2.13 Employers Recruiting PWD Adoption Fraction from Word of Mouth



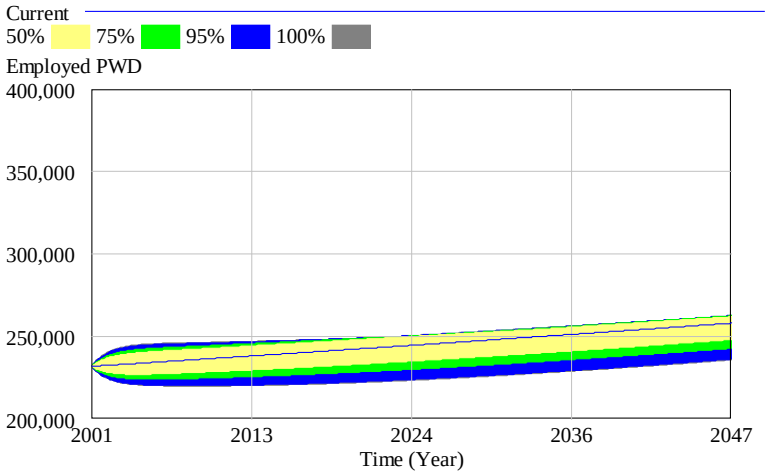


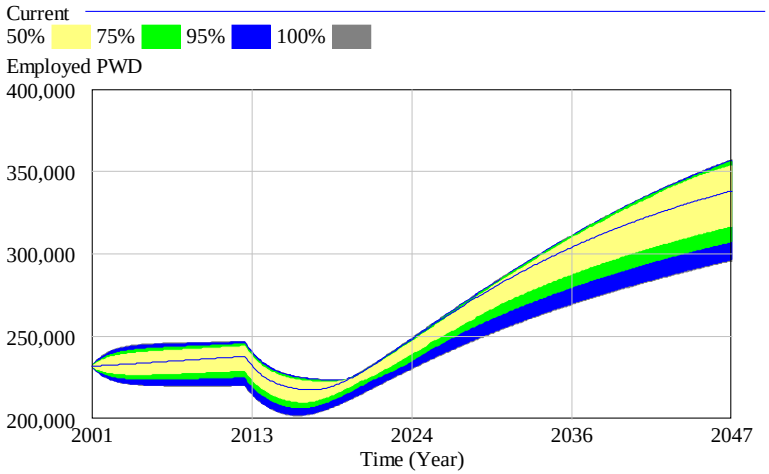
C.2.14 Initial All Employers Fraction Having No Disabled Employees but Possible to Have



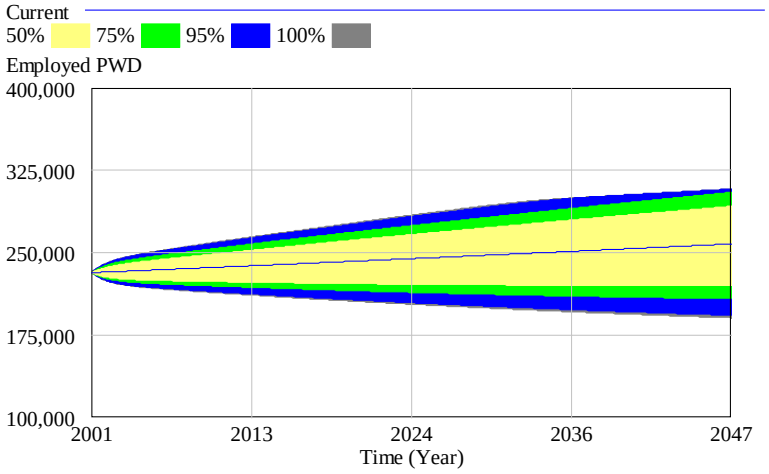


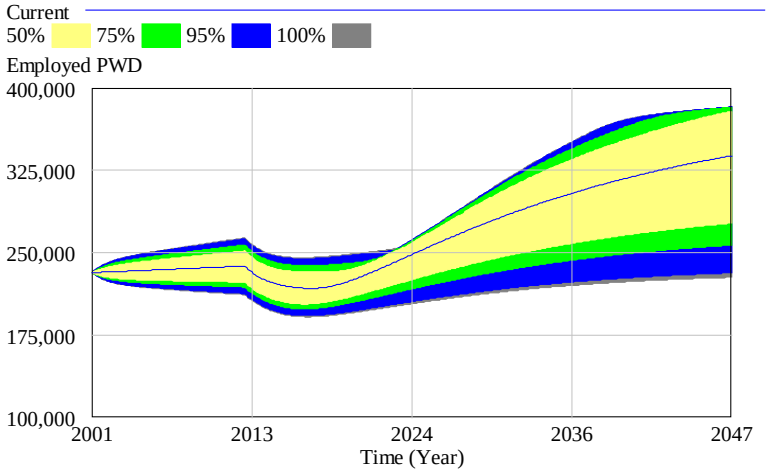
C.2.15 Initial All Employers Fraction Having One or More Disabled Employees



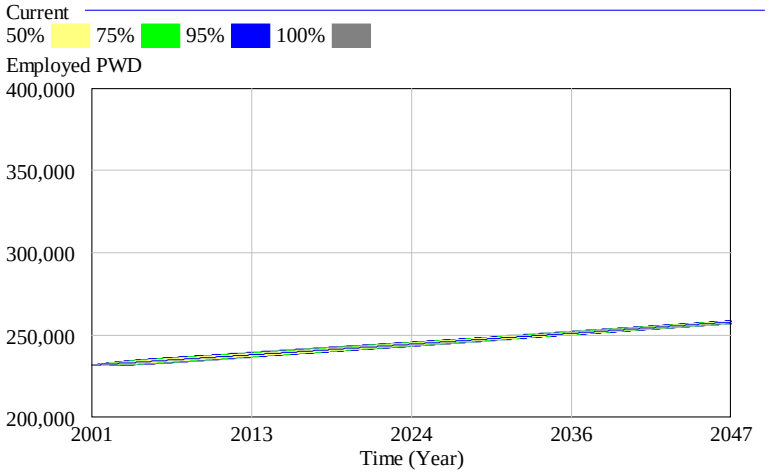


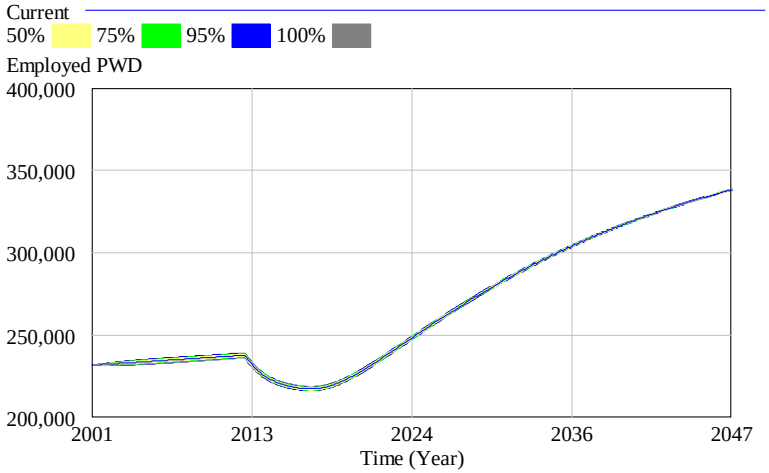
C.2.16 Initial All Employers Having Employees



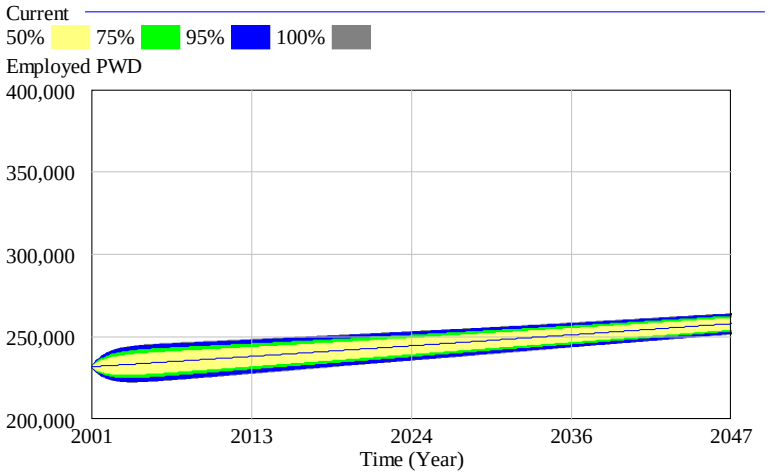


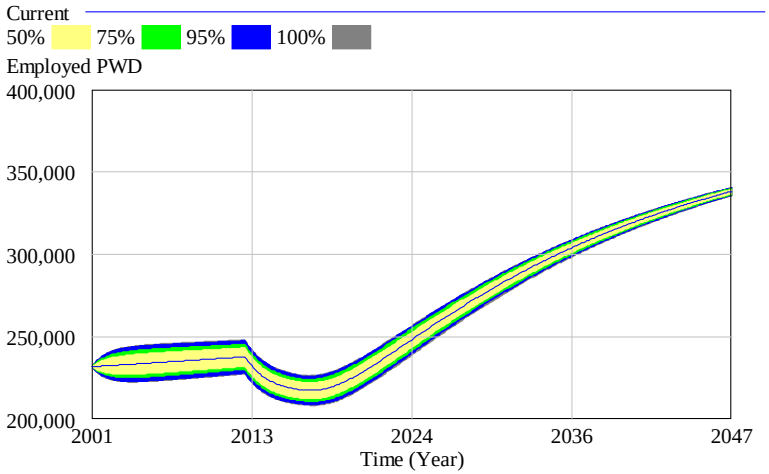
C.2.17 Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees with Accommodations or Assistive Aid



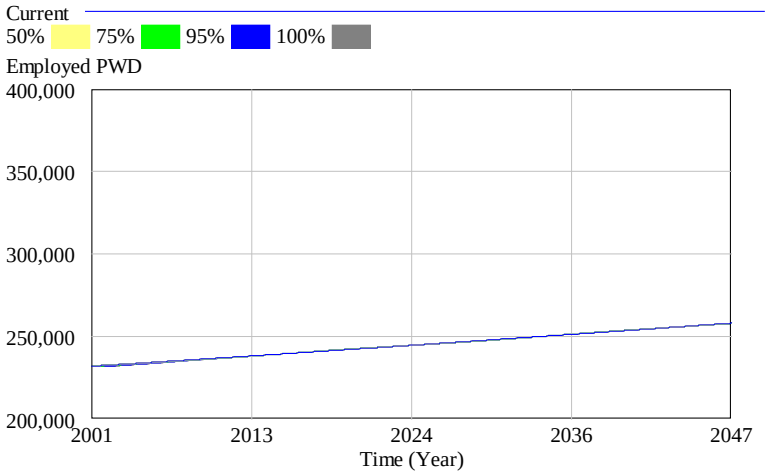


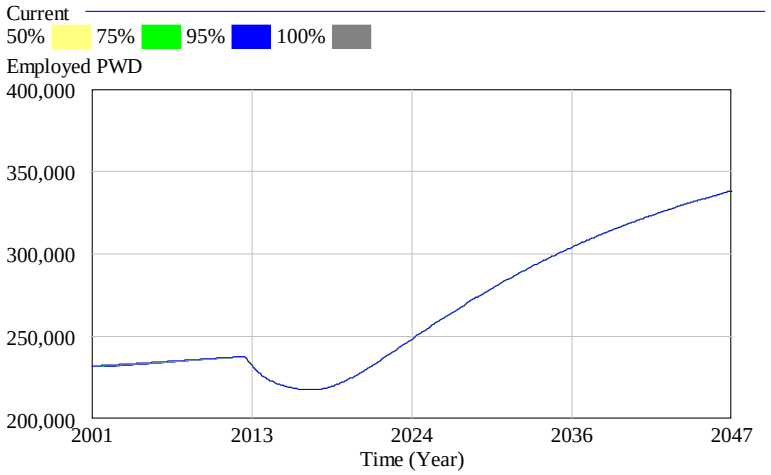
C.2.18 Initial All Employers Having No Disabled Employees Fraction Having Jobs Available for Disabled Employees without Special Arrangements



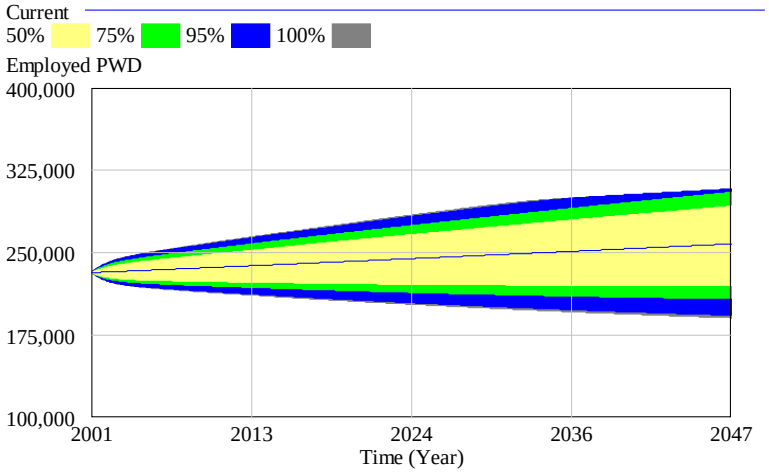


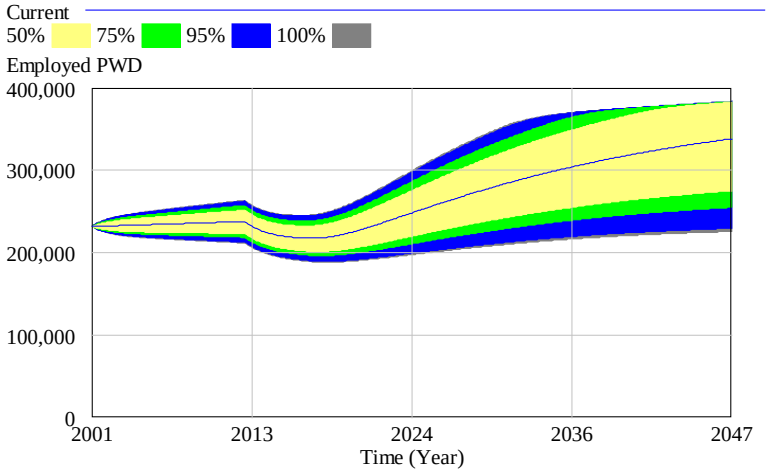
C.2.19 Initial Ratio of PWD Able to Work and Interested in Work to All PWD in Working Age Using Welfare



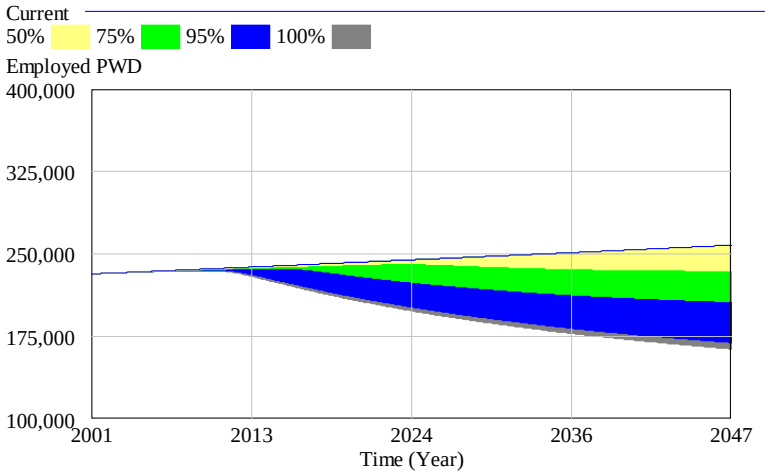


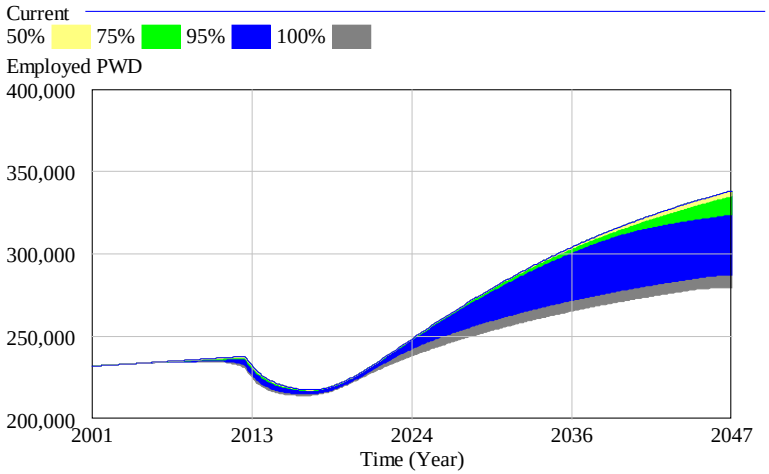
C.2.20 Potential Vacancies for PWD per New Employers Recruiting PWD



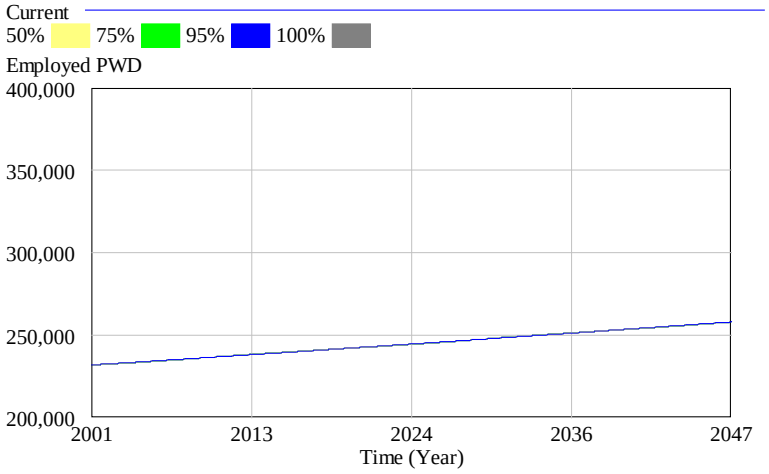


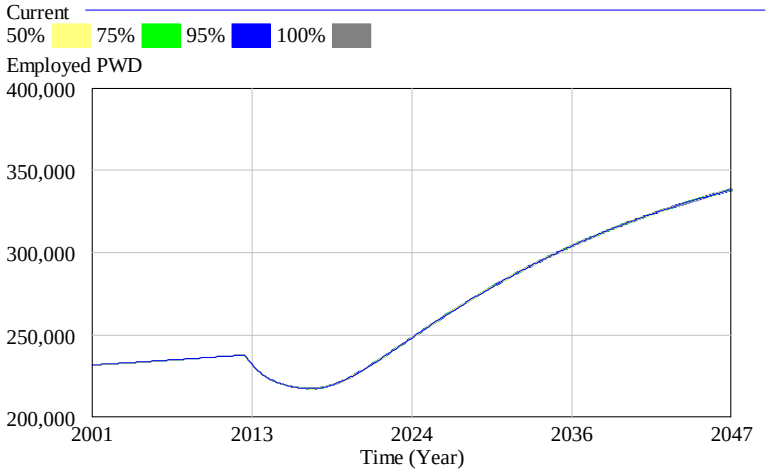
C.2.21 PWD Contact Rate



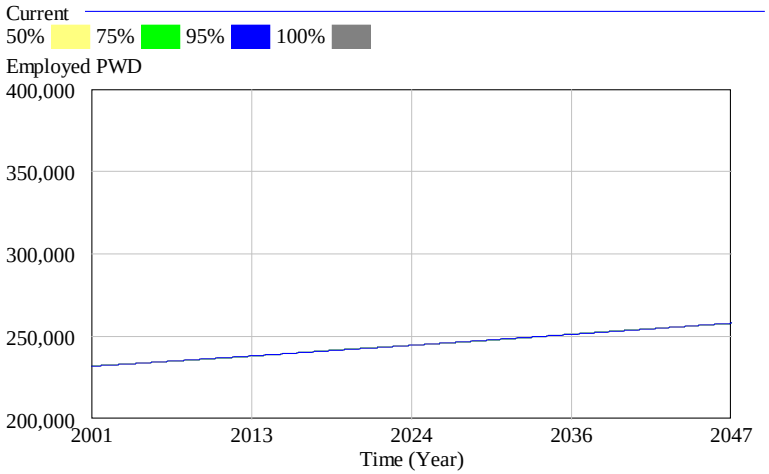


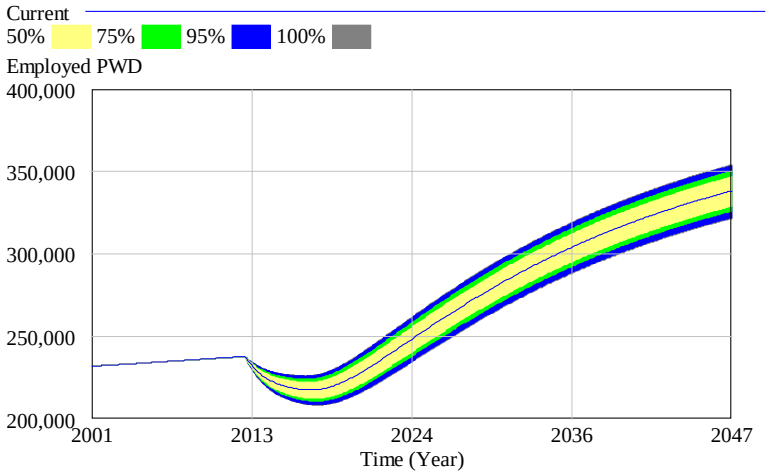
C.2.22 PWD Fail Programme Training Fraction



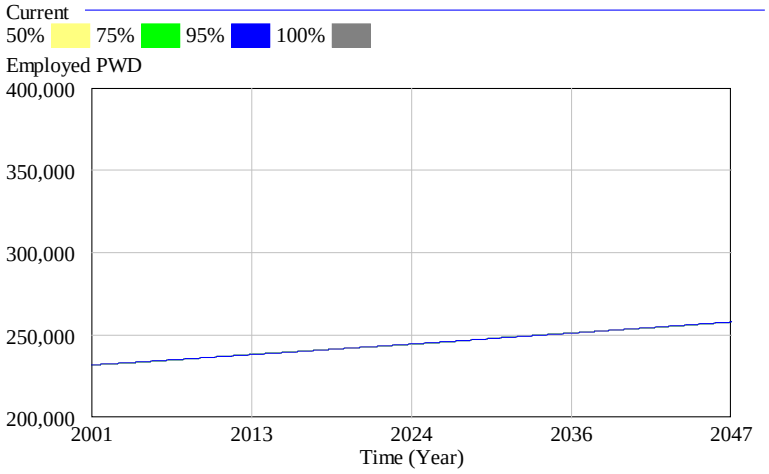


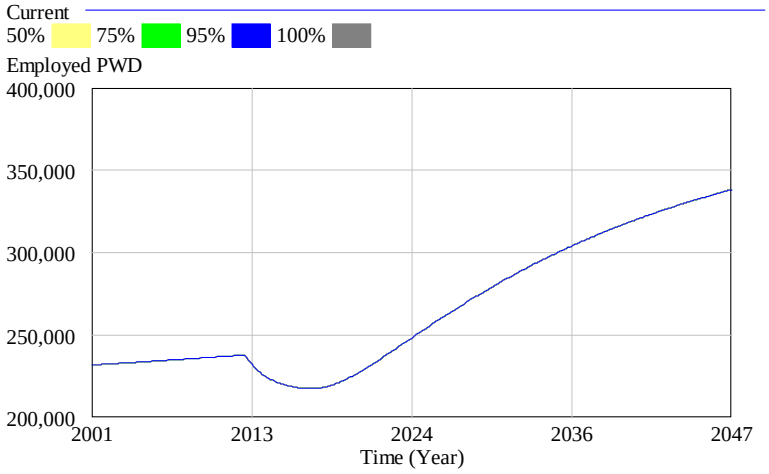
C.2.23 PWD Fraction Recruited in Old Jobs after Disability



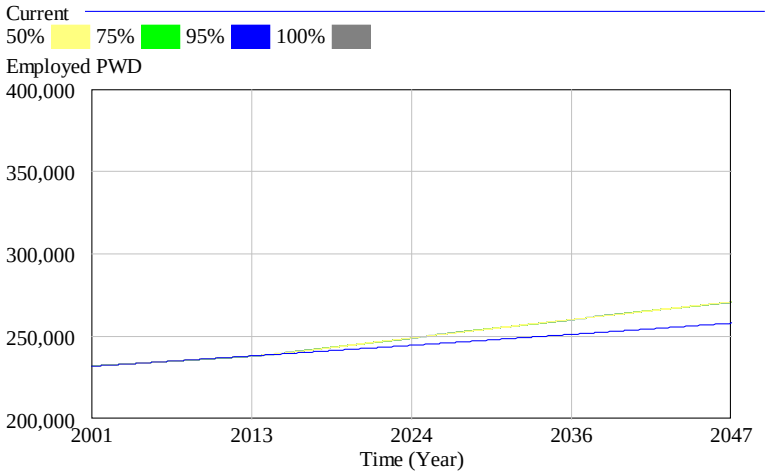


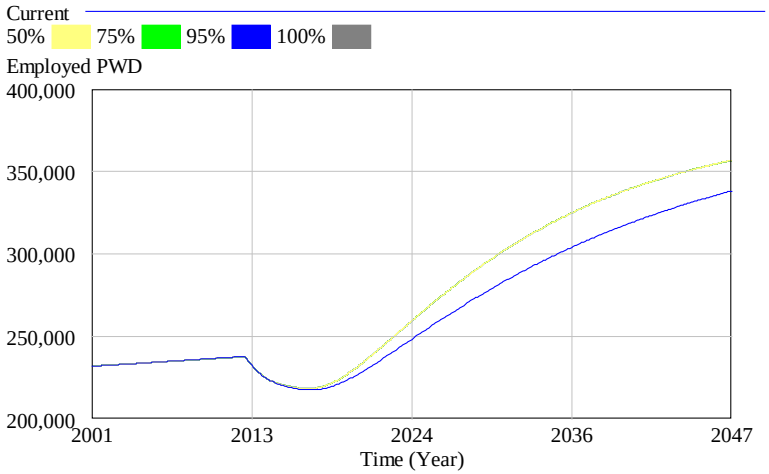
C.2.24 PWD in Working Age Using Welfare Fastest Draining Time



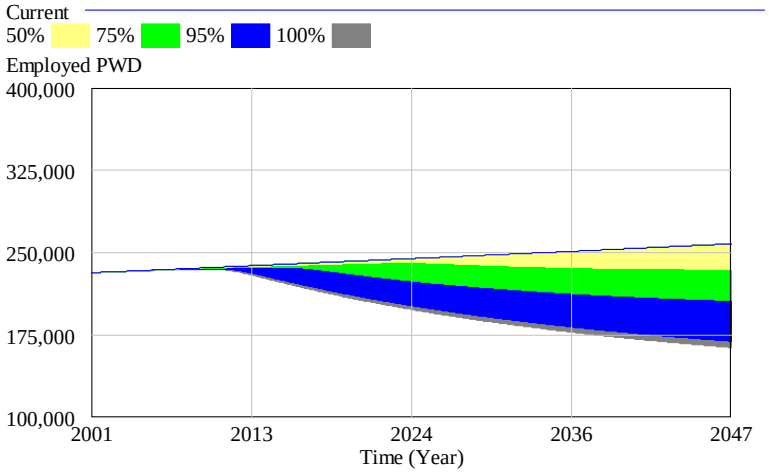


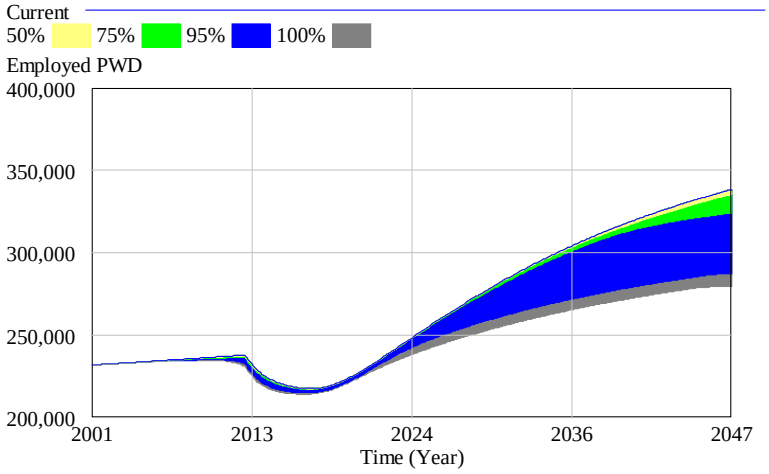
C.2.25 PWD Wage Percentage Paid by the Government



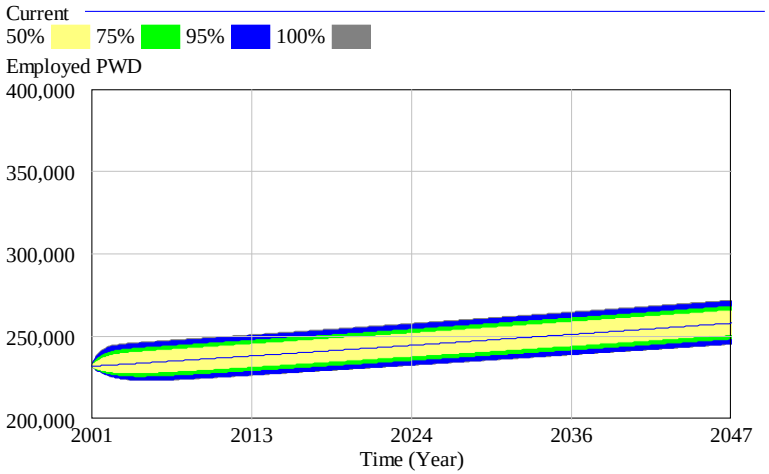


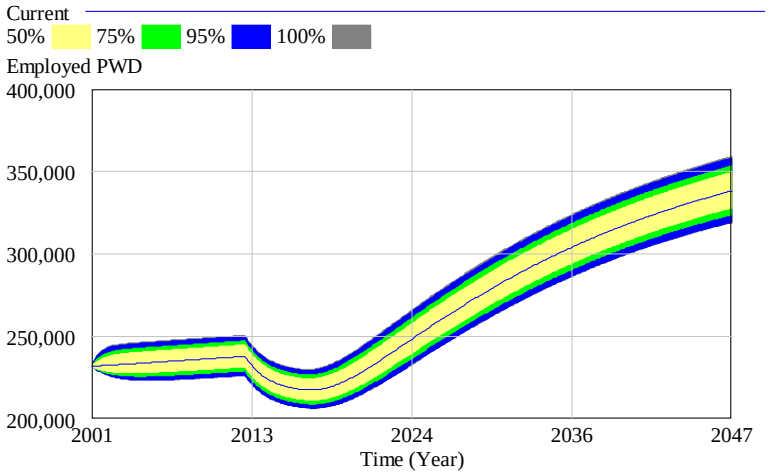
C.2.26 PWD Work Adoption Fraction



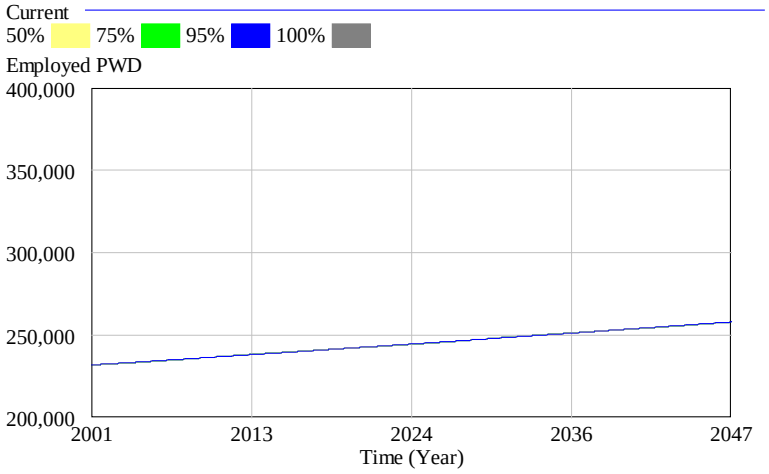


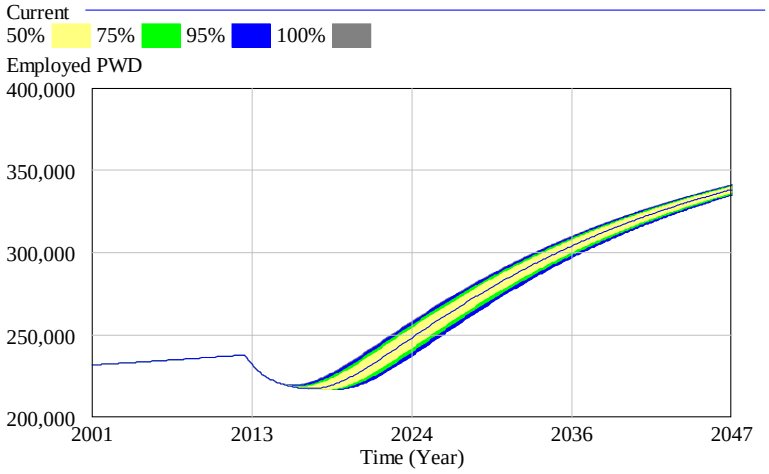
C.2.27 Shortest Time to Fill All Available Vacancies



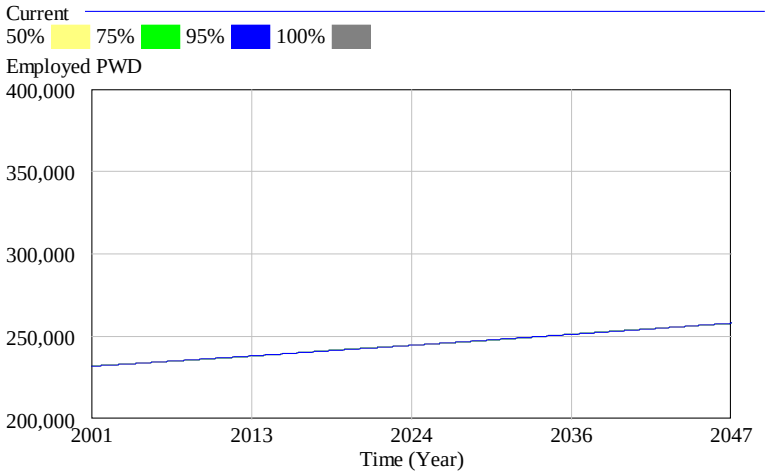


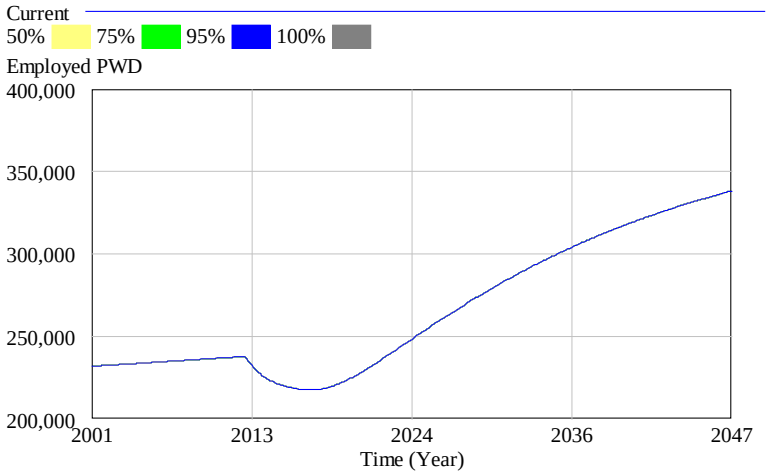
C.2.28 Smoothing Time



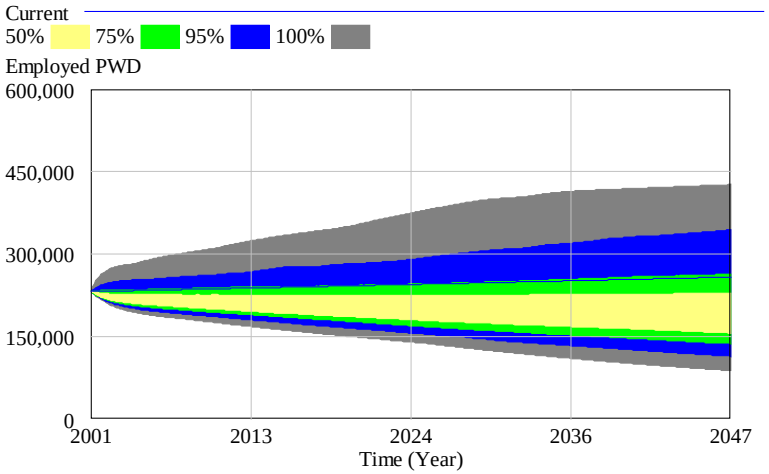


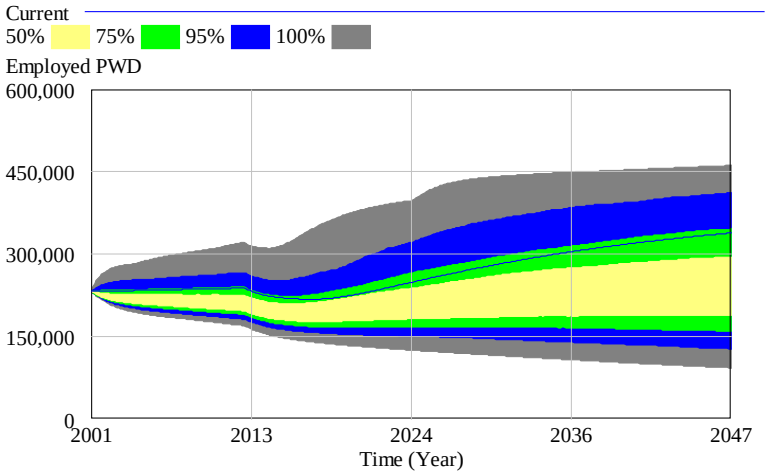
C.2.29 Targeted Employers Fastest Draining Time





C.3 Multivariate Sampling





D Sensitivity Analysis Report of eAccessibility of Norwegian Municipal Website SD Model

D.1 Overview

Like the last appendix, we have run 200 Monte-Carlo simulations per parameter. As no further information about the probability distribution of the parameters was available, we opted for Uniform probability distribution for all parameters. Again we should note that our systems exhibit emergence or emergent behaviour. This was clear in the results of the univariate sampling of this model. Many parameters exhibit no or very subtle effect on the *Website Accessibility Indicator* variable, which we consider it the principal model output. Accordingly, we have followed the univariate sampling by a multivariate sampling where all the parameters were changed together. The following table shows the minimum and maximum values used in the sensitivity analysis for all parameters.

Parameter Name	Min	Max	Value	Units
Average All Tests Applied per Webpage related to Technology	0.4534195	1.3602585	0.906839	Tests/Webpage
Delayed Technology Update Level Delay Duration	0.5	1.5	1	Weeks
Editor Effective Experience Gain Rate due to One Hour of Training	0.75	2.25	1.5	Weeks*Person/Hour
Editor Normal Articles Productivity	11.25	33.75	22.5	Articles/(Person* Week)
Editor Normal Articles Quality	0.4	1	0.8	Dimensionless
Editor Normal Effective Experience in Articles	13	39	26	Weeks
Editors Effective Experience Fractional Decay Rate	0.05	0.15	0.1	Dimensionless/Year
Editors Fractional Leave Rate	0.25	0.75	0.5	Dimensionless/Year
Fastest Articles Draining Time	0.5	1.5	1	Week
Fastest Templates Draining Time	0.5	1.5	1	Week
Main Editor Effective Experience Gain Rate due to One Hour of Training	0.75	2.25	1.5	Weeks*Person/Hour
Main Editor Effective Experience in Templates Gain Rate due to One Hour of Training on Templates	0.078	0.234	0.156	Weeks*Person/Hour
Main Editor Normal Articles Productivity	11.25	33.75	22.5	Articles/(Person* Week)

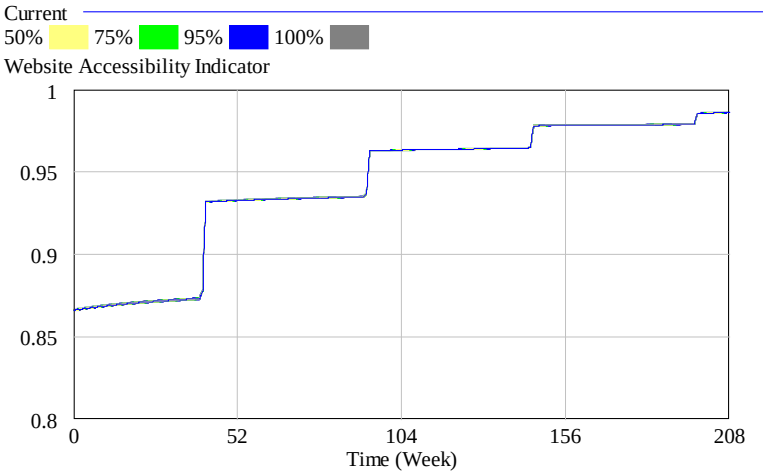
Parameter Name	Min	Max	Value	Units
Main Editor Normal Articles Quality	0.4	1	0.8	Dimensionless
Main Editor Normal Effective Experience in Articles	19.5	58.5	39	Weeks
Main Editor Normal Effective Experience in Templates	26	78	52	Weeks
Main Editor Normal Templates Productivity	7.5	22.5	15	Templates/(Person* Week)
Main Editor Normal Templates Quality	0.4	1	0.8	Dimensionless
Main Editors Effective Experience Fractional Decay Rate	0.05	0.15	0.1	Dimensionless/Year
Main Editors Effective Experience in Templates Fractional Decay Rate	0.05	0.15	0.1	Dimensionless/Year
Main Editors Fractional Leave Rate	0.001	0.003	0.002	Dimensionless/Year
Nominal Barriers per New Article	0.77168	2.31504	1.54336	Tests/Article
Nominal Barriers per New Template	5.98895	17.96685	11.9779	Tests/Template
Nominal Fractional Barriers Removal per Enhanced Article	0.25	0.75	0.5	Dimensionless
Nominal Fractional Barriers Removal per Enhanced Template	0.355	1.065	0.71	Dimensionless
Required Articles per Week	6.8	20.4	13.6	Articles/Week
Required Templates per Year	0.45	1.35	0.9	Templates/Year
Shortest Assimilation Period	0.5	1.5	1	Weeks
Time to Add New Editor	0.5	1.5	1	Weeks
Time to Hire or Fire Main Editor	5.5	16.5	11	Weeks
Time to Transfer Editor	0.5	1.5	1	Weeks
Vendor Templates Production per Consultancy Week	11.25	33.75	22.5	Templates/Week
Vendor Templates Quality	0.4	1.2	0.8	Dimensionless [0,6]

We did not have any benchmark for the numerical changes in the *Website Accessibility Indicator* variable due to the change in any of the tested parameters to test our results against. However, in all sensitivity graphs in the following sections, we did not notice any

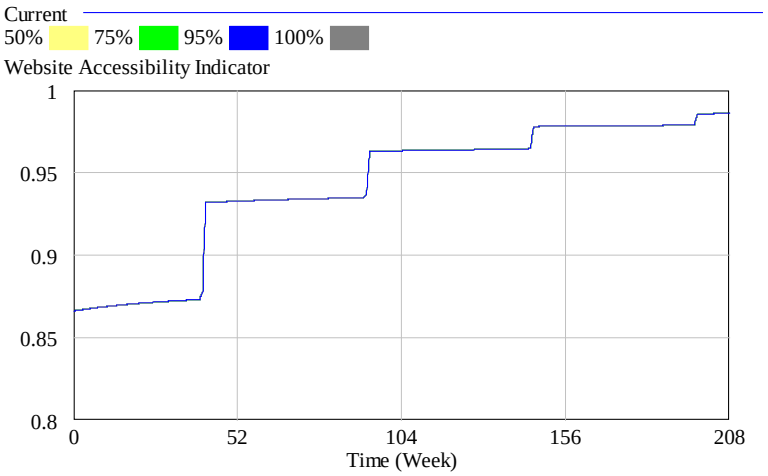
change in the modes of behaviour, consequently no policy implications change due to the change in the values of the parameters. Accordingly we find the results acceptable

D.2 Univariate Sampling

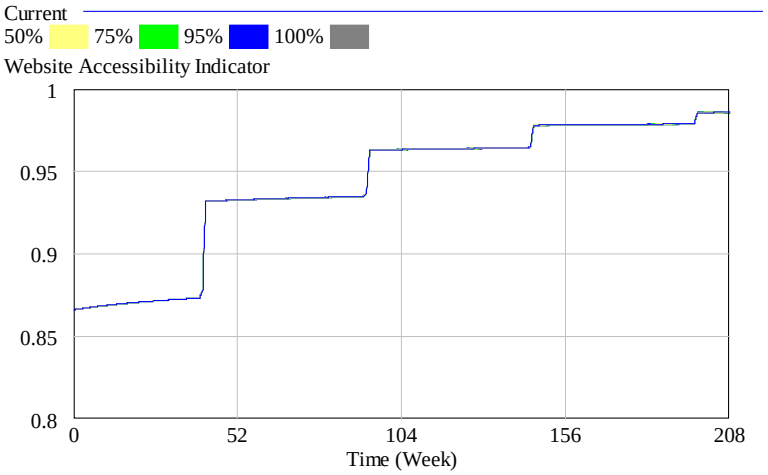
D.2.1 Average All Tests Applied per Webpage related to Technology



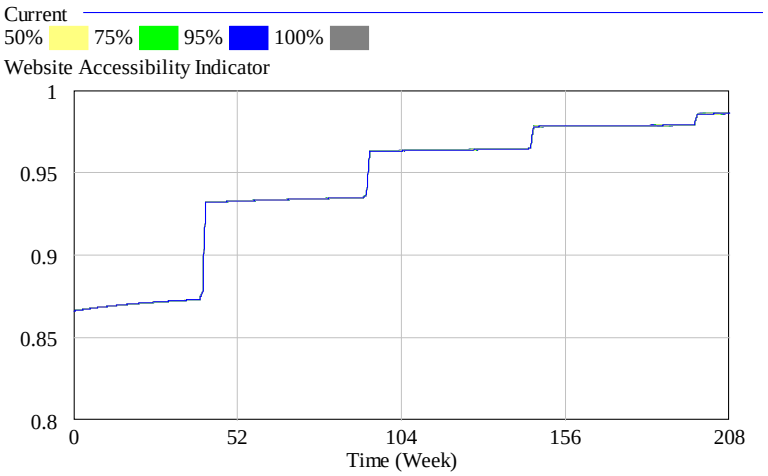
D.2.2 Delayed Technology Update Level Delay Duration



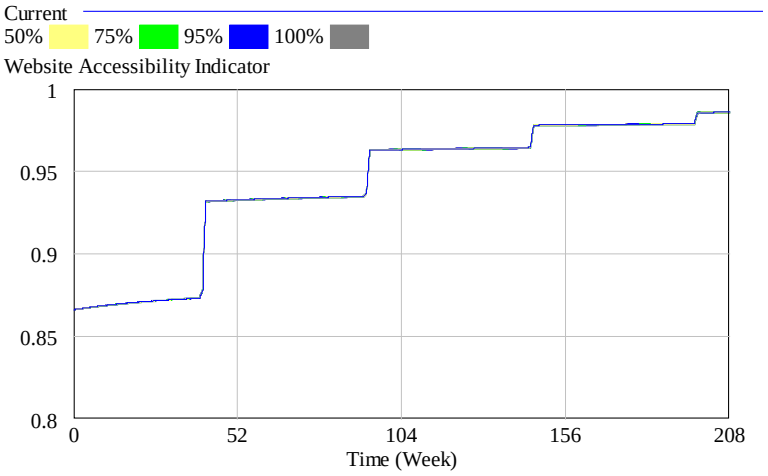
D.2.3 Editor Effective Experience Gain Rate due to One Hour of Training



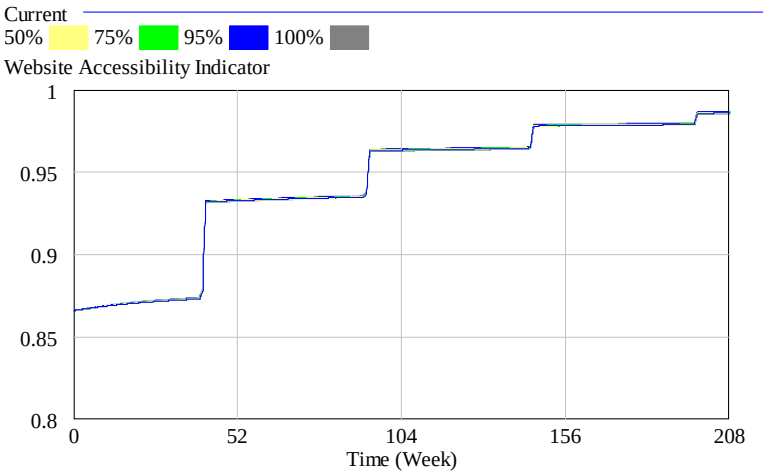
D.2.4 Editor Normal Articles Productivity



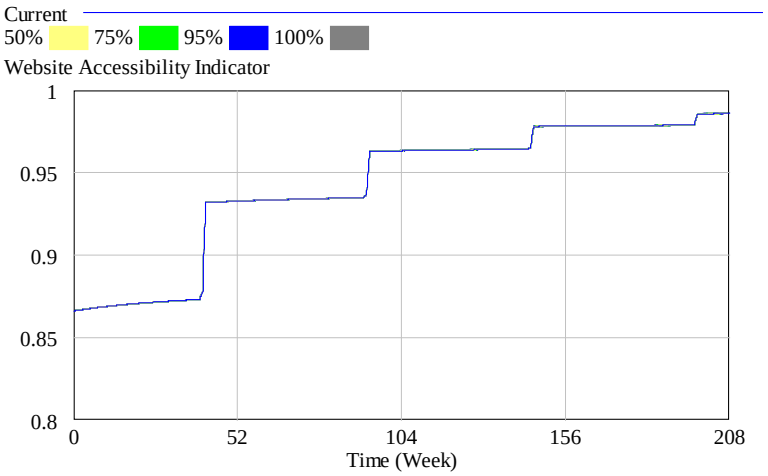
D.2.5 Editor Normal Articles Quality



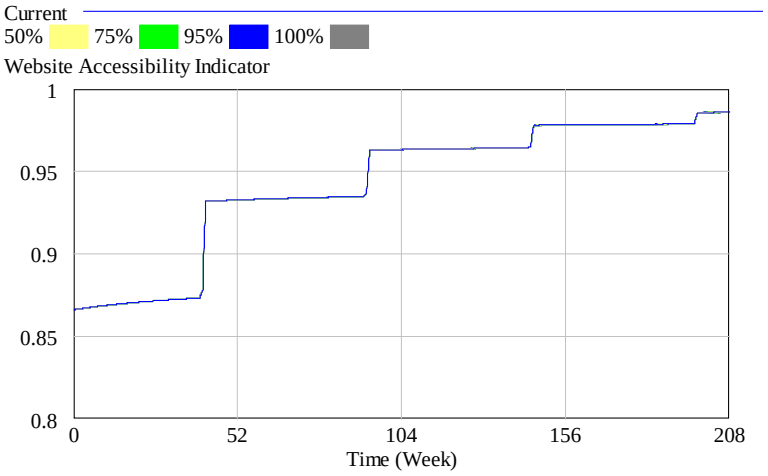
D.2.6 Editor Normal Effective Experience in Articles



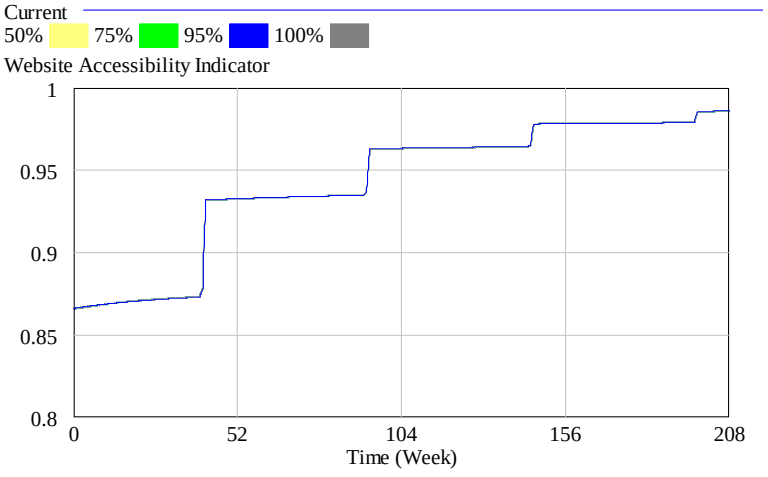
D.2.7 Editors Effective Experience Fractional Decay Rate



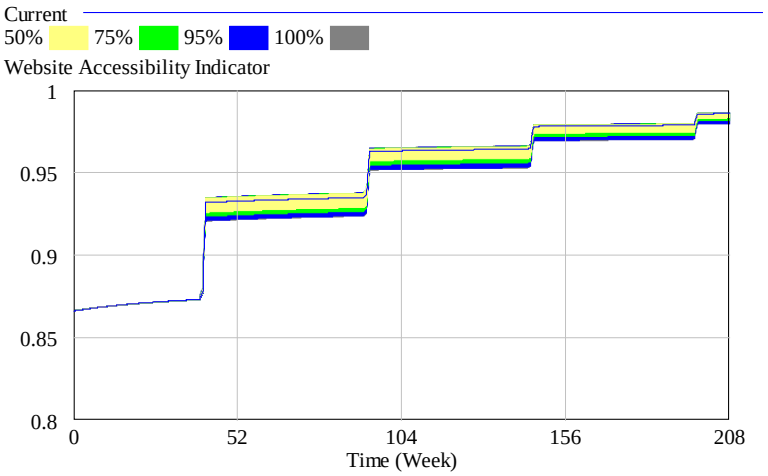
D.2.8 Editors Fractional Leave Rate



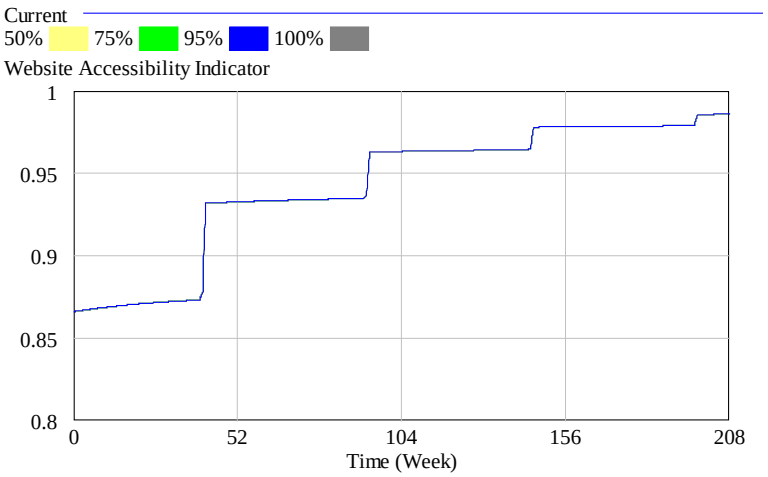
D.2.9 Fastest Articles Draining Time



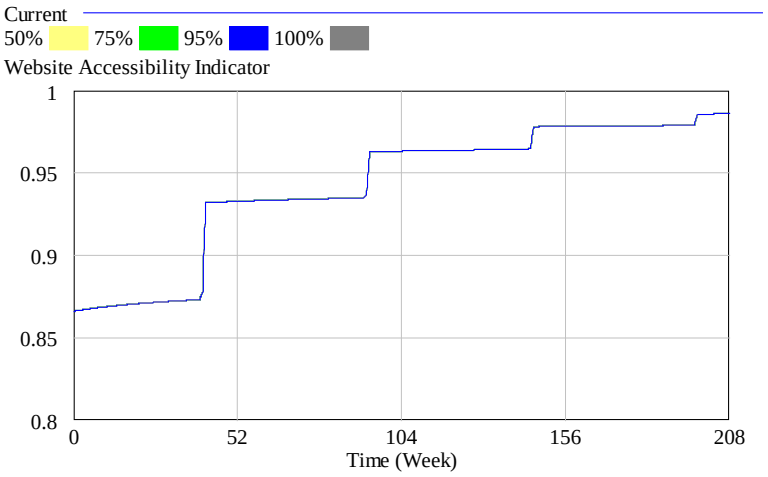
D.2.10 Fastest Templates Draining Time



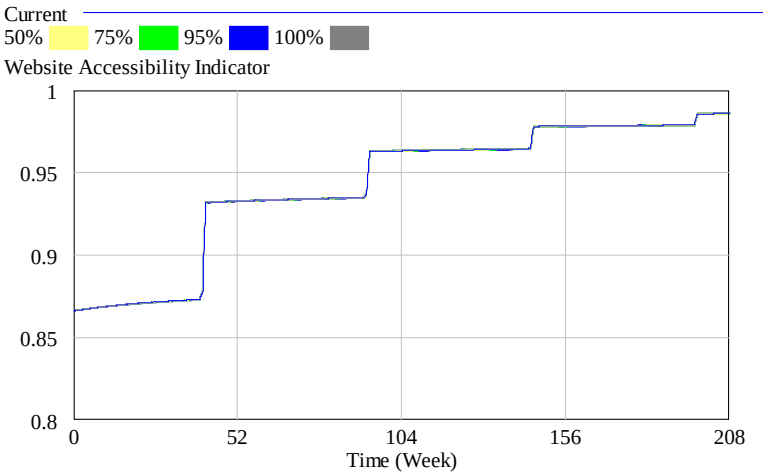
D.2.11 Main Editor Effective Experience Gain Rate due to One Hour of Training



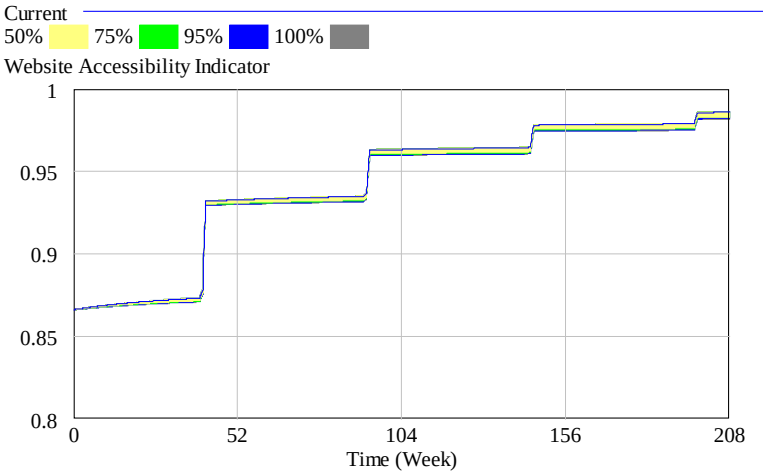
D.2.12 Main Editor Effective Experience in Templates Gain Rate due to One Hour of Training on Templates



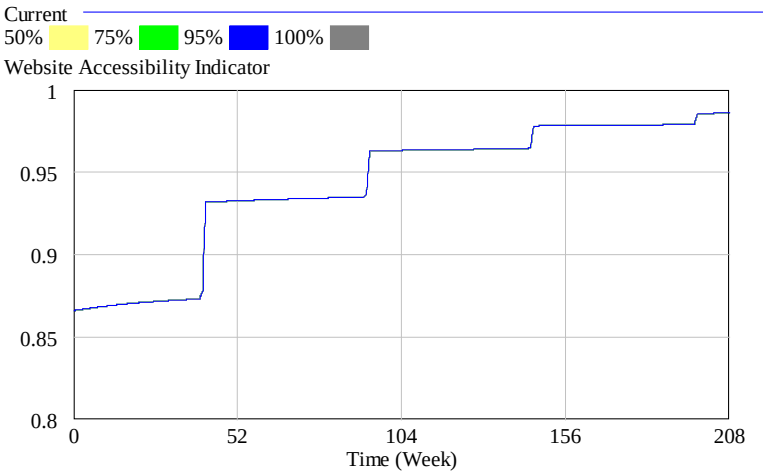
D.2.13 Main Editor Normal Articles Productivity



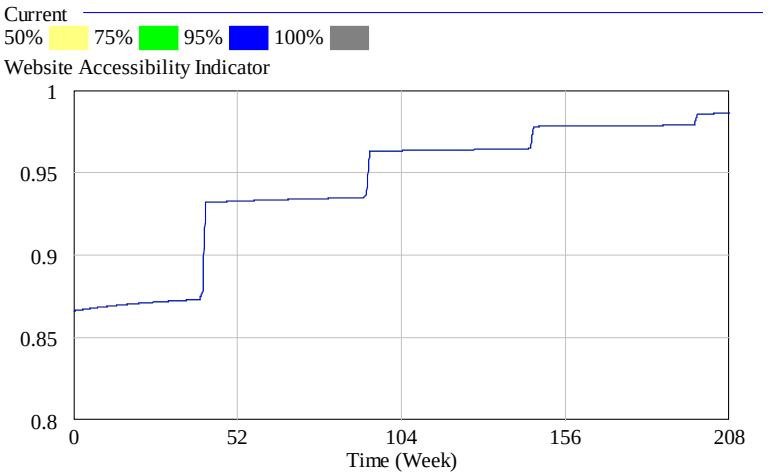
D.2.14 Main Editor Normal Articles Quality



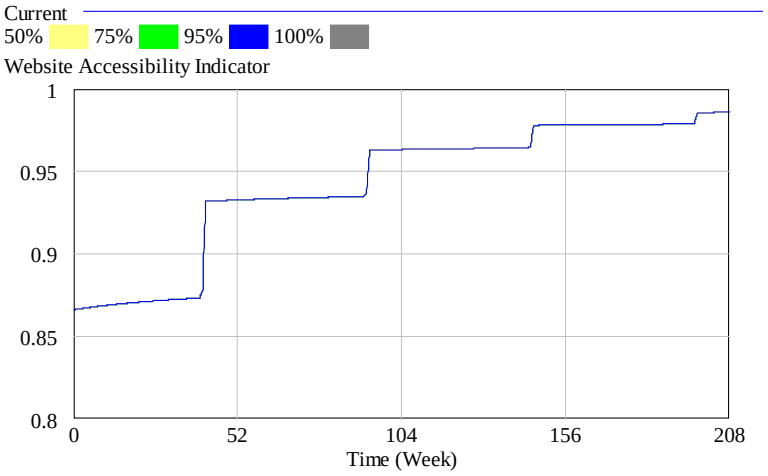
D.2.15 Main Editor Normal Effective Experience in Articles



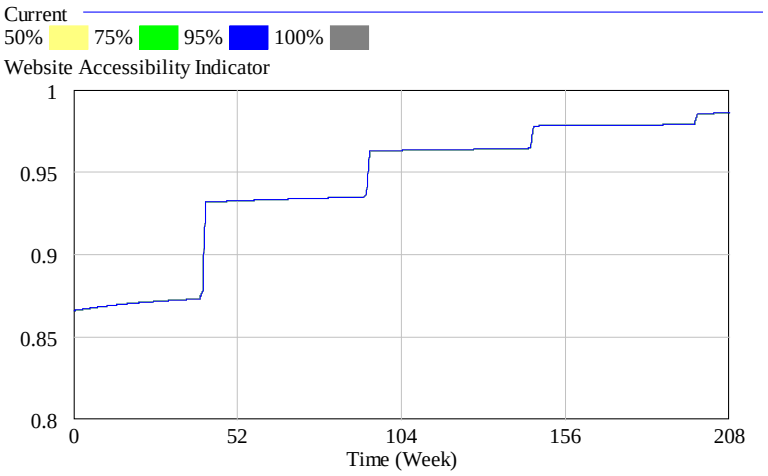
D.2.16 Main Editor Normal Effective Experience in Templates



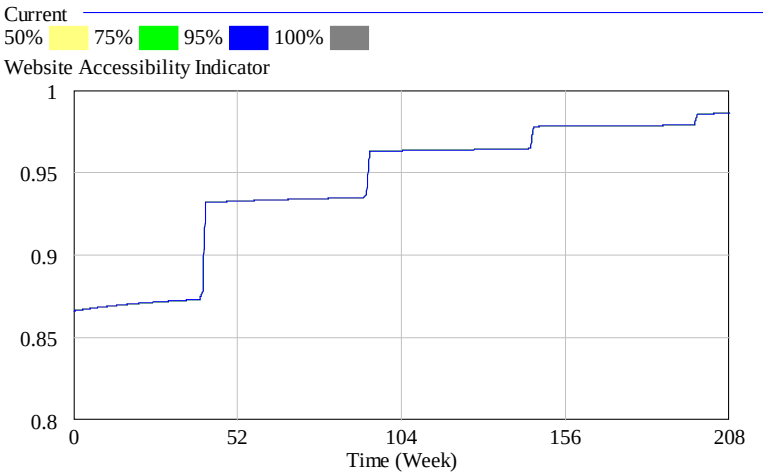
D.2.17 Main Editor Normal Templates Productivity



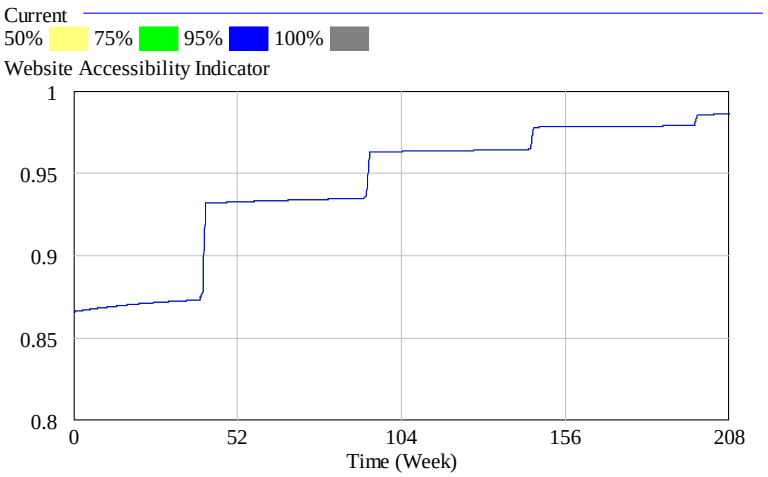
D.2.18 Main Editor Normal Templates Quality



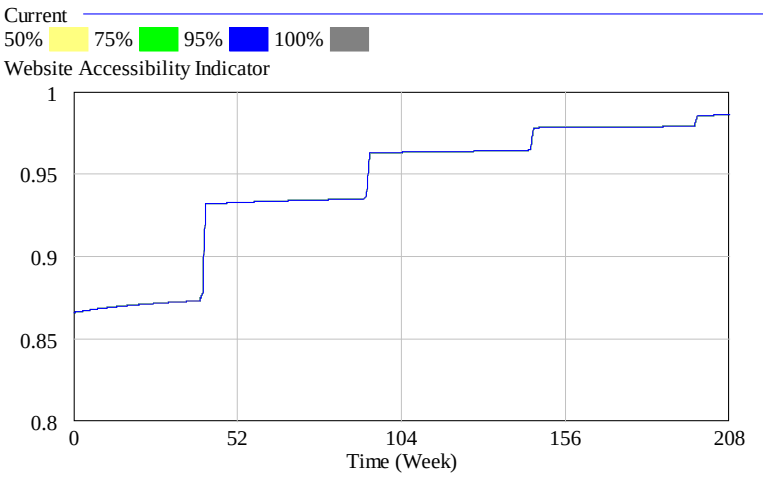
D.2.19 Main Editors Effective Experience Fractional Decay Rate



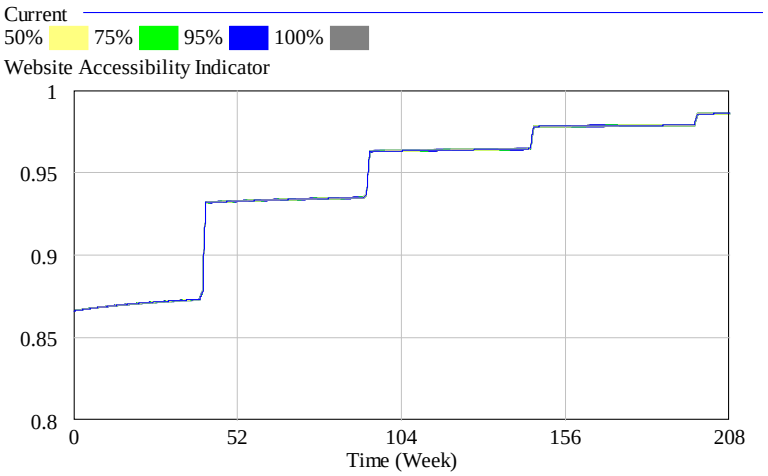
D.2.20 Main Editors Effective Experience in Templates Fractional Decay Rate



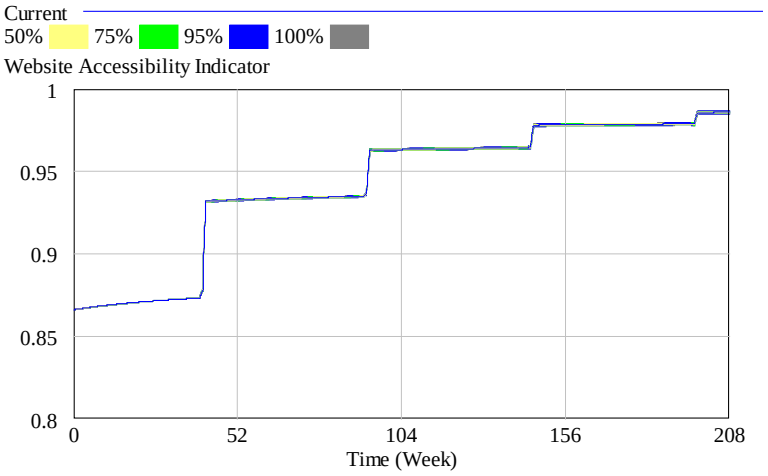
D.2.21 Main Editors Fractional Leave Rate



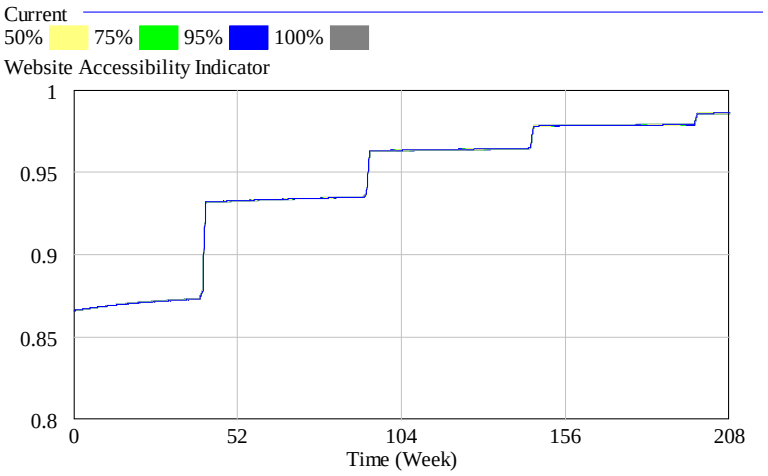
D.2.22 Nominal Barriers per New Article



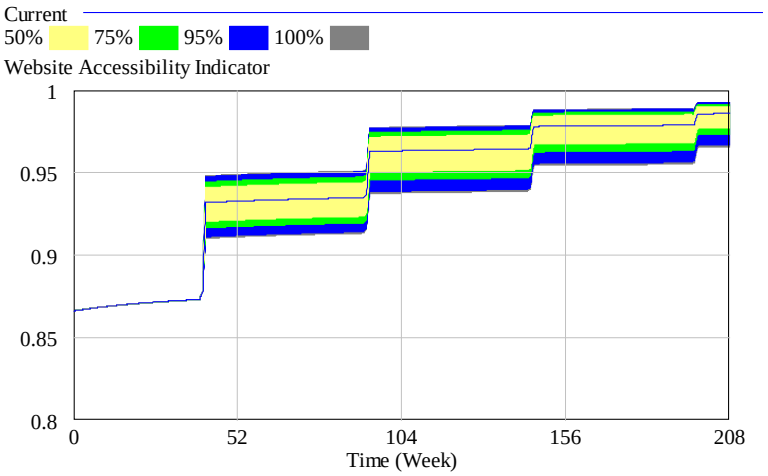
D.2.23 Nominal Barriers per New Template



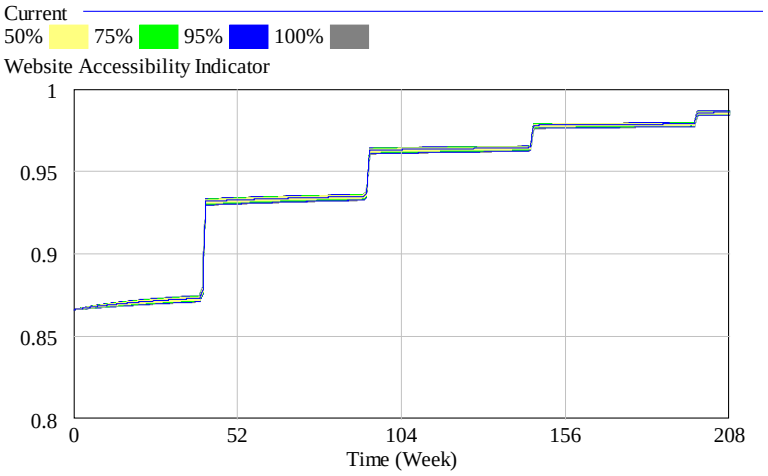
D.2.24 Nominal Fractional Barriers Removal per Enhanced Article



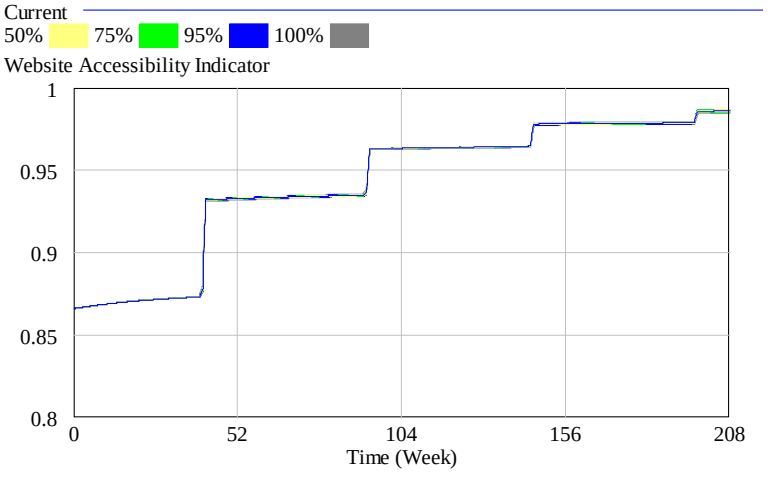
D.2.25 Nominal Fractional Barriers Removal per Enhanced Template



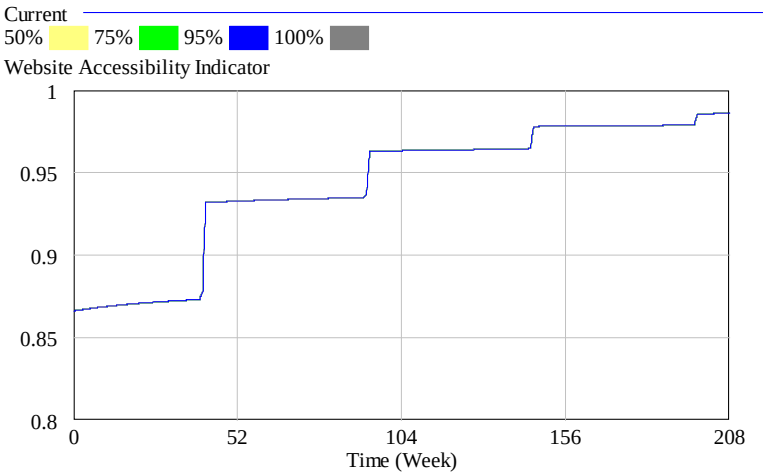
D.2.26 Required Articles per Week



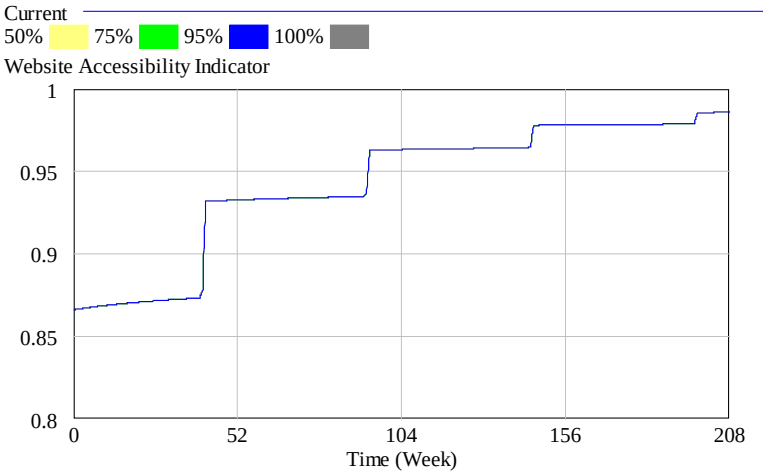
D.2.27 Required Templates per Year



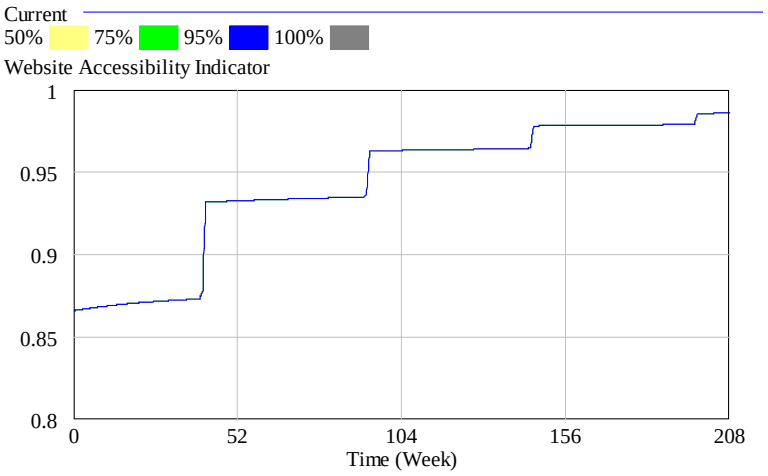
D.2.28 Shortest Assimilation Period



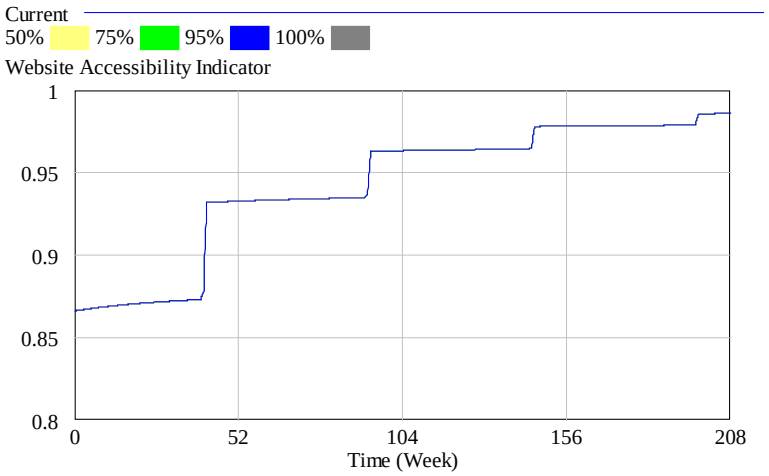
D.2.29 Time to Add New Editor



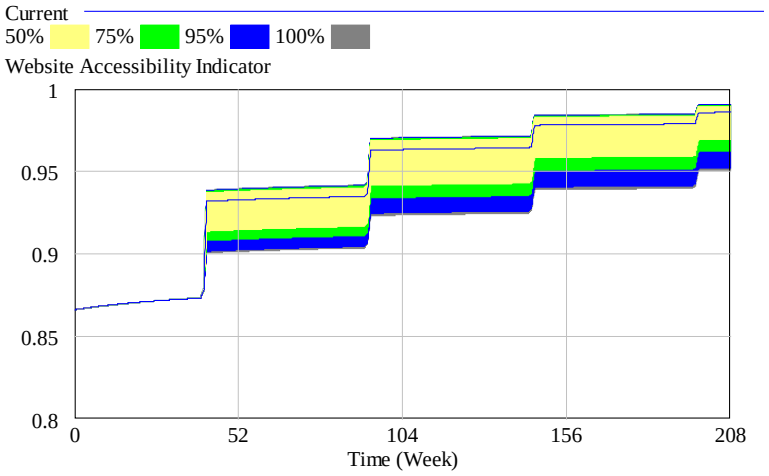
D.2.30 Time to Hire or Fire Main Editor



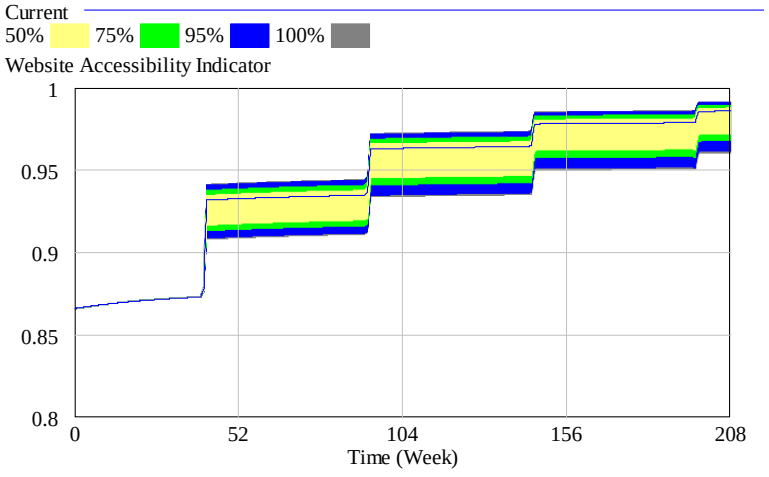
D.2.31 Time to Transfer Editor



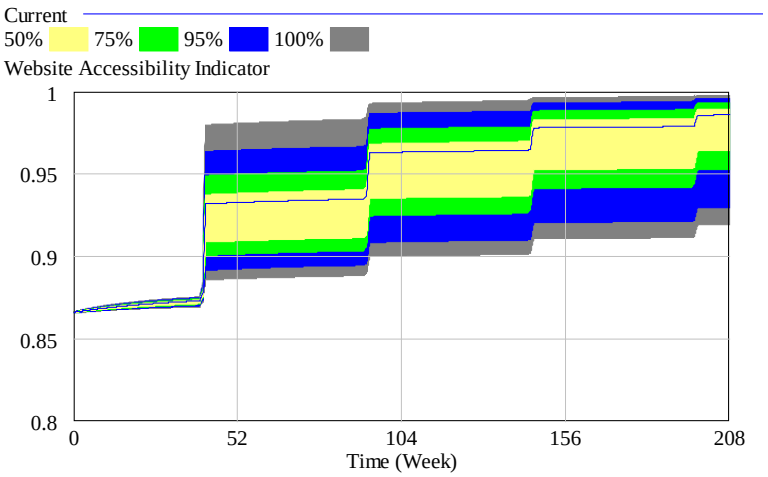
D.2.32 Vendor Templates Production per Consultancy Week



D.2.33 Vendor Templates Quality



D.3 Multivariate Sampling



Appendix III. Questionnaires

Table of Questionnaires

A Disabled People Attitudes towards Employment Questionnaire

Introduction

In Norway the employment rates for disabled people remains unchanged since 2000. Only around 44% of disabled people are in employment, compared to 53% in Denmark and 62% in Sweden.

This survey is carried out to help removing barriers that may prevent disabled people from taking-up and keeping jobs.

Your answers are important to help removing these barriers.

Your identity will not be revealed by any means and the information will be treated strictly anonymously, and filling out the questionnaire should only take a few minutes.

You can navigate forward through the questionnaire by pressing the **Next** button, or backward by pressing the **Previous** button.

What is your age?

—

What is your gender?

- ❑ Male
- ❑ Female

In which county do you currently live?

- ❑ Østfold
- ❑ Akershus
- ❑ Oslo
- ❑ Hedmark
- ❑ Oppland
- ❑ Buskerud
- ❑ Vestfold
- ❑ Telemark
- ❑ Aust-Agder
- ❑ Vest-Agder
- ❑ Rogaland
- ❑ Hordaland
- ❑ Sogn og Fjordane
- ❑ Møre og Romsdal
- ❑ Sør-Trøndelag
- ❑ Nord-Trøndelag
- ❑ Nordland
- ❑ Troms
- ❑ Finnmark

What is your education level?

- ❑ School Level "grunnskole"
- ❑ Secondary school "Videregående"
- ❑ University education level (1-3 years)

❑ University and college level (over 3 years)

Please describe your disability type: (mark one or more boxes)

❑ Mobility impairment
❑ Visual impairment
❑ Hearing impairment
❑ Asthmas or allergies
❑ Other (please describe) _____

What is your degree of disability? (indicate the percentage)

___

Which of the following support do you receive? (mark one or more boxes)

❑ No benefits
❑ Disability pension "Uførepensjon"
❑ Basic "Grunnstønad" or attendant benefits "Hjelpestønad"
❑ Rehabilitation funds / benefits "Attføringspenger"
❑ Rehabilitation benefits "Rehabiliteringspenger"
❑ Sick pay "Sykepenger"
❑ Financial benefits from private holdings
❑ Others (please specify) _____

Are you aware of any national support to enable disabled people to work?

❑ Yes ❑ No

How did you get to know about the national support provided to enable disabled people to work? (mark one or more boxes)

❑ Through the health services
❑ Through NAV
❑ Through my school
❑ Through neighbours or friends
❑ Through my disability organisation
❑ By searching the Internet
❑ By other means (please describe): _____

Will one or more of the following factors enable you to work?

	Yes	No
Availability of accessible transportation to workplace	❑	❑
Availability of accessible teleworking facility from home without cost on you	❑	❑
Availability of accessible workplace facilities or alternative work enabled from home without cost on you	❑	❑
For part-time workers, improved system for keeping disability pension when having salaried employment	❑	❑
Other (please specify)	❑	❑

_____

Will one or more of the following factors encourage you to take an available work opportunity?

	Yes	No
Possibility to combine salary and welfare benefits	❑	❑
Flexible working hours	❑	❑
Flexible working tasks	❑	❑
Access to personal computer with assistive technology or assistant	❑	❑
Access to employment training	❑	❑
Achieve self-fulfilment	❑	❑
Increase your social interaction	❑	❑
Enhance your social status	❑	❑
Availability of suitable jobs	❑	❑
Other factors (please specify)	❑	❑

_____

Will one or more of the following factors prevent you from active job application?

	Yes	No
Risk of losing current welfare benefits	❑	❑

	Yes	No
Expect not to get any job offer	❑	❑
Risk of not being able to fulfil the job expectations	❑	❑
Administrative hurdles in case a return to welfare support is necessary	❑	❑
No suitable jobs available	❑	❑
Other factors (please specify)	❑	❑

_____

Thank you for taking the time to complete this questionnaire ...

Please press the **Finish** button to end the questionnaire and send your answers to us!

B Employers Attitudes towards Employing Disabled People Questionnaire

Introduction

In Norway the employment rates for disabled people remains unchanged since 2000. Only around 44% of disabled people are in employment, compared to 53% in Denmark and 62% in Sweden.

This survey is carried out to help removing barriers that may prevent employers from recruiting people with disabilities.

Your answers are important to help removing these barriers.

Your identity will not be revealed by any means and the information will be treated strictly anonymously, and filling out the questionnaire should only take a few minutes.

You can navigate forward through the questionnaire by pressing the **Next** button, or backward by pressing the **Previous** button.

In which county is your company?

- ❑ Østfold
- ❑ Akershus
- ❑ Oslo
- ❑ Hedmark
- ❑ Oppland
- ❑ Buskerud
- ❑ Vestfold
- ❑ Telemark
- ❑ Aust-Agder
- ❑ Vest-Agder
- ❑ Rogaland
- ❑ Hordaland
- ❑ Sogn og Fjordane
- ❑ Møre og Romsdal
- ❑ Sør-Trøndelag
- ❑ Nord-Trøndelag
- ❑ Nordland
- ❑ Troms
- ❑ Finnmark

What is the sector of your organisation?

- ❑ Agriculture, forestry and fishing
- ❑ Mining and quarrying
- ❑ Manufacturing
- ❑ Electricity, water supply, sewerage, waste managem.
- ❑ Construction
- ❑ Wholesale, retail trade; repair of motor vehicles
- ❑ Transportation and storage
- ❑ Accomm. and food service activities

❑ Information and communication
❑ Financial and insurance activities
❑ Real estate and technical activities
❑ Administrative, support service activities
❑ Public administration and defence
❑ Education
❑ Human health and social work act.
❑ Other service activities, extraterritorial org.

How many employees do you have in your organisation?

_____

Do you have employees who were diagnosed as disabled in your organisation?

❑ Yes (how many?) _____
❑ No

Is your organisation aware of the IA agreement "IA-avtale og protokoll"?

❑ Yes ❑ No

Has your organisation signed the IA agreement "IA-avtale og protokoll"?

❑ Yes ❑ No

Because:

_____

In general what are the results of signing the IA agreement "IA-avtale og protokoll"?

_____

Is your organisation aware of any of the following?

	Yes	**No**
Your organisation can receive financial support from the government when employing disabled people	❑	❑
The government will provide your organisation with assistive technology when employing disabled people	❑	❑

	Yes	No
Your organisation can receive financial support from the government to adapt its workplace for disabled people	❑	❑
Disabled and elderly employees can benefit your organisation with their valuable experiences	❑	❑
Flexible work arrangements can yield full working capacity from employees with disabilities	❑	❑

Will one or more of the following factors encourage your organisation to employ a disabled person?

	Yes	No
Employing disabled people will increase the chances of your organisation to sell to public sector (Public Procurement)	❑	❑
Other organisations (competitors of your organisation) are recruiting disabled people	❑	❑
Your organisation wants to demonstrate social responsibility	❑	❑
The government will financially support your organisation employing disabled people	❑	❑
The government will provide your organisation with the needed assistive technology when employing disabled people	❑	❑
Disabled and elderly employees can benefit your organisation with their valuable experiences	❑	❑
Certain flexible work arrangement can yield full working capacity from employees with disabilities	❑	❑
Your organisation can receive financial support from the government to adapt its workplace to suit disabled employees	❑	❑
Other factors (please specify):	❑	❑

Will one or more of the following factors prevent your organisation from employing a disabled person?

	Yes	No

	Yes	No
The need to adapt office, if costs are believed not to be covered by government	❑	❑
Expected overhead in dealing with social benefits because of for example lack of easily accessed information or lack of fast response from public authorities when help related to disabled employees is needed	❑	❑
Lack of government supported salary system	❑	❑
May expect lower efficiency from disabled employees	❑	❑
May expect disabled employees to need more flexibility tasks	❑	❑
May expect disabled employees to need more flexibility working hours	❑	❑
General difficult financial situation, crisis ... etc.	❑	❑
Other factors (please specify):	❑	❑

Thank you for taking the time to complete this questionnaire ...

Please press the Finish button to end the questionnaire and send your answers to us!

C Questionnaire to Disabled People from Welfare to Jobs SDBILE Users

EDUEgypt Experiment

Please tell us how much do you agree or disagree with the following statements (Strongly Disagree, Disagree, Neutral, Agree, or Strongly Agree):

1. Removing the administrative overhead facing employers while dealing with social benefits to employ disabled people leads to an immediate increase in the number of employers employing disabled people
2. Providing employers with government financial support to employ disabled people leads to an increase after short delay in the number of employers employing disabled people
3. During the application Open Mind like programme, increasing the percentage of employers targeted by awareness campaign for a short period has a strong effect on the number of employed disabled people
4. Executing the government initiative to generalise Open Mind like programme, leads to an increase after long delay in the number of employed disabled people
5. Limiting public procurement to companies employing disabled people leads to a significant saving in the annual government spending on disabled people compared to not to
6. Removing the administrative overhead facing employers while dealing with social benefits to employ disabled people leads to saving in the annual government spending on disabled people compared to not to
7. Providing disabled persons with PC with assistive technology or assistant for a short period has strong effect on the number of employed disabled people
8. Removing the administrative barriers facing disabled people when trying to return to welfare support leads to saving in the annual government spending on disabled people compared to not to
9. Providing employers with government financial support needed to adapt workplace for disabled employees for a short period has a sustainable effect on the number of employers employing disabled people
10. Removing both administrative barriers facing disabled persons when trying to return to welfare support and administrative overhead facing employers while dealing with social benefits to employ disabled people leads to a significant saving in the annual government spending on disabled people compared to not to

11. Providing employers with assistive technology needed to employ disabled people for a long period has sustainable effect on the number of employers employing disabled people
12. During the application Open Mind like programme, decreasing the percentage of disabled people targeted by awareness campaign for a long period has a strong effect on the number of employed disabled people
13. During the application Open Mind like programme, increasing the percentage of employers targeted by awareness campaign leads to a significant saving in the annual government spending on disabled people compared to not to
14. Making it possible for disabled persons to combine salary and welfare benefits leads to an increase after short delay in the number of employed disabled people
15. Providing a disabled person with accessible transportation to work for a long period has a strong effect on the number of employed disabled people

UiA Experiment

Please tell us how much do you agree or disagree with the following statements (Strongly Disagree, Disagree, Neutral, Agree, or Strongly Agree):

1. A reduction of the bureaucracy employers encounter when recruiting disabled people, will immediately increase employers interested in employing disabled people
2. Governmental financial support to employ disabled people, will after a delay (less than 1 government term) increase employers interested in employing disabled people
3. An "Open Mind"-like programme will have almost no effect on employed disabled People, even if it is applied countywide and all disabled people are targeted by awareness campaigns (to encourage them to join labour force) all the time, while employers are targeted by awareness campaigns (to encourage them to recruit disabled employees) just for a limited period (less than 1 government term)
4. A countywide "Open Mind"-like programme, will after at least 1 government term increase employed disabled people
5. Giving companies employing disabled people preference in public procurement, will significantly decrease the annual governmental spending on disabled people
6. A reduction of the bureaucracy employers encounter when recruiting disabled people, will not lead to significant saving in the annual government spending on disabled people

7. Governmental provision of PCs with assistive technology or assistants for disabled people seeking employment, will in less than 1 government term increase employed disabled people significantly
8. Reducing administrative barriers disabled people face trying to return back to welfare support, will lead to significant saving in the annual governmental spending on disabled people
9. Governmental provision of financial support needed to adapt employers workplaces to suit disabled employees even for less than 1 government term, will have a sustainable effect on employers employing disabled people
10. Reducing administrative barriers disabled people face trying to return back to welfare support, in addition to reducing the bureaucracy employers encounter when recruiting disabled people simultaneously, will lead to a very significant saving in the annual governmental spending on disabled people
11. Governmental provision of assistive technology for employers whenever needed at least for 2 full government term, will have a sustainable effect on employers employing disabled people
12. Allowing disabled people to combine both salary and welfare benefits in the same time, will immediately increase employed disabled people
13. Governmental provision of accessible transportation to work for disabled people seeking employment even for more than 2 government term, will not significantly increase employed disabled people

Poll of Experts' Additional Comments and Recommendations

Was it easy to use this Interactive Learning Environment in general?

❑ Yes ❑ No

Any additional thoughts about/comments on the ease of use of this Interactive Learning Environment in general?

_____

Could this Interactive Learning Environment help decision-makers?

❑ Yes ❑ No

Any additional thoughts about/comments on what this Interactive Learning Environment could provide to help decision-makers?

_____

Could this Interactive Learning Environment support more targeted discussions among individual citizens, disability organisations, and policy makers?

❑ Yes ❑ No

Any additional thoughts about/comments on what this Interactive Learning Environment could provide to support more targeted discussions among individual citizens, disability organisations, and policy makers?

_____

Could this Interactive Learning Environment reconnect ordinary people with the problem of disabled people employment and the policies affecting it?

❑ Yes ❑ No

Any additional thoughts about/comments on what this Interactive Learning Environment could provide to reconnect ordinary people with the problem of disabled people employment and the policies affecting it?

_____

Do you think that this Interactive Learning Environment useful in general?

❑ Yes ❑ No

Any additional thoughts about/comments on the usefullness of this Interactive Learning Environment in general?

_____

Any final thoughts about/comments on this Interactive Learning Environment?

_____

D Identifying Sources of Accessibility Barriers Questionnaire

Introduction

The objective of this questionnaire is to identify the reasons behind UWEM failed test /barriers in Norwegian municipal websites, namely web-editor (Content Provider) or CMS/Templates.

Your answers are important to help identifying the sources of these barriers and consequently help in removing them.

Your identity will not be revealed by any means and the information will be treated strictly anonymously, and filling out the questionnaire should only take a few minutes.

You can navigate forward through the questionnaire by pressing the **Next** button, or backward by pressing the **Previous** button.

How do you find the following statement:
"Webpages fail UWEM 1.1_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 1.1_HTML_01 test is targeted to check that non-text content has a text equivalent.

❑ Disagree Strongly	❑ Disagree	❑ Somewhat Disagree	❑ Somewhat Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 1.1_HTML_06 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 1.1_HTML_06 test is targeted to non-text content embedded with the non-standard embed element.

❑ Disagree Strongly	❑ Disagree	❑ Somewhat Disagree	❑ Somewhat Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 3.2_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 3.2_HTML_01 test is targeted to check that the document contains a valid document type declaration.

❑ Disagree Strongly	❑ Disagree	❑ Somewhat Disagree	❑ Somewhat Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 3.2_HTML_02 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 3.2_HTML_02 test is targeted to find violations against the formal schema for HTML 4.x or XHTML 1.0.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 3.5_HTML_03 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 3.5_HTML_03 test is targeted to check that no levels are skipped in the heading hierarchy.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 3.6_HTML_03 test most likely because of accessibility barriers caused by the Web-editor (Content Provider)"?
Note: UWEM 3.6_HTML_03 test is targeted to find paragraphs, line breaks and numbers that are used to simulate numbered lists and which can be replaced with the ol element.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 6.4_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 6.4_HTML_01 test is targeted to check that mouse-specific event handlers have a keyboard-specific (or device-independent) version.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 7.2_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 7.2_HTML_01 test is targeted to find any blink elements.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

How do you find the following statement:
"Webpages fail UWEM 7.3_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 7.3_HTML_01 test is targeted to find marquee elements.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

How do you find the following statement:
"Webpages fail UWEM 7.4_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 7.4_HTML_01 test is targeted to find elements that can cause page refreshing.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

How do you find the following statement:
"Webpages fail UWEM 7.5_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 7.5_HTML_01 test is targeted to find elements that can cause page redirecting.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

How do you find the following statement:
"Webpages fail UWEM 9.1_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 9.1_HTML_01 test is targeted to find server-side image maps.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

How do you find the following statement:
"Webpages fail UWEM 11.1_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?

Note: UWEM 11.1_HTML_01 test is targeted to find out whether the latest versions of W3C technologies for HTML and XHML have been used.

❑ Disagree Strongly	❑ Disagree	❑ Somewhat Disagree	❑ Somewhat Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 11.2_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 11.2_HTML_01 test is targeted to find deprecated HTML elements.

❑ Disagree Strongly	❑ Disagree	❑ Somewhat Disagree	❑ Somewhat Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 11.2_HTML_02 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 11.2_HTML_02 test is targeted to find deprecated HTML attributes.

❑ Disagree Strongly	❑ Disagree	❑ Somewhat Disagree	❑ Somewhat Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 12.1_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 12.1_HTML_01 test is targeted to find frames without description.

❑ Disagree Strongly	❑ Disagree	❑ Somewhat Disagree	❑ Somewhat Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 12.3_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?
Note: UWEM 12.3_HTML_01 test is targeted to find fieldsets without legend.

❑ Disagree Strongly	❑ Disagree	❑ Somewhat Disagree	❑ Somewhat Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:
"Webpages fail UWEM 12.3_HTML_04 test most likely because of accessibility

barriers in the CMS or Templates"?

Note: UWEM 12.3_HTML_04 test is targeted to find optgroup elements without label.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:

"Webpages fail UWEM 12.4_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?

Note: UWEM 12.4_HTML_01 test is targeted to find form control elements without id.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:

"Webpages fail UWEM 12.4_HTML_02 test most likely because of accessibility barriers in the CMS or Templates"?

Note: UWEM 12.4_HTML_02 test is targeted to find form control elements without label element.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:

"Webpages fail UWEM 13.1_HTML_01 test most likely because of accessibility barriers in the CMS or Templates"?

Note: UWEM 13.1_HTML_01 test is targeted to find a and area elements with the same title and text with different different link target (href). If no title attribute is provided, only the element text is checked.

❑ Disagree Strongly	❑ Disagree	❑ Some-what Disa-gree	❑ Some-what Agree	❑ Agree	❑ Agree Strongly

---

How do you find the following statement:

"Webpages fail UWEM 3.2_CSS_01 test most likely because of accessibility barriers in the CMS or Templates"?

Note: UWEM 3.2_CSS_01 test is targeted to find violations against the formal grammar for CSS 1.0 or CSS 2.x.

❑ Disagree	❑ Disagree	❑ Some-	❑ Some-	❑ Agree	❑ Agree

Strongly		what Disagree	what Agree		Strongly

How many years have you been working with accessibility of Norwegian municipal websites?

__

How do you find the following statement:
"My expertise in working with accessibility of Norwegian municipal websites was enough to answer this questionnaire correctly"?

❑ Disagree Strongly	❑ Disagree	❑ Somewhat Disagree	❑ Somewhat Agree	❑ Agree	❑ Agree Strongly

Thank you for taking the time to complete this questionnaire ...

Please press the **Finish** button to end the questionnaire and send your answers to us!

E Questionnaire to eAccessibility of Norwegian Municipalities Websites ILE Users

Please tell us how much do you agree or disagree with the following statements (Strongly Disagree, Disagree, Neutral, Agree, or Strongly Agree):

1. Either increasing or decreasing the consultancy hours won't have sustainable effect on eAccessibility
2. Provided that your main-editors were trained to develop templates, asking them to devote more time to enhance existing templates has sustainable effect on eAccessibility
3. Provided that you requested certain consultancy hours from your vendor, asking the vendor to dedicate more time to enhance existing templates on only one occasion, will show a significant effect on eAccessibility
4. Either increasing or decreasing you editors, will have no effect on backlog of required articles
5. Asking your editors to devote less time to publishing new articles, leads to immediate increase in backlog of required articles
6. Provided that you requested certain consultancy hours from your vendor, asking the vendor to dedicate either more or less time to authoring new templates, has sustainable effect on eAccessibility
7. Upgrading CMS will take a long period (not less than 2 years) to show any effect on eAccessibility
8. Provided that your main-editors were trained to develop templates, asking them to devote more time to authoring new templates will take a long period (not less than 2 years) to show any effect on eAccessibility
9. By training your main-editors to develop templates, you can achieve the same eAccessibility with lower cost compared to consulting your vendor
10. Provided that your main-editors were trained to develop templates, depending on them to author and enhance templates, can improve eAccessibility faster than consulting your vendor

Appendix IV. Published Papers

Table of Published Papers

A. A. Abdelgawad, J. Radianti, M. Snaprud, and J. Krogstie, 'Simulation Models in eGovernment using System Dynamics: A Literature Survey', in *IST-Africa 2016 Conference Proceedings*, Durban, South Africa, 2016, pp. 1–8.

B. A. Abdelgawad, M. Snaprud, J. Krogstie, and R. Brynn, 'Disabled People from Welfare to Jobs: A Decision Support Tool', in *Modelling Symposium (AMS), 2012 Sixth Asia*, Bali, Indonesia, 2012, pp. 132 –137.

C. A. Abdelgawad, J. Radianti, M. Snaprud, and J. Krogstie, 'Disabled People from Welfare to Jobs: An Interactive Learning Environment Experimental Investigation', in *Proceedings of the 34th International Conference of the System Dynamics Society*, Delft, Netherlands, 2016.

D. A. Abdelgawad and M. Snaprud, 'A Survey of Current Measurement Methods for eGovernment User-satisfaction', in *Proceedings of the Fourth International Conference on Developments in E-Systems Engineering (DESE2011)*, Dubai, UAE, 2011.

E. A. Abdelgawad and M. Snaprud, 'A Survey of Current Measurement Methods for eGovernment Impact', in *Fourth International Conference on Internet Technologies and Applications (ITA 11)*, Wrexham, North Wales, United Kingdom, 2011.

F. A. Abdelgawad, M. Snaprud, and J. Krogstie, 'Accessibility of Norwegian Municipalities Websites: A Qualitative System Dynamics Approach', in *Proceedings of the 28th International Conference of the System Dynamics Society*, Seoul, Korea, 2010.

G. A. Abdelgawad, M. Snaprud, and J. Krogstie, 'Accessibility of Norwegian Municipalities Websites: A Decision Support Tool', in *UKSim 5th European Modelling Symposium on Computer Modelling and Simulation*, Madrid, Spain, 2011, pp. 225–230.

H. A. Abdelgawad, J. Radianti, M. Snaprud, and J. Krogstie, 'Experimentation with a System Dynamics Based Interactive Learning Environment: A Case Study of Accessibility of Norwegian Municipalities Websites', *International Journal of Simulation Systems, Science & Technology*, vol. 17, no. 35, 2016.

A Simulation Models in eGovernment using System Dynamics: A Literature Survey

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Abstract: *System Dynamics (SD) is a method to build simulation models using computers, to study the behaviour of systems, and apply what-if scenarios aiming at achieving optimal policy design. To have an overview of the current state-of-the-art of SD use in the eGovernment field; we have surveyed related literature. Our main goal is to uncover the possibilities for future research by clarifying the shortages. The identified literature is not very large. In most of the literature, SD models use was limited to SD practitioners. We discovered low usage of Group Model Building and workshops despite their usefulness in involving non-SD practitioners in the model building process. Additionally, there is a large untapped potential in using Interactive Learning Environment, in spite of its importance in involving non-technical users in conducting what-if scenario testing, and changing users' mental models by uncovering the underlying system structure.*

Keywords: eGovernment, system dynamics, literature review

A.1 Introduction

In 2013, Dawes wrote: "the failure rate of investments in ICTs to meet governmental needs remains high and consumes both resources and credibility" [1]. In 2014, another report claimed that –despite little data availability– from 60% to 80% of eGovernment projects fail [2].

The failure of eGovernment projects is mainly caused by bad implementation [3], or bad management practices [3]. This in turn, is due to inconsistencies between the targets and needs these projects have been established to suffice, and what happens in reality [3]. Clearly, methods that can help researchers and practitioners in estimating eGovernment projects results, can greatly increase the probability of success [1]. In 1998, during one of the US National Science Foundation Digital Government Research Program workshops, a research wish list was prepared. One of these wishes was: "Intuitive decision support tools for public officials. Technologies and data standards that encourage information search, selection, analysis, and sharing can strongly influence

the nature and effectiveness of decision making by elected officials, senior executives, and program managers alike. The use of new tools by decision makers may also have implications for public participation and open government" [4]. In 2013, this list is still relevant [1].

An eGovernment system is –like any other Information System– a socio-technical system, composed of various internal components: software, hardware, telecommunications, data, people, procedures [5]. From a different angle, eGovernment is governed by the mutual interaction between three types of agents: government, businesses and citizens, rendering it as a dynamically changing and complex system [6]. Considering the interactions among eGovernment components and agents especially from the management point of view, many ways could be proposed to enhance its performance [7]. Taking into consideration that interactions among eGovernment system components are dynamically complex and changing over time, makes System Dynamics (SD) one of the most suitable methods to be used in modelling such a system [5].

SD is a method to build simulation models using computers, to study the behaviour of systems [7]. It is an application of Servomechanism or Information Feedback Systems Theory (Control Theory) [8] to almost all kinds of social systems. SD models enable users to understand how policies and decisions interact with the underlying structure of the system to influence its behaviour [8]. Furthermore, they enable them to apply different what-if scenarios, for different sets of policies aiming at reaching optimal policy design [7].

To stand on the current state-of-the-art of SD use in the eGovernment field; we would like to investigate the accumulated literature on eGovernment models using SD. In addition to knowing the present situation which could have a great impact on our understanding of the depth of SD use in this field, our main goal is to uncover the possibilities for future research by clarifying the shortage. The following section describes the methodology we used to achieve our investigation goal. Afterwards we describe the findings and results. In the last section the paper concludes.

A.2 Methodology

Our investigation started by searching two popular reference databases; the first is the "E-Government Reference Library (EGRL) version 10.5" published in January 25, 2015, hosted by Hans Jochen Scholl, University of Washington,[90] the other is the SD

[90] Available at: https://catalyst.uw.edu/webq/survey/jscholl/22768

bibliography database ver. 2015a published in 2015 and hosted by the SD Society.[91] The EGRL includes 7,237 eGovernment related references, 45% of them are journal articles and 51% are conference papers, book sections and edited books. The SD bibliography database contains 11,046 SD related reference, 23% of them are journal articles and 46% are conference papers, book sections and edited books.

Our main search focused on the eGovernment keyword variants: "electronic government", "digital government", "egovernment", "e-government" and "egov" in all fields of the SD bibliography database. Additionally, we added "Information Technology", "IT", "Information and Communication Technology", and "ICT" to "government" as extra search keywords. For the EGRL database, we used "System Dynamics" and "System Thinking" as search keywords in all fields.

The last step was followed by pairing each eGovernment search keyword with each SD search keyword. These pairs were used to search all databases available from EBSCO Information Services, hosted by EBSCO Information Services.[92] Finally, the search process was wrapped up by using Google Scholar.[93] Many repetitions were found and removed during the process. The resulted references were skimmed to be sure of their eligibility for this research. The final step we conducted on the filtered publications list was reviewing the citations forward and backward. This step added few extra publications to the final list.

We excluded a couple of SD Society's conferences papers. Only the abstracts of these two papers were available in the proceedings. We have contacted the SD Society and the first two authors of both papers; however these trails were not fruitful. For one conference paper we could find merely a presentation on the conference website, in addition the issue of the paper was republished by the same authors the following year in a different conference. Only the latter paper was taken into consideration.

A.3 Results

A.3.1 Bird's–Eye View

The overall search process resulted in more than 115 publications, of which more than 80% were not related to our topic and thus eliminated. For example some of the eGovernment related papers appeared in the search because they quoted one or more SD re-

[91] Available at: http://www.systemdynamics.org/bibliography-download-page

[92] Available at: https://search.ebscohost.com

[93] Available at: https://scholar.google.com

lated references, and vice versa. Only 28 publications were found relevant, and included in the final list.

Conferences accounted for 57% of the used publication channels. 25% of the publications reviewed were journal articles. As shown in Figure A-1, the overall publication rate is increasing over time.[94] Figure A-2 shows the concentration of 75% of eGovernment investigated projects in the United States and Mexico.

Investigated publications differed in their information sources approaches. 71% and 54% of the reviewed publications used *Case Study* and *Interviews* as a main or one of the main sources respectively, ranking them as the most engaged approaches. *Group Model Building* followed with 29%. Using *Workshops* and *Surveys* as main source of information came last.

Authors preferred different tools and methods to analyse and present their results. *Stock and Flow diagram* was the most frequently used tool with 71% of all reviewed publications. 46% of the investigated publications used *Causal Loop diagram* to present their understanding about the system under-investigation. 61% of the reviewed publications have stepped to present simulation results. The use of the more advanced technique of *Interactive Learning Environment* was limited to merely 7% of the reviewed publications.

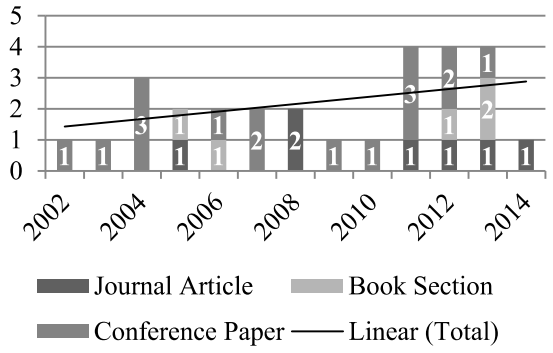

Figure A-1: Publication frequency by type and total over time

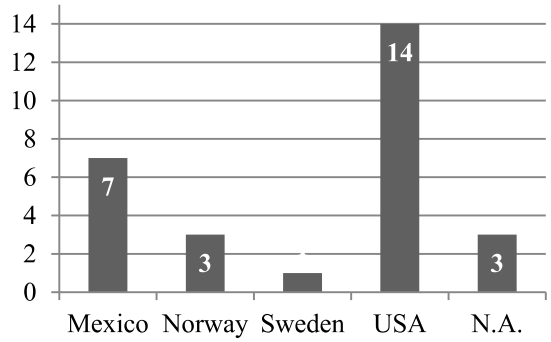

Figure A-2: Location of the eGovernment project application

79% of the reviewed publications were used in presenting project cases on the local municipal/territorial/city level, while only 21% addressed national/county-wide level. The reviewed publications were almost equally distributed between being used in supporting specific and general eGovernment projects. Table A-1 compiles a list of distri-

[94] Only 5 publications were published in a SD related channel. This could be considered as an indicator on the acceptance of SD in publication channels that are not related to SD domain.

bution of investigated publications over all information sources, used tools, scopes, and usages.

Table A-1: Filtered publications distribution over information sources, used tools, scope, and usage

Information source(s)					Used tool(s)/method(s)				Scope		Usage	
Case study	Group model building	Interviews	Survey	Workshops	Causal Loop diagram	Stock and Flow diagram	Simulation results	Interactive Learning Environment	County Wide /National	Local/Municipal	General Case	Specific Case
71%	29%	54%	11%	14%	46%	71%	61%	7%	21%	79%	46%	54%

A.3.2 Deeper Look into the Models

We were able to distribute the models presented in the surveyed papers over 4 different topics:

4. Collaboration and knowledge sharing
5. Development and success/failure factors
6. System security
7. Government 2.0 applications

Collaboration and Knowledge Sharing. Like any other project, a successful eGovernment project requires smooth collaboration among involved parties. This includes aspects like trust and consequently data, information and knowledge sharing among these parities. According to our survey, the first SD model focusing on eGovernment was introduced in 2002 by Cresswell *et al.* [9]. The model explored the dynamics of collaboration and knowledge sharing among different governmental agencies. The model used the data and information retrieved during the implementation of the *Homeless Information Management System* (HIMS) for the state of New York in the United States. Seven other publications explored the HIMS projects and its SD model [10]–[16].

Information integration in the context of inter-governmental agencies collaboration was tackled in another model that was built by Luna-Reyes *et al.* [17], [18]. In 2011, Scholl and Luna-Reyes presented a model envisaging the relationships among different government stakeholders (namely, the Congress, the president, the people, and the press) as controlled by the US constitution [19]. This model focused on the effect of transparency and open government in promoting a less secretive government.

Development and Success/Failure Factors. eGovernment development process is affected by many factors in addition to the actions of several parties. Understanding this process, can help in identifying the leverage points, success and failure factors. A theoretical and an analytical framework explaining eGovernment development was embodied in a causal loop diagram introduced by Martinez-Moyano and Gil-Garcia [20]. Their aim was to find leverage points of intervention. In the following year, Luna-Reyes *et al.* investigated the social and organizational factors causing success and failure of a governmental information systems development based on the New York state's *Multi-purpose Access for Customer Relations and Operational Support* (MACROS) project findings [21]. The development of the eGovernment organisational and technological sophistication was explored by Martinez-Moyano [22] via a preliminary causal loop diagram to be used later in group model building sessions. Nevertheless, this was never used further.

Kim *et al.* introduced a model that helps in deciding whether the city of Philadelphia in the United States should compete with private sector providers in the local Wi-Fi market [23]. eMexico program is a Mexican eGovernment initiative that includes different internet service portals. Luna-Reyes and Gil-Garcia combined the institutional theory and SD to build a preliminary model in order to understand the interactions among institutional, organisational, and technological components of the eGovernment in Mexico based on information recovered from the eMexico program [24]. The model was re-introduced in an extended version of the same paper in 2011 [25].

In a couple of papers, Abdelgawad *et al.* explored the non-technical factors affecting the eAccessibility of Norwegian municipal local government websites. Presenting a causal loop diagram in the first paper, while in the second they introduced a model and an Interactive Learning Environment to be used as a decision support tool [26], [27].

Navarra and Bianchi presented an abstract model to be built and applied in the context of territorial governance, to support sustainable development [28]. They used Hammarby in Sweden as their case-study.

Luna-Reyes, Gil-Garcia and Ramirez-Hernandez proposed a resource-based view of the eGovernment service provider using SD modelling [29]. This was preceded by a preliminary conceptual SD model that renders the fundamental capabilities and resources required to achieve a successful transformation to eGovernment on the local level [30]. This paper was an extended version of the former. The authors used SD and dynamic-capabilities view of the eGovernment service provider [31] to identify the core capabilities and resources necessary to develop a successful eGovernment strategy

was introduced as a continuation of the same line of work in and extended version of the two former papers [32].

Rich and Nelson addressed the problems caused by shifting the requirements in large government IT projects using SD modelling [33]. Luis F. Luna-Reyes and Gil-Garcia used SD to present a theory of the co-evolution of technology, organizational networks, and institutional arrangements in government transformation via IT [34]. The same model was reintroduced in an extended version paper [35].

System Security. An eGovernment system is vulnerable to several types of risks. These risks could range from hacking and virus attacks to hardware failures and natural disasters. Understanding the causes and effects of these risks is critical in understanding the ramifications and preparing the mitigation strategies. Tang and Jia constructed an open-loop system model for estimating the risks the eGovernment services face, and how to sustain the security of these services [36]. Open-loop systems ignore information feedback. This prevents the model behaviour from being affected by its past values [7]; consequently ignoring that circular causality.

Government 2.0 Applications. Abdelgawad *et al.* presented a SD model and Interactive Learning Environment depicting the situation of disabled people employment in Norway [37]. This Interactive learning Environment could be used as a tool to promote citizen participation, by involving ordinary citizens in politics and policy-making process.

A.4 Conclusion

Our goal is to understand the situation of using SD in the eGovernment field, in order to increase our understanding of the depth of that practice, and uncover the possibilities for future research by shedding the light on the shortage. The identified literature applying SD in the context of eGovernment is not very large. Furthermore, it was clear that in the majority of cases, the use of SD models is limited to SD practitioners. Albeit, the real power of SD does not only lie in its powerful modelling capabilities, but also in its ease of use and comprehension by both users involved in the modelling process and users of the final model.

Group Model Building and workshops are vital tools to involve non-SD practitioners in the model building process. Yet, their use in the surveyed literature is low. The cost of involving people in the modelling process both financially and time-wise cannot be ignored, however the benefits are obvious. More focus on using both tools is inevitably required if increasing the use of SD in the eGovernment field is targeted.

With a couple of exceptions, most of the models investigated have no Interactive Learning Environment. Consequently, they can neither be used directly by non-technical users to conduct what-if scenario testing, nor help them in changing their mental models by uncovering the underlying system structure. Perhaps time and costs involved in developing an Interactive Learning Environment play a principal role in this situation, nevertheless extra momentum is a must to increase the models usability especially among non-technical users. Finally, it is worth mentioning that very few models address national level/county-wide projects. Further attention could be devoted to building models that are concerned with situations on that level.

A.5 Next Step in Africa

In the context of ICT development in developing countries, Dahan wrote that SD "is increasingly proving its applicability and relevance to developing work. Policy-makers need to look for innovative approaches that offer guidance on improving the design and implementation of development programs, and help identify critical activities, knowledge gaps, as well as the highest payoffs to filling those gaps. [SD] seems to be a good candidate in addressing these challenges" [38]. In Europe, many universities teach and use SD in research e.g. University of Bergen in Norway, University of Palermo in Italy, and Radboud University in the Netherlands. Their wide range of SD modelling knowledge and experience could greatly help the growing eGovernment field in African countries in building useful SD decision support tools. Many African students and practitioners have studied SD in these universities; however more cooperation in conducting practical research would be very beneficial. Moreover, if covering the shortage we have shed the light on in SD research is expected to be fruitful in general, we believe that the effect would be manyfold in the context of African eGovernment.

A.6 References

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B Disabled People from Welfare to Jobs: A Decision Support Tool

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Abstract: *Despite repeated statements from successive governments in Norway, disabled people employment rate remains unchanged since 2000. A range of studies to describe and analyse the situation qualitatively and quantitatively have been performed, however we have not been able to find any study containing a decision support tool focusing on this issue. This paper presents a simulation model, built using the System Dynamics methodology. The model focuses on enabling disabled people to move from welfare to work, incorporating attitudes of disabled people and employers. The model is designed to cover selected factors that are believed to enable and encourage disabled people to take up jobs. It is intended to be used by policy makers, disability organisations, and individual citizens, and support more targeted discussions among them. To build the underlying model we have conducted an extensive literature review, and two surveys on attitudes of disabled people and employers. The paper contains a description of the model structure, and its behaviour.*

Keywords: Decision Support; Policy Making; System Dynamics; Disabled People Employment; Interactive Learning Environment

B.1 Introduction

Despite repeated statements from successive governments in Norway, the employment rates for disabled people remains unchanged since 2000, only around 44% of disabled people (aged 16-66) are in employment [1]. In Norway's neighbour countries, the case is different. In Denmark, 53% of disabled people (aged 16-64) are in employment [2], and 62% in Sweden (aged 16-64) [3].[95] These low rates of employment among disabled

[95] Such employment rates are generally based on different national-level surveys, with different designs, timings, surrounding economic conditions, and definitions of being employed [4].

people comes even under the protection of anti-discrimination law and a high governmental spending on employment efforts compared to any other country [1].
The Norwegian government has introduced different vocational rehabilitation programmes to increase the employment probability of disabled people through re-education. However, these vocational rehabilitation programmes suffer from many problems, for example according to [5], disabled people with the lowest work opportunity will benefit the most from the vocational rehabilitation, however they have the lowest opportunity to be included in such programmes. Another research paper [6] shows that although vocational rehabilitation programmes in Norway increase the employment probability of disabled people, the net effect is nearly zero because of the time elapsed during the training without looking for jobs.
The Norwegian telecommunication company *Telenor*[96] has introduced a very successful 2 years vocational rehabilitation programme called *Handicapped-Programme* (HCP) or *Open Mind Programme* [7], [8]. HCP is operated and mostly executed by Telenor. The programme consists of 3 months of class training, and 21 months of on-the-job training in Telenor or one of its partner companies [7], [8]. This approach combines on-the-job training, with a wage subsidised programme, that were both proven to be the most effective in increasing employability of disabled people [5]. Furthermore, at least 75% of the trainees have got permanent jobs after finishing the programme [8]. Although the programme is on a very small scale,[97] the results are encouraging. It has been copied in Sweden and Pakistan [7]. Moreover, in [8], simple calculations were made to show the overall effect on government budget resulted from employing trainees of Telenor's HCP till their retirement. It has been shown that accumulated net savings in terms of saved disability benefits and increased tax revenue after removing HCP programme cost is positive.
Inspired by the success of Telenor's HCP, we are interested in exploring factors that can enable more disabled people to take up jobs, since this would be a substantial contribution to the individual capacity building, and for the national financial bottom line. To do that, a System Dynamics (SD) [9] model was built, intending to enable a better understanding of factors that can enable and encourage the currently disabled people to take up jobs. Furthermore, the model takes into consideration the associated costs and savings for individuals, employers, and nationally through the *Norwegian Labour and*

[96] http://www.telenor.no

[97] On average 8 to 10 persons pass through the HCP annually [8].

Welfare Administration (NAV)[98] and the tax authority. Measures to change the employment situation will often need time to take effect. A well-established model could build a common understanding of the causalities and motivate policy makers and citizens voting for them, to keep a selected policy long enough to achieve the anticipated benefits.

In addition, the model has an easy-to-use GUI that enables it to be used as an *Interactive Learning Environment* (ILE) [9], hence to support more targeted discussions among individual citizens, disability organisations, and policy makers. The envisaged approach can contribute to improve the eParticipation, by "reconnecting ordinary people with politics and policy-making and making the decision-making processes easier to understand and follow through the use of new Information and Communication Technologies" [10].

The remainder of this paper is organised as follows: The first section gives a brief introduction to SD. The second section outlines the sources of information used. The third section explores the background and the structure of our SD model sectors, in addition to the model testing and behaviour. Finally, the paper concludes.

B.2 System Dynamics

SD is a methodology to build simulation models using computers, to study the behaviour of systems [9], [11]. It is an application of Servomechanism or Information Feedback Systems Theory [11] to almost all kinds of social systems. Like any mathematical modelling methodology [12], SD is an abstraction of the reality into a system of mathematical equations, specifically a system of simultaneous non-linear first order differential equations.

SD classifies variables of a system into two main types of variables; the first type is called *Flow* or *Rate*, which accumulates or depletes the other type called *Stock* or *Level* over time. In mathematical notation, a *Stock* is the integration of a *Flow* over time, i.e.:

$$Stock = \int_{t_0}^{t} Flow \cdot dt + Stock_0$$

Where t is time. $Stock_0$ and t_0 are initial values of $Stock$ and t respectively. Auxiliary variable is another type of variables that may exist in SD model, and contains additional algebraic expressions needed to compute the flows from the other variables in the model. Constants or parameters may be used in the SD model as well.

[98] http://www.nav.no

Stock and Flow diagram is a graphical representation of SD model. Stocks are distinguished from other variables with rectangles around them. In addition, there are two types of connectors to define relationships between variables, single and double lined arrows to denote information flows and material flows (tangible substances) respectively.

To familiarise the reader with Stock and Flow diagram conventions, Figure B-1 shows a simplification of population dynamics model adapted from [9]. In this model, a *population* stock is increased by a flow of births controlled by *birth rate*, and decreased by another flow of deaths controlled by *death rate*.[99] Furthermore, two information connectors pass the value of population stock and the environment *carrying capacity* (constant in this example) to an auxiliary variable called *population relative to carrying capacity*. This auxiliary variable limited by *maximum fractional birth rate* and *minimum fractional death rate* decides the values of *fractional birth rate* and *fractional death rate* respectively. In turn, both as fractions of population determine the values of birth rate and death rate respectively.

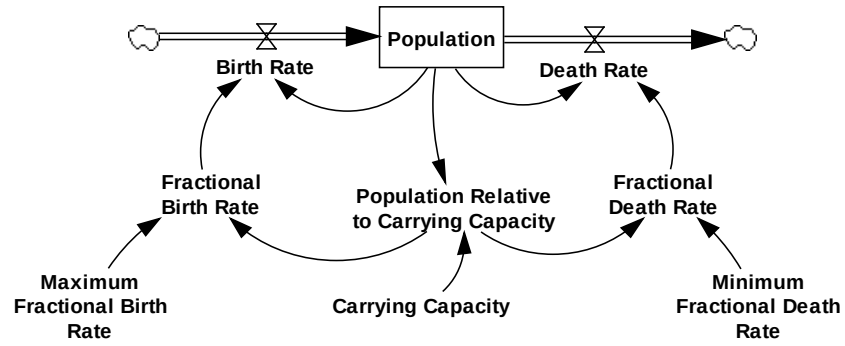

Figure B-1: Example of Stock and Flow diagram (adapted from [9])

B.3 Information Sources

The main source of information to build the SD model presented in this paper is extensive literature review from both national sources like *Statistics Norway* (SSB), [100] and international sources like *Organisation for Economic Co-operation and Development* (OECD).[101] Furthermore, two surveys were conducted; the first was done among disabled people to understand their attitudes towards taking up jobs, while the second was conducted on employers to understand their attitudes towards recruiting disabled peo-

[99] A cloud denotes a source or a sink that is outside model boundaries.

[100] http://www.ssb.no

[101] http://www.oecd.org

ple. The model structure is based on the *Bass Diffusion Model* of Frank Bass [13], and its SD version [9], in addition to different structures from the SD molecules [14], and other SD literature as will be shown in the following subsections.

B.4 SD Simulation Model for Transferring Disabled People from Welfare to Jobs

B.4.1 Model Structure

Figure B-2 presents the conceptual diagram of the model. There are two main blocks: disabled people and employers. On the disabled people block: government decisions and awareness of disabled people about their competence and possibilities available for them, are playing main role in making these disabled people using welfare interested in work. By training and enabling these disabled people, they are ready to fill potential vacancies.

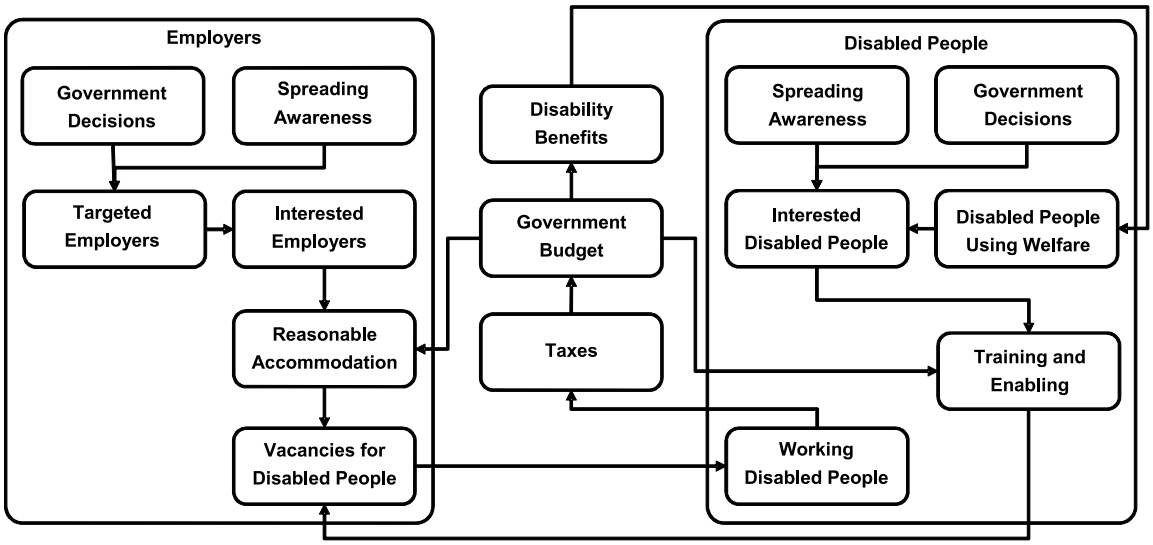

Figure B-2: Model conceptual diagram

On the employers block: government decisions and awareness of employers about the possibilities available for them when recruiting disabled employees, are playing main role in making these employers interested in recruiting disabled people. By providing reasonable accommodation[102] to employers, vacancies for disabled employees are created. Both training and vacancy creation for a disabled person put pressure on govern-

[102] Reasonable accommodation "means necessary and appropriate modification and adjustments not imposing a disproportionate or undue burden, where needed in a particular case, to ensure to persons with disabilities the enjoyment or exercise on an equal basis with others of all human rights and fundamental freedoms" [15].

ment budget. However, when a disabled person gets a job, she leaves the welfare benefits and converts to a tax payer, accordingly ease the pressure on government budget. Based on this structure, the model is divided into sectors. The following subsections explore the Stock and Flow diagrams and the processes inside these sectors.

B.4.1.1 Current Situation Structure

B.4.1.1.1 Disabled People Sector

Figure B-3 shows our understanding of the current process of shifting disabled people from using welfare to work.[103] We have assumed that disabled people in Norway are either welfare recipients or employees paying taxes. Also, we have assumed that all disabled people start first as welfare recipients. The number of welfare recipients is increased by an increase fraction that was computed based on the figures extracted from [16].[104] Only a fraction[105] of the welfare recipients becomes interested in work. This conversion is regulated by the "social exposure and imitation" effect of the Bass Diffusion Model (usually word of mouth, in this case via day-to-day contacts among working and non-working disabled people, specially through disability organisations[106]) [9]. In the current situation, we were not able to identify "external sources of awareness and adoption" (usually advertising) [9].[107] The next step is that some of the disabled people interested in work can find suitable vacancies and move to work.

Intuitively, some of the employed disabled people will quit or have their employment ended and leave back to welfare waiting for another potential vacancy.[108] No specific value for disabled people employment quitting rate could be identified, so we used the employment quitting rate computed for the general population from [17]. It is worth mentioning that all stocks of disabled people shown in the figure, are subject to de-

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[103] In figures, variables names delimited by pointy brackets are pictures of their corresponding variables. If a variable is computed in a different sector, its pictures will be coloured in grey.

[104] The increase rate is not shown in the figure.

[105] The fraction of disabled people who are enable and encouraged to work will be covered in the attitudes sector subsection.

[106] For example, the *Norwegian Federation of Organisations of Disabled People* (FFO) http://www.ffo.no

[107] Older advertising encounter was identified, however very limited and for a very short period. So, we felt safe to assume its inexistence in the current situation. More information is available in the advertising sector subsection.

[108] We have assumed that they will not give up being interested in work.

crease with the same decrease fraction that was computed based on the figures extracted from [16].[109]

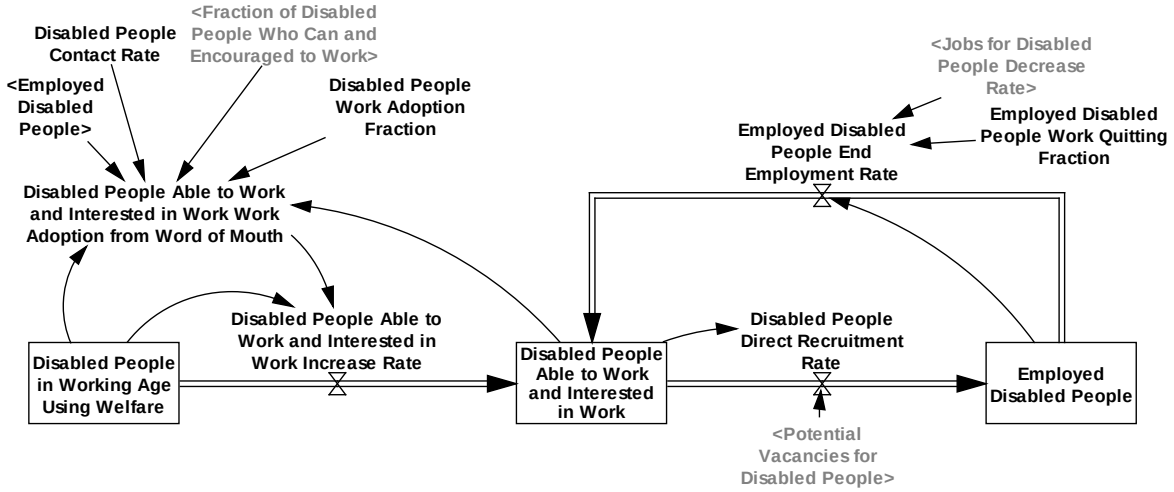

Figure B-3: Disabled people shift to work (Current situation)

B.4.1.1.2 Disabled People's Employers, Jobs, and Vacancies Sector

Targeted employers are employers that are not currently employing any disabled employees. They are increased by an increase fraction that was computed from figures provided via [18], [19].[110] In this sector, as shown in Figure B-4, there is a process similar to the one where disabled people shift from welfare to jobs through being interested in work first. Only a fraction[111] of targeted employers becomes interested in recruiting disabled employees. Similar to the disabled people sector, this conversion is regulated by the "social exposure and imitation effect" of the Bass Diffusion Model (also, usually word of mouth [9], in this case via interactions among employers recruiting and not recruiting disabled people). Again, in the current situation, we were not able to identify "external sources of awareness and adoption" (usually advertising) [9].

Employers interested in recruiting disabled people will have to wait for the governmental agencies to provide them with the reasonable accommodation required to create vacancies for disabled people. After an average waiting time, an employer interested in recruiting disabled employees is ready, and turns to be an employer able to recruit a

[109] The decrease rates are not shown in the figure.

[110] The increase rate is not shown in the figure.

[111] The fraction of employers that are enable and encouraged to recruit disabled employees will be covered in the attitudes sector subsection.

certain number of disabled people,[112] by adding vacancies to the potential vacancies for disabled people stock, in a co-flow dynamics style [9]. The stock of potential vacancies for disabled people will be depleted in the interest of increasing the stock of jobs for disabled people by disabled people recruitment rate, which is computed in the disabled people sector.

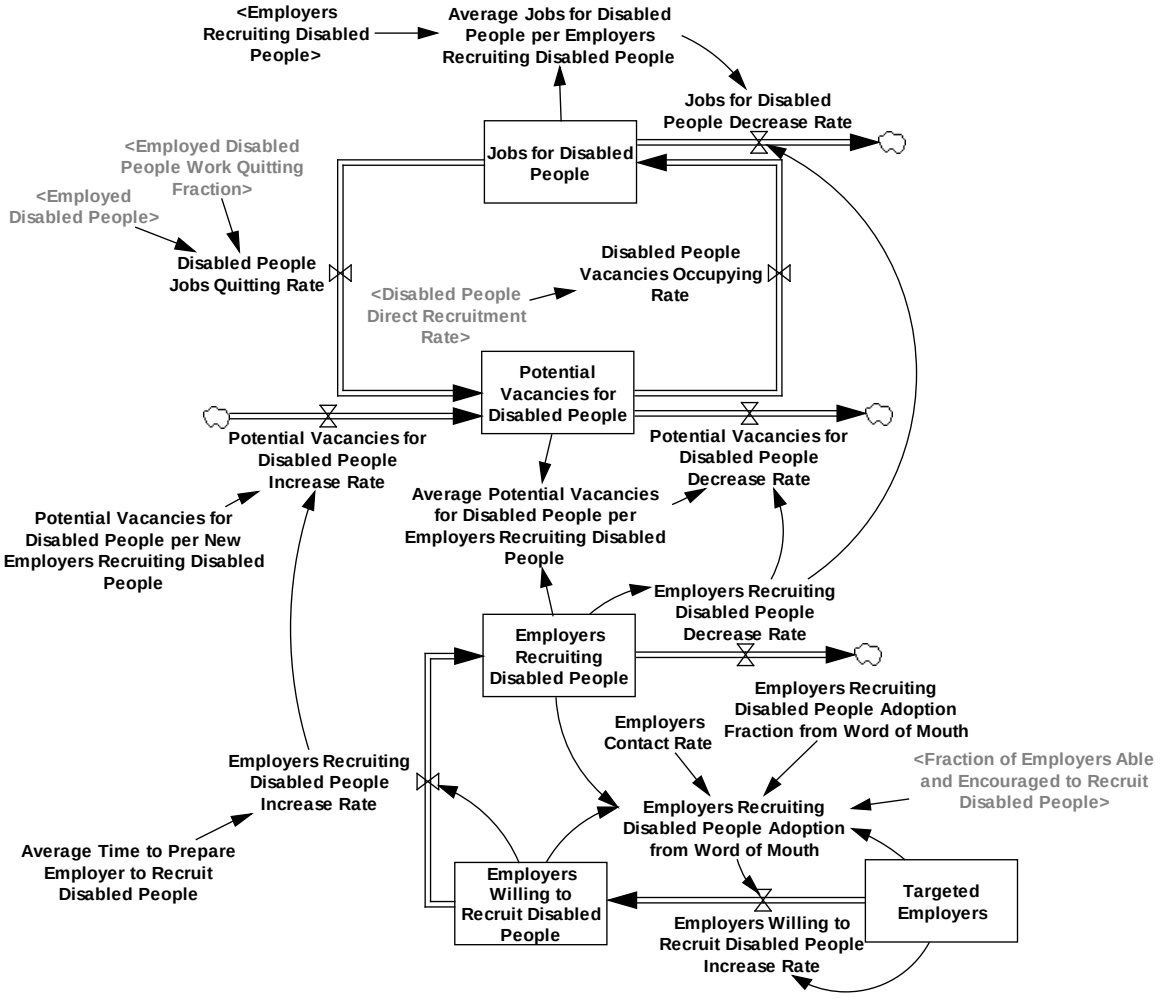

Figure B-4: Employers preparation and vacancies creation (Current situation)

We have assumed that an employer recruiting disabled people will never stop doing that unless this employer is totally out of business. Employers are out of business with a certain decrease fraction that was computed based on the figures provided in [18], [19]. All employers stocks are decreased with that decrease fraction.[113] When an em-

[112] This stock is for employers having jobs, vacancies, or both for disabled employees, as will be shown later in this subsection.

[113] The decrease rates are not shown in the figure.

ployer goes out of business, average vacancies and jobs per employer are removed from vacancies and jobs stocks respectively. Furthermore, when disabled employees quit jobs, their jobs go back to vacancies stock.

B.4.1.2 Handicap-Programme Like Structure

Figure B-5 shows additional structure depicting the idea of Telenor's HCP-like programme on a larger scale, where the government takes a similar role Telenor's. The government can invest in creating jobs including training opportunities, by enabling and encouraging employers to do so [20]. As shown in the figure, disabled people interested in work are transferred to the new HCP-like training according to the availability of vacancies, which will be created in the employers, jobs, and vacancies sector.

Around 42% of employed disabled people are recruited in the same jobs they had before becoming disabled [1]. In our model, we have assumed that this percentage is the minimum flow that continues to be transferred directly to work when our HCP-like programme starts. Like Telenor's HCP, our programme training time is 2 years, after which the fraction of disabled people succeeded in passing the training will be employed, save the fraction assumed to fail.

B.4.1.2.1 Advertising Sector

Although the government has established a system to fund reasonable accommodation to enable employers to recruit disabled employees, the system is highly underutilised. Employers' lack of knowledge is blamed for this [1]. In 2004, the *Social Security Administration* (Trygdeetatens)[114] had a campaign aiming at sending more disabled people to work. Posters were put up on busses and trains with messages conveying that disabled people are competent, and challenging the general attitude towards disabled employees [21]. However, both new disabled people and new employers are entering the market every day, while old are exiting, which intuitively emphasises that continuous advertising and information spreading campaigns in different types of media are required to keep a sustainable effect.

An advertising effort by the government aims at increasing the awareness about competencies of disabled employees, possibilities for employers, and our HCP-like programme for both disabled people and employers. Additional advertising structure simi-

[114] Currently, Trygdeetatens is part of NAV.

lar to [9] is suggested for both disabled people sector (shown in Figure B-5) and disabled people's employers, jobs, and vacancies sector.

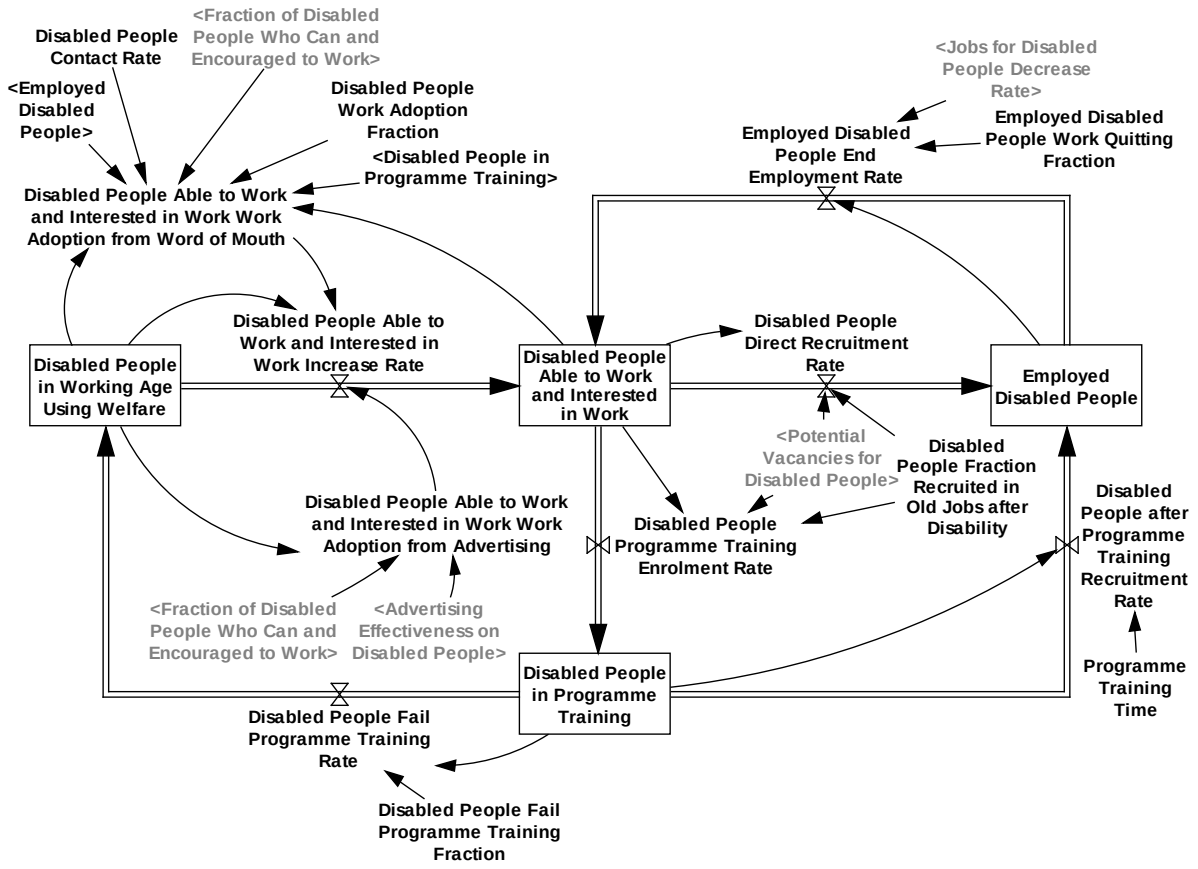

Figure B-5: Disabled people shift to work (Proposed programme)

B.4.1.2.2 Attitudes Sectors

Surveys focusing on attitudes of employers towards recruiting disabled employees, like [18], and [22] are available. Moreover, the *Labour Force Survey-Ad hoc module* conducted by SSB has some questions targeting attitudes of disabled people towards employment [23]. However, we couldn't use the results of these surveys in our SD model, because the results of both disabled people and employers were not consistent with each other, as they come from different sources. Consequently we had to conduct our own set of surveys that has matching encouraging and enabling factors for both disabled people and employers. We have conducted the two internet surveys during the first half of 2011. The questionnaires of both surveys were prepared through successive discussions and literature review. Both samples were convenience samples [24].

In the first survey, the questionnaire was completely filled out by 302 respondents, who are members of organisations that are members of FFO. In addition to identification information, disability type and level, benefits received from government, the question-

naire explored factors enabling disabled people to work, encouraging them to take available work opportunities, and preventing them from active job application. In the second survey, the questionnaire was completely filled out by 103 respondents that are companies and organisations having their contacts displayed through finn.no,[115] in addition to companies that have relations with some of the staff members of the ICT department at the University of Agder. In addition to identification information, the number of employees and disabled employees, awareness and signing status of the *Inclusive Workplace Agreement* (IA-avtale og protokoll) [25], the questionnaire explored employers' awareness of facts about disabled employees, factors encouraging employers to, and preventing them from recruiting disabled people.

Numerous matching enabling[116] and encouraging factors collected from both surveys were introduced to the model in the form of *user-defined* decisions and *model-computed* decisions. The user-defined decisions are left to the model user to decide during simulation exogenously, while the model-computed decisions are computed by the model based on values of other variables endogenously. The results of changing these decisions will start to take effect after the year 2012 of the simulation time. Before 2012, the default values of these decisions predominate.

The results of these decisions were introduced to the model as the fraction of disabled people that are enabled and encouraged to work, and the fraction of employers that are enabled and encouraged to recruit disabled people. Using Matlab, the values of these two fractions were computed, for all the possible values of decisions. These values were connected to the decisions in the model in the form of nested *if-then-else* relationships.

B.4.1.3 Interactive Learning Environment

The model's ILE has a control panel and a set of dashboards. The control panel contains a set of *slider controls* to enable ILE users to test different *what-if* scenarios, by changing the values of user defined decisions and a switch to start our HCP-like programme, values of advertising spending for both employers and disabled people, in addition to functions to decide how spending on advertising should change over time. The

[115] http://www.finn.no

[116] For disabled people, enabling factors are survey's enabling factors set difference preventing factors set. While for employers, we have assumed that all employers are enabled by default save prevented.

set of dashboards display graphs depicting results of different scenarios over time. Parts of the ILE are shown Figure B-6.

The model is licensed under a *Creative Commons Attribution Share-Alike* license, and can be found at:

http://forio.com/simulate/ahmedg/disabled-people-from-welfare-to-jobs-a-decision-support-tool

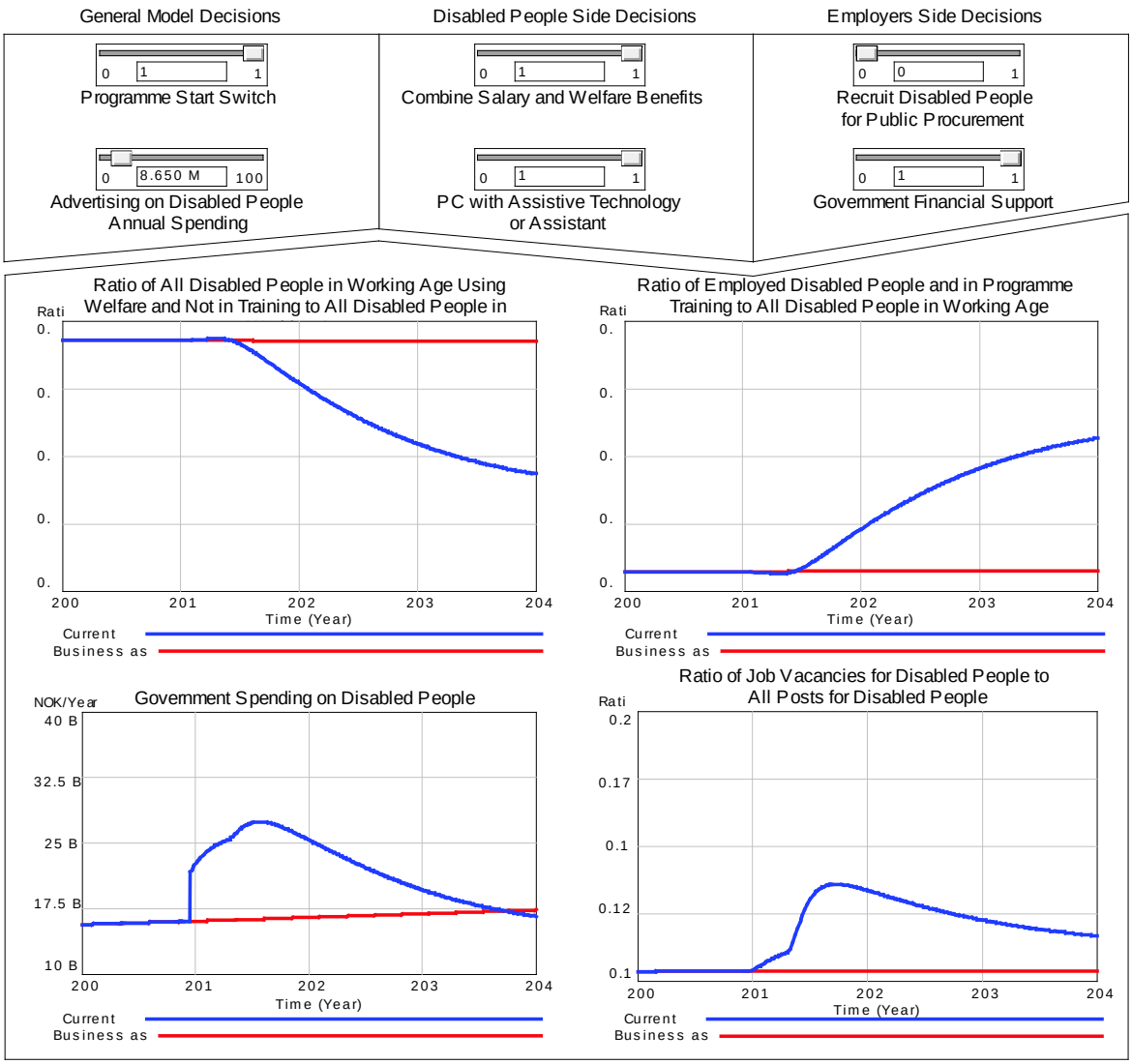

Figure B-6: Model ILE

B.4.2 Model Testing and Results

To validate this model, we have used the set of tests suggested in [9]. *Boundary Adequacy* was tested through presenting the model to experts in the field in two different occasions. *Structure Assessment* test was conducted through exposing the model in different development stages to criticism by experts in SD also in two different occa-

sions. While *Dimensional Consistency* was fully assured using the unit check feature of Vensim DSS SD software package [26].

For the *Parameter Assessment*, Matlab was used to analyse the data retrieved from SSB and NAV. Other parameters were taken from different textbooks and published papers. Finally, the rest of the parameters were estimated to tune the results to historical data and constant ratios from literature using optimisation algorithm built in Vensim DSS. Furthermore, the model robustness has been tested under *Extreme Conditions*. Moreover, the model was tested for *Integration Error* and a suitable time step was used. *Behaviour Reproduction* was tested using historical data, as shown Figure B-7.

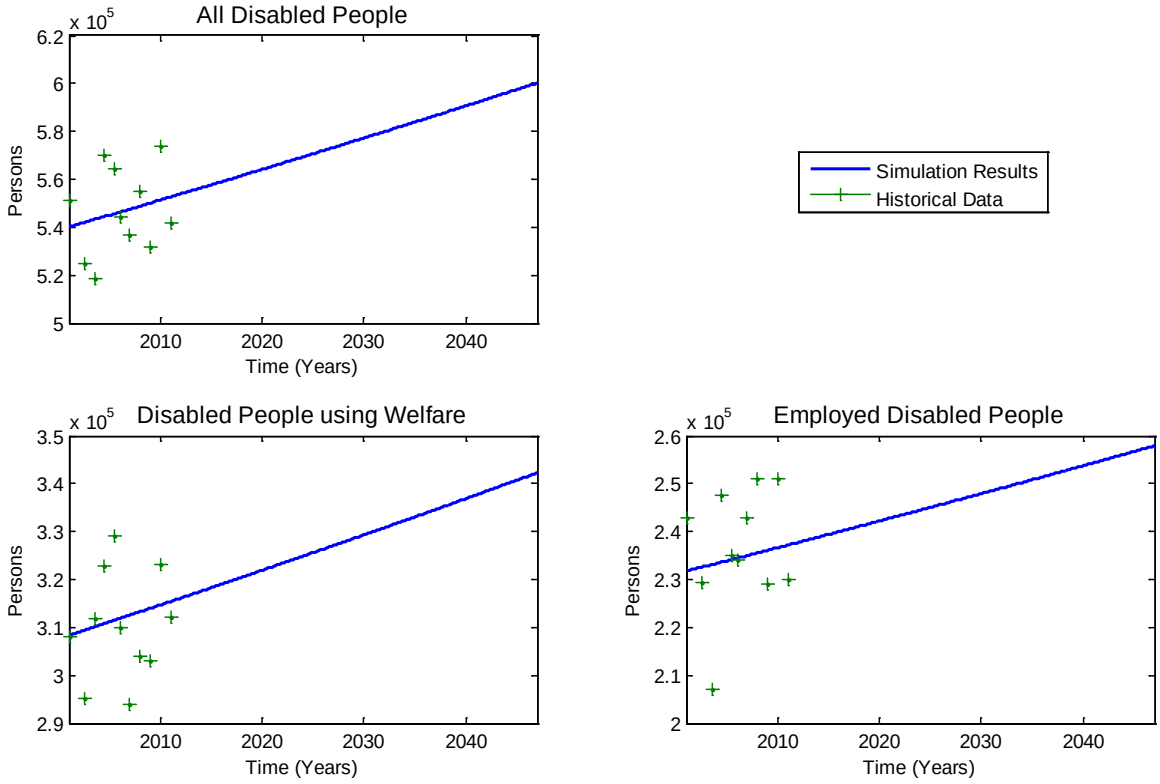

Figure B-7: Model results

Nevertheless even after all the precautions that have been taken to guarantee validity of the model, it is still prone to certain validity threats [27]. From a *Population Validity* point of view, the samples of disabled people and employers surveys are not representative. From an *Ecological Validity* point of view, time is a very important factor, especially because attitudes of disabled people and employers may change over time.

B.5 Conclusion

To conclude, we have presented a SD model that incorporates the effect of possible decisions inspired by the attitudes of disabled people towards employment and employers towards recruiting disabled employees, on transferring disabled people from welfare

recipients to jobs. Moreover, the model aims at testing the effect of a programme similar to Telenor's HCP if used on the employment of disabled people in Norway on a larger scale.

The model is intended to help policy makers in taking more informed decisions, and to give them knowledge about the underlying structure of the system. Furthermore, policy makers, disability organisations, and individual citizens can use the model to understand how the suggested policies and decisions interact with the underlying structure of the system to influence system behaviour. Most importantly, the model enables applying different what-if scenarios, for different sets of policies aiming at comparison and achieving optimal policy design. Finally, the model's ILE can promote eParticipation by helping individual citizens to understand the policy making process and participate in politics [10]. Consequently, support more targeted discussions among citizens, disability organisations, and policy makers.

B.6 Acknowledgment

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C Disabled People from Welfare to Jobs: An Interactive Learning Environment Experimental Investigation

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Abstract: *A System Dynamics model focusing on enabling disabled people to move from welfare to work in Norway was encapsulated in an Interactive Learning Environment (ILE) to contribute in linking ordinary people with policymaking. The ILE and the model behind it are intended to enable people to get a better understanding of the policy options to inform better decisions, and ultimately change users' mental models. To explore how this ILE could change how users think and take decisions, the ILE was assessed by an expert opinion poll, and tested with users in 2 different experiments. To identify the type of change this ILE is capable of causing, we have conducted α, β, and γ change analysis on the results of these experiments. 67% of the sample of our expert opinion poll think that the ILE achieves the intended goals. 33% of the users who were included the analysis of both experiments have shown a change in their understanding and perceptions of the system's causalities and policy options. 38% have redefined the standards they use to assess or evaluate these causalities and policy options. In total, 71% of the users have redefined certain knowledge as a result of using the ILE.*

Keywords: Experimental Design; Expert Opinion Poll; Alpha, Beta, Gamma Analysis; Disabled People Employment; System Dynamics; Interactive Learning Environment

C.1 Introduction

Despite repeated statements from successive governments in Norway, the employment rates for disabled people[117] remains unchanged since 2000, on average only around 44% of disabled people in working age are in employment [1]; the numbers even became stable at 43% for the last 3 years [2]. In Norway's neighbour countries, the case is different. In Denmark, around 56% of disabled people are in employment [3], and 53%

[117] We use the term "disabled people" as it is the term used by *Statistics Norway* (http://www.ssb.no). A more correct term is "people with disabilities", as used by the *Convention on the Rights of Persons with Disabilities* (http://www.un.org/disabilities/convention/conventionfull.shtml).

in Sweden [4].[118] These low rates of employment among disabled people comes even under the protection of anti-discrimination law and a high governmental spending on employment efforts compared to any other country [6].

The Norwegian government has introduced different vocational rehabilitation programmes to increase the employment probability of disabled people through re-education. However, these vocational rehabilitation programmes suffer from many problems, for example according to Westlie [7], disabled people with the lowest work opportunity will benefit the most from the vocational rehabilitation, however they have the lowest opportunity to be included in such programmes. Another research by Røed and Raaum [8] shows that although vocational rehabilitation programmes in Norway increase the employment probability of disabled people, the net effect is nearly zero because of the time elapsed during the training without looking for jobs.

On the contrary, the Norwegian telecommunication company *Telenor*[119] has introduced a very successful 2 years vocational rehabilitation programme called *Open Mind Programme* –previously known as *Handicapped-Programme*– [9], [10]. At least 75% of this programme participants have got permanent jobs after finishing the programme [10]. Although the programme is on a very small scale,[120] the results are encouraging. Moreover, Skøien, Hem, and Tyrmi in [10] via simple calculations verified a net positive effect on government budget resulted from employing trainees of the Open Mind programme till their retirement.

Inspired by the idea of generalising the Open Mind programme country-wide, Abdelgawad *et al.* [11] built a System Dynamics (SD) model "Disabled People from Welfare to Jobs",[121] intending to enable a better understanding of factors that can enable and encourage the disabled people to take up jobs, taking into consideration the associated costs and savings for individuals, employers, and nationally. Figure C-1 shows the model's subsystems diagram.

This model is intended to enable its users to get a better understanding of the system's causalities and policy options to inform better decisions from one side. From the other side the model aims at changing its users' perceptions and attitudes about the issue, in

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[118] Such employment rates are generally based on different national-level surveys, with different designs, timings, surrounding economic conditions, and definitions of being employed [5].

[119] http://www.telenor.no

[120] On average 8 to 10 persons pass through the Open Mind annually [10].

[121] The model is licensed under the creative commons, and available at: http://forio.com/simulate/ahmedg/disabled-people-from-welfare-to-jobs-a-decision-support-tool/model/

other words changing their mental model [12]. The envisaged approach promises to contribute in linking ordinary people with policymaking and rendering the decision making processes easier to comprehend, for an ultimate goal of supporting more targeted discussions among individual citizens, disability organisations, and policy makers.

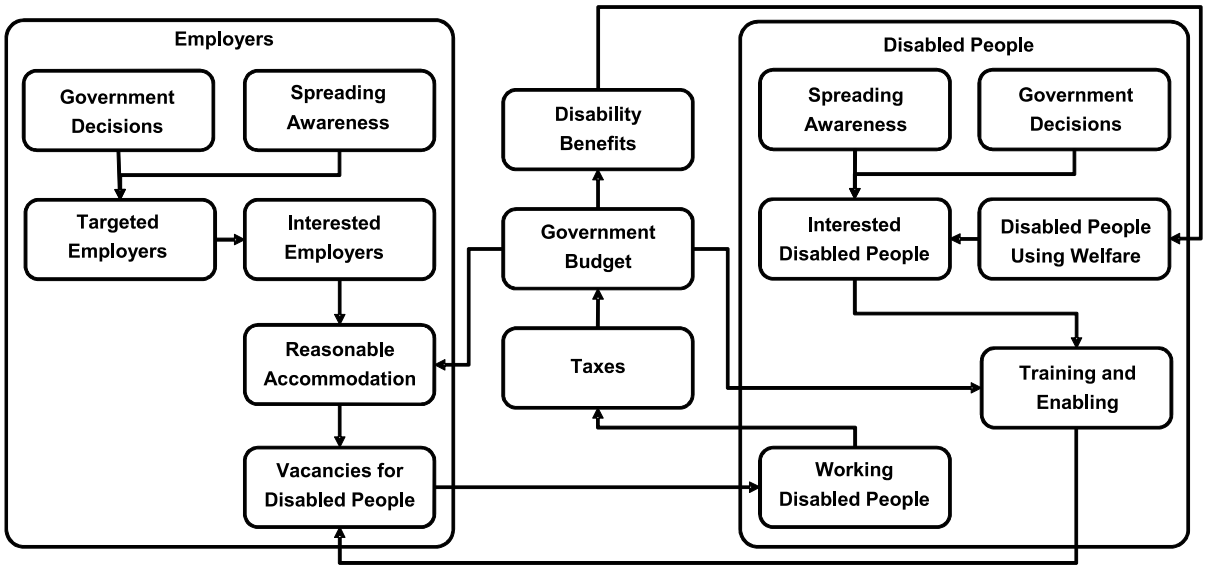

Figure C-1: Subsystem diagram for the "Disabled People from Welfare to Jobs" model

The research question we pursue in this paper is to what extent this model is really capable of changing its users' understanding and perceptions of the system's underlying structure and policy options, and consequently achieve its goals.

The remainder of this paper is organised as follows: the next section will describe the framework of the ILE developed for this research. In addition, it will provide a detailed description of the procedure followed to conduct the expert opinion poll and the experiments, including the analysis method. The section that follows will explore and discuss the results of the experiments. The last section concludes the paper.

C.2 Research Methodology

To answer our research question, we have updated the model and developed an Interactive Learning Environment (ILE) [12] with the model in its core, prepared a testing tool, conducted an expert opinion poll, as well as 2 experiments with people using this ILE. The ILE consists of client-side used by users, and a server-side that was used to log users' interactions with the system as well as answering the questionnaires of the experiments.

C.2.1 ILE Framework

C.2.1.1 Client-Side

The ILE we have developed for this experiment is web-based. It was built using Forio.com Epicenter.[122] We have used the best practices presented in Sterman [13], [14] to design our ILE's Graphical User Interface (GUI). The ILE GUI has 4 navigation tabs: Home, Instructions, Control Panel, and Dashboard, shown in Figure C-2, Figure C-3, Figure C-4, and Figure C-5 respectively. The Home tab briefly introduces the topic of the ILE, including basic knowledge about disabled people situation in Norway, Open Mind programme, and other policy options. The Instructions tab puts the user in the context of using the ILE, including specific instructions to guide her/him through the gameplay. The Control Panel tab has all policy options available by the ILE to control the simulation, in addition to simulation time progress buttons, which is either 5 years ahead or to the end of the simulation time.

The simulation starts in the year 2001 and can be progressed up to the year 2050. Nonetheless, the user can control the simulation merely starting from the year 2015. The period from 2001 to 2015 is included in the simulation solely to show the user a comparison between the behaviour of the model and the historical data. In the Control Panel, the user can reset the simulation and start a new scenario from the beginning, whether the current scenario reached the year 2050 or not. Policy options available are represented by graphical control elements to operationalise Open Mind-like programme country-wide including financing awareness campaigns targeting selected ratios of disabled people and potential employers, selected disabled people's preferences, and selected employers' preferences. The Dashboard tab includes charts showing over time behaviour of important simulation variables, needed by the user to stand on the current results reflected by her/his policies entered in the Control Panel.[123]

Epicenter is a very powerful tool, having all what is needed to build an ILE, nevertheless for our interface charts, we have replaced Forio's Polymer-based[124] charts with our JavaScript charts. Our JavaScript code for charts is still based on Forio's charts code, and uses the same powerful open source Forio's Contour Library;[125] but in addition it

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[122] Forio's 3rd generation platform for simulation, modelling, and analytics (http://forio.com/).

[123] The ILE is available at: https://forio.com/app/ahmedg/eparticipation/eparticipation.html

[124] https://www.polymer-project.org

[125] https://github.com/forio/contour

is able to show many scenarios on the same chart. Our JavaScript code for charts is generic, so that others can use it in building their ILEs.[126]

[126] https://forio.com/app/ahmedg/eparticipation/elements/contour-chart.js

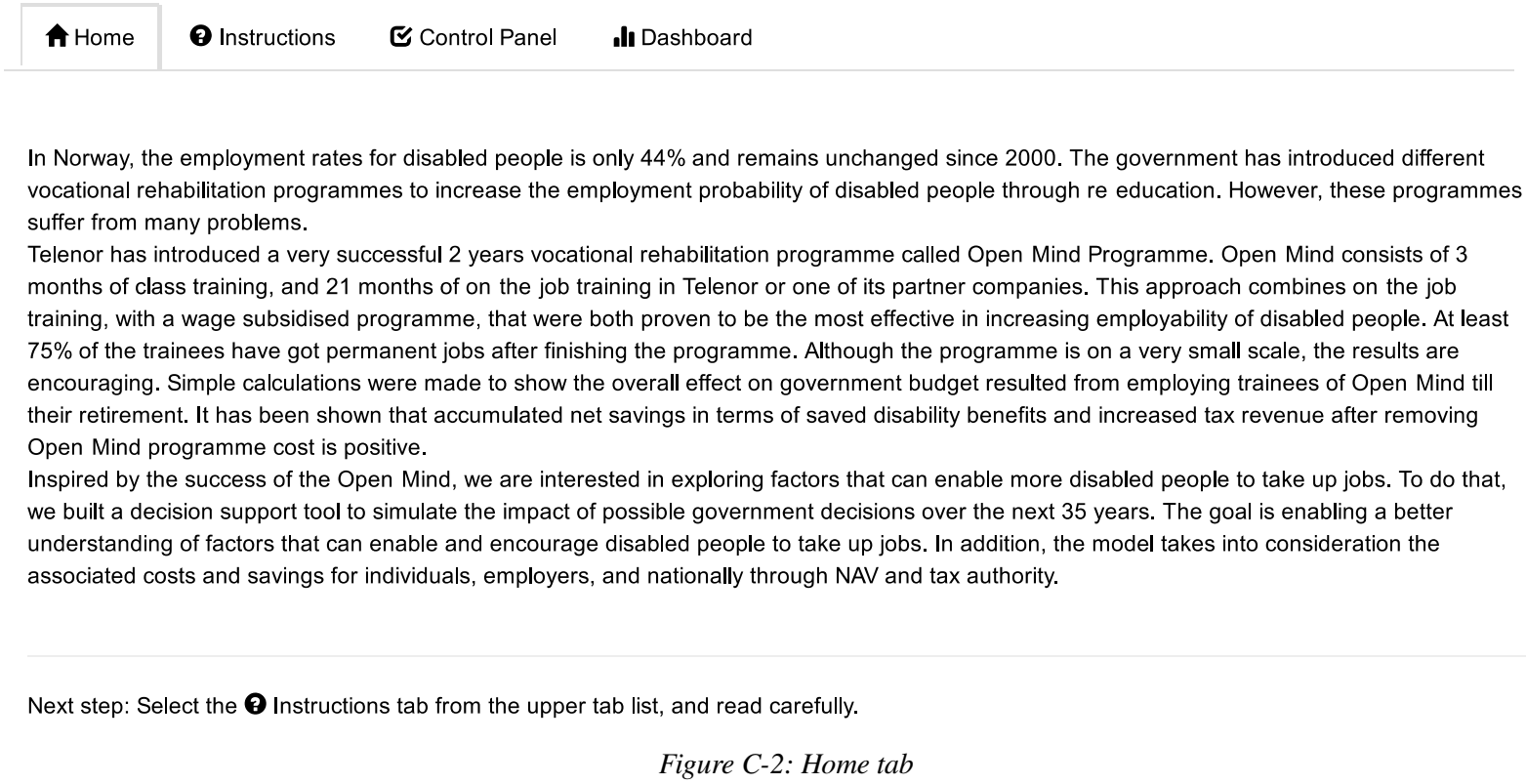

Figure C-2: Home tab

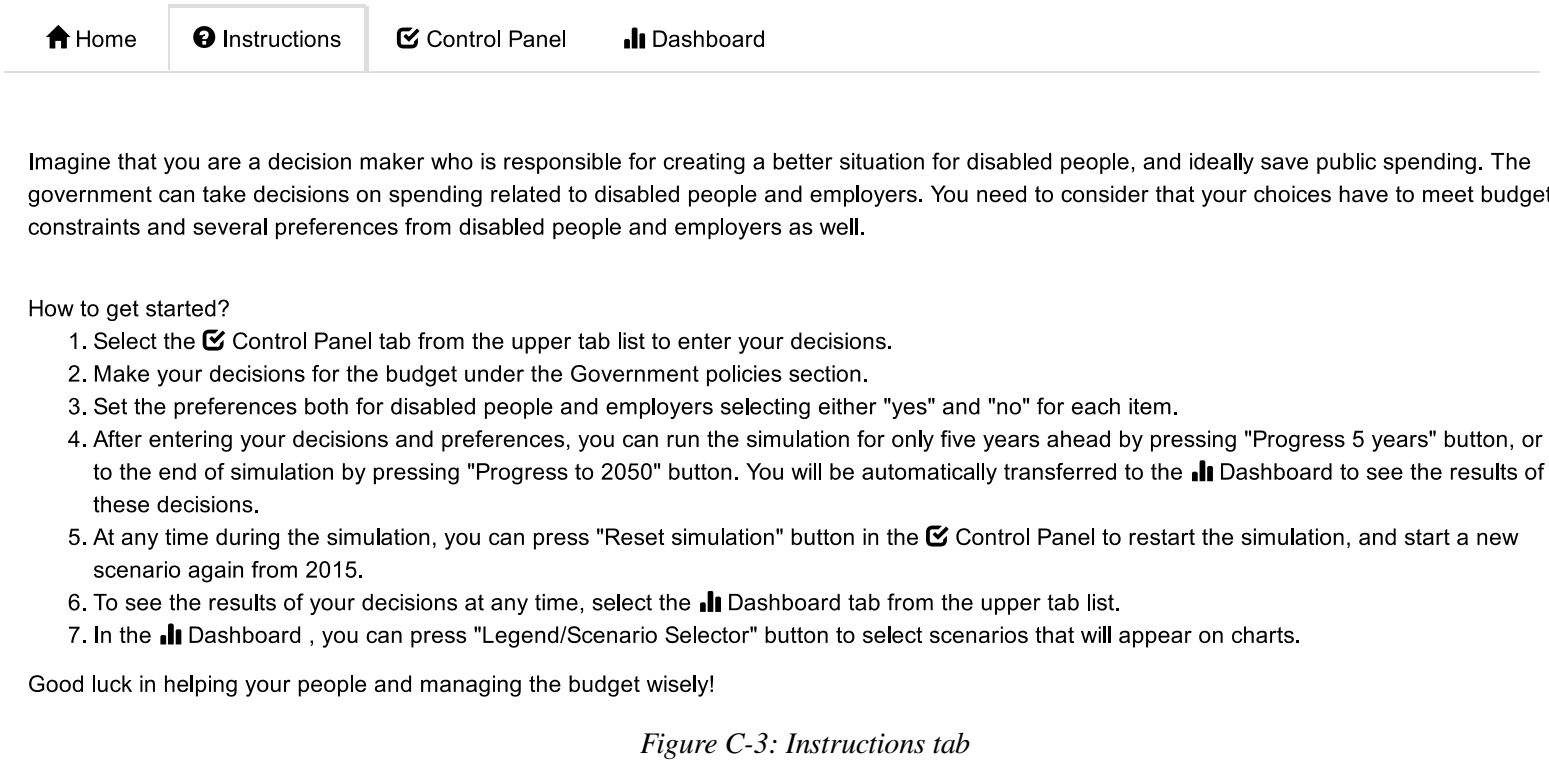

Figure C-3: Instructions tab

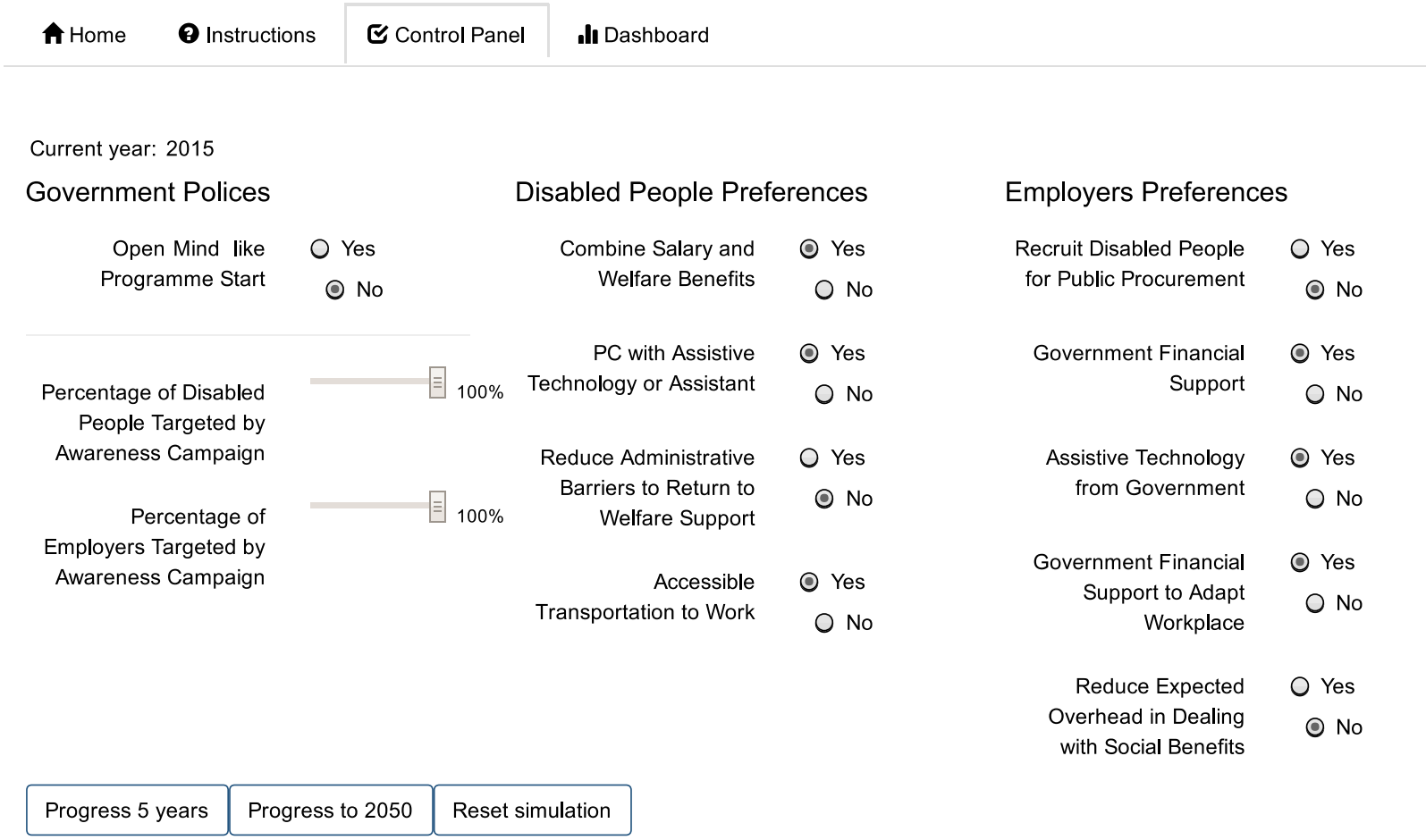

Figure C-4: Control panel tab

Figure C-5: Dashboard tab

C.2.1.2 Server-Side

The ILE is fully functioning by using solely the client-side, yet we wanted to log users' interactions with the ILE i.e. record the decisions they take and their results. To accomplish such task, Epicenter uses Node.js[127] for client-server communications, which then could be logged to a database; however this is limited to paid subscribers. We wanted to have a generic framework that could be used by everyone.

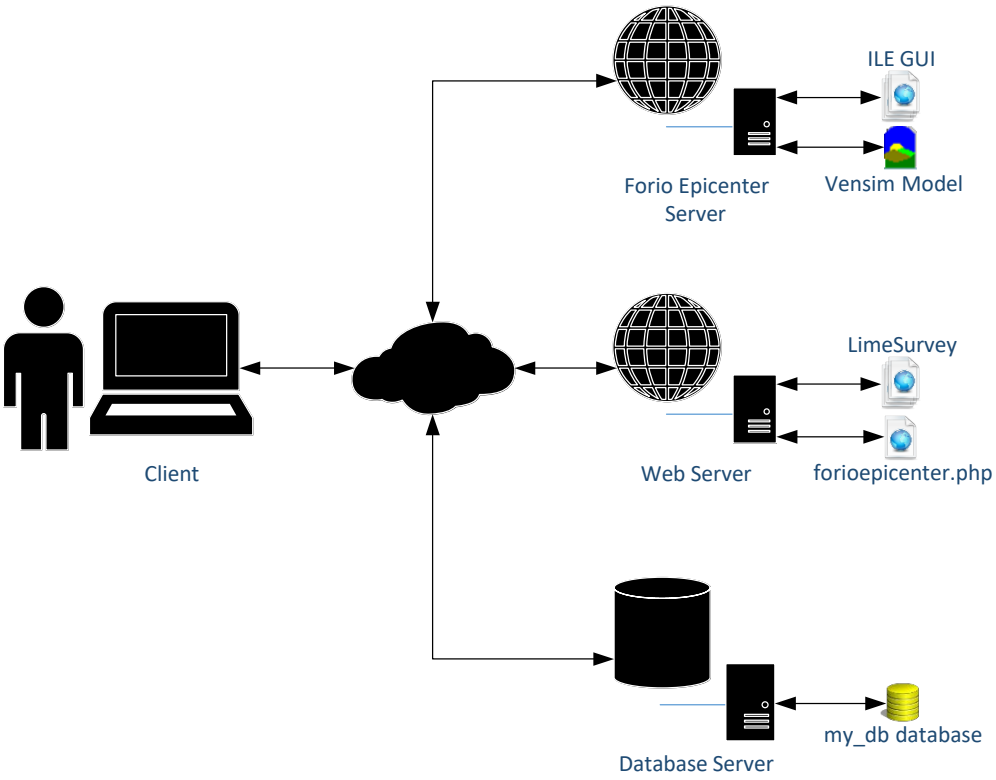

Figure C-6: ILE system framework

To log users' interactions, we have developed JavaScript snippets[128] and added them to all decision control elements (policy options in the control panel of the client-side) and charts (charts in the dashboard of the client-side) available on the GUI. These JavaScript snippets communicate with a PHP file called forioepicenter.php.[129] We developed

[127] https://nodejs.org

[128] The snippets are available inside HTML of the ILE. It could be shown by viewing the page source using any web browser. Furthermore, we have made these snippets generic, and marked them by HTML comment "<!--begin " and "<!--end ", to be easily copied to any other ILE.

[129] forioepicenter.php can be deployed to any server/web hotel supporting PHP, available at: https://forio.com/app/ahmedg/eparticipation/helper/forioepicenter.php

the forioepicenter.php to save the values sent by the GUI to MySQL database.[130] Finally, a survey tool was needed to deploy our pre- and post-test questionnaires, we opted for Limesurvey.[131] The ILE system framework is shown in Figure C-6.

C.2.2 Procedure

We have conducted an expert opinion poll and 2 different experiments with users. For the expert opinion poll, we have invited 7 experts in the field of disability employment in Norway. The expert opinion poll session was totally online via video conference. Though, only 3 of the experts could attend the session on the 2nd of September 2015. Their ages covered age groups of 35-44, 45-54, and 55-64. While their educational degrees ranged between bachelors and doctorate degrees, and their years of experience in the field of disability employment in Norway ranged between 7 and 20 years. The poll began by a presentation of around 30 minutes about the model, the ILE, and the experimental setting. The video conference session was ended by sending a URL invitation to each expert to connect to our experiment server via her/his web-browser. The video conference stopped during the experiment session that was supposed to take no more than 40 minutes to answer the questionnaires and use the ILE. The video conference was resumed afterwards to discuss the experts' experience and hear their comments on the text of the experimental questionnaires and the ILE interface, which were used afterwards to enhance these texts. It was discovered that not all of them had finished the whole experiment; so based on where each of them has stopped in the experiment, we followed up by customising a continuation session and sending her/him its URL. The last response collected was on the 7th of September 2015. In addition to their answers to the experimental questionnaires, they have answered an additional set of questions about the usefulness and expected use of the ILE. Table C-1 summarises the dates and number of participants in our expert opinion poll and experiments.

Our 1st experiment with users was conducted on the 13th of July 2015 in Cairo University, Egypt. This experiment was conducted with the available students attending a course provided by EDUEgypt programme[132] at the university by that time, whom were 14 students. By the end of the experiment, we could extract 11 completed and useful surveys. Table C-2 shows demographic data of these participants. Subjects of our 2nd

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[130] MySQL database tables needed by forioepicenter.php, can be reproduced in any MySQL using my_db.sql, available at: https://forio.com/app/ahmedg/eparticipation/helper/my_db.sql

[131] https://www.limesurvey.org

[132] http://www.eduegypt.gov.eg/

experiment were volunteer students from the University of Agder (UiA), Norway, on the 8th of September 2015. A couple of weeks earlier we started spreading the invitation for a gameplay session with free pizza in Grimstad campus of the university. At the day of the experiment, 17 students showed up. Some faced technical troubles with the experimentation system, and by the end we could extract 10 useful finished surveys. Their demographic data are presented in Table C-3.

In all cases, the experimental session took around 1 hour. For 20 minutes, we gave a presentation to introduce the participants to the topic and the ILE. The presentation included the terms which the participants would experience during the intervention using the ILE. By the end of the presentation, the participants were asked to connect to the Limesurvey server prepared earlier via their web-browsers. In the case of EDUEgypt experiment, the text of the presentation and the ILE referring to the Norwegian case was changed to a general case to decrease any probable confusion; also participants were informed about an honorarium of 150 Egyptian pounds for the 3 highest-performing participants. In the case of UiA, in addition to the free pizza that was promised to everyone, the 2 highest-performing participants were promised a piece of Egyptian pharaonic collectable each.

The testing session started by the pre-test questionnaire that was consisted of 13 Likert 5-point scale items (strongly disagree, disagree, neutral, agree, or strongly agree).[133] These Likert items constitute multiple-item scale unidimensional construct as described by Brodersen and Thornton [15], designed to test the participants' knowledge about the system's causalities and possible policy options.

To build the statements of these Likert items, we have enumerated all model variables affecting the disabled people employment rate. Possible changes in the values of these variables (for example: increase in, decrease in) were listed with different combination of possible resulted changes on the disabled people employment rate (for example: increase after short delay, no effect, immediate decrease, etc.). These combinations constituted the statements of the Likert items. These statements were ordered according to their importance based on our knowledge of the system, what we wanted to show and test, and how much they are clear while using the ILE. Further, to suit the experiment duration, 13 of these statements were selected, keeping a balance between reversed and non-reversed statements, and mostly following the recommendations stated by Weijters

[133] Only in the case of EDUEgypt, the Likert items consisted of 15 items; they were decreased afterwards to shorten questionnaire time.

and Baumgartner [16]. Finally we polished the wording of the final statements, for example, participants were asked to report their level of agreement or disagreement with this statement: "Allowing disabled people to combine both salary and welfare benefits in the same time, will immediately increase employed disabled people".[134]

Table C-1: Accepted Surveys

Survey	Date	Participants	
Experts (online), Norway	02.09.2015/07.09.2015	7 invited	3 attended
EDUEgypt, Cairo University, Egypt	13.07.2015	14 attended	11 accepted surveys
University of Agder, Norway	09.09.2015	16 showed-up	10 accepted surveys

Table C-2: Properties of Participants Whose Surveys Were Accepted – EDUEgypt Experiment

Property	Value	%
Age Group	18-24	91%
	25-34	9%
Gender	Female	64%
	Male	36%
Field of Study/Work (specialisation)	Pharmacy	100%
Knowledge of Math Modelling	Yes	0%
Knowledge of System Thinking/Dynamics	Yes	0%

Table C-3: Properties of Participants Whose Surveys Were Accepted – UiA Experiment

Property	Value	%
Age Group	18-24	70%
	25-34	30%
Gender	Male	80%
	Female	20%
Field of Study/Work (specialisation)	Information and Communication Technology (ICT)	30%
	Computer Engineering	20%
	Economics	20%
	Engineering	10%
	Mechatronics	10%
	Renewable Energy	10%
	Mechatronics	10%
Knowledge of Math Modelling	Yes	40%
Knowledge of System Thinking/Dynamics	Yes	30%

[134] All the Likert statements are available at: https://forio.com/app/ahmedg/eparticipation/helper/questionnaires.txt

The Pre-test questionnaire was supposed to take no more than 7 minutes; nevertheless it was left to the participants to take as much time as they needed. The participants were informed that they could ask us for help all the time; however we abstained from providing any help that could lead to biases in participant answers to the questionnaire.
For a participant, the intervention using the ILE or the gameplay started as she/he ended the Pre-test questionnaire, without the option of going back to the Pre-test. The gameplay was limited to 25 minutes. During these 25 minutes, participants were instructed to imagine themselves as decision makers responsible for creating a better situation for disabled people, and ideally save public spending. After finishing the gameplay, all participants were automatically directed to the post-test questionnaire, without the option of going back to the gameplay session.
The Post-test questionnaire contained exactly the same Likert items used in the Pre-test questionnaire. However once finished answering how she/he thinks now about each statement after using the ILE, the participant was asked to think back and report how much she/he agreed or disagreed with the same statement in the beginning of the session, based on her/his new understanding. This is called Retrospective Pre-test or Then-test [17]. It is very common that participants change their understanding between Pre-test and Post-test [18]. The Then-test gives the participant the opportunity to re-answer the Pre-test based on her/his new understanding/perception after the intervention. In this case, the Post-test and the Then-test have the same base frame of reference [18].

C.2.2.1 α, β, and γ Change

Different SD literature presented methods to measure changes in mental models, or to compare them, for example [19]–[23]. These methods either need a human rater, or require the test subjects to have prior knowledge about certain knowledge elicitation tools, for example Causal Loop Diagrams (CLD). We were interested in a method free from these requirements. Human raters might cause experimenter bias [22], while there was no guarantee that our test subjects would have enough knowledge about any knowledge elicitation tools.
Golembiewski *et al.* [25] distinguished among 3 different types of attitude change as a result of an intervention, namely α, β, and γ. α change refers to an absolute quantitative change [26]. For example, a person might "agree" that "spending on an awareness campaign to reach all disabled people potential employers to convince them to recruit disabled people will immediately cause a decrease in disabled people unemployment rates". After the intervention, this person's level of agreement about the same state-

ment increases to “strongly agree”. This is a real change in her/his opinion on a fixed measurement scale, or α change.

β change refers to a measurement scale intervals recalibration, i.e. a redefining in the measurement standards. For example, a person has certain understanding of the values of different agreement levels (strongly disagree, disagree … etc.) regarding a claim like “spending on an awareness campaign to reach all disabled people potential employers to convince them to recruit disabled people will immediately cause a decrease in disabled people unemployment rates”. Based on this understanding, this person indicates that she/he “strongly agrees” with that claim. After the intervention, this person finds out that what she/he used to interpret as “strongly agree” means just “agree”, consequently his answer to such a claim would change, although this does not reflect any change in her/his opinion. This is a change in the measurement continuum, or a change in the measurement standard/scale, or β change.

γ change refers to a conceptual change, i.e. a redefinition of the measurement construct [25]. For example, a person might have no idea that “spending on an awareness campaign to reach all disabled people potential employers to convince them to recruit disabled people will immediately cause a decrease in disabled people unemployment rates” or about “awareness campaigns targeting disabled people potential employers” at all. After the intervention, this person is provided with an understanding of the “awareness campaigns” and what they can do, i.e. a new conceptual frame of reference, which causes a meaningful answer based on this new understanding, or γ change.

Many methods to assess α, β, and γ changes appeared since 1976, including the method suggested by Golembiewski and his colleagues [25]. According to a comprehensive literature review conducted by Riordan *et al.* [26], there are 5 major methods to detect α, β, and γ changes:

1. Ahmavaara's technique [25]
2. Actual-ideal difference measures [27]
3. Retrospective accounts [28]
4. Confirmatory factor analysis [29]
5. Latent growth modelling [30]

Our expectations about the number of participants taking part in our experiment were very modest, because of limited participants’ availability as well as financial support. Based on that, we have opted for using the Retrospective accounts method, as it is the only method that does not require a large sample, in addition to that it can test for α, β, and γ change independently [26]. Furthermore, it's worth mentioning that although we are not aware of any application of this method in assessing SD ILE effect, using this

specific method for that purpose was suggested by Friedman, Cavaleri, and Raphael [31].

C.2.2.2 Retrospective Accounts

Since Post-test and Then-test are answered based on the same understanding/perception as mentioned above, the Retrospective accounts method detects α change by detecting the change between them. Furthermore, Pre-test and Then-test are basically measuring the same thing based on either 2 different understandings/perceptions or 2 differently calibrated measurement scales, γ and β change are detected by detecting the change between Pre-test and Then-test [28].

The Retrospective accounts method supports analysis on both group and individual levels. However we have chosen to focus merely on the individual level analysis, because of the limited number of participants. After all, group change is the sum of its individuals' change. Occasionally certain individual change could be covered by detecting just group changes [15], [32]. Furthermore, "*a large amount of change exhibited by only a few individuals may be taken as evidence that the intervention had a group effect*" [15].

To apply the Retrospective accounts method to our collected data, we have followed the practice of Birkenbach [32] in general. Nevertheless, we have opted for following Brodersen and Thornton [15] in detecting γ change first, then remove the participants showing γ change from the process of detecting α and β. According to Porras and Singh [33] when γ change is detected, the detection of α or β becomes problematic.

Answers to questionnaire items from Pre-, Post-, and Then-tests of each participant were used as raw data/basic data points [33]. So for every participant, we have compiled 3 paired samples **Pre**, **Post**, and **Then**. The first step is to try detecting γ change per participant. Terborg and his colleagues [28] suggested 2 methods:

1. *Using Correlation*:

For every participant, correlations between the following pairs are calculated:

- **Pre** and **Then** ($r_{\text{Pre Then}}$)
- **Post** and **Pre** ($r_{\text{Post Pre}}$)
- **Post** and **Then** ($r_{\text{Post Then}}$)

To test for differences between the pairs $r_{\text{Post Then}}$ & $r_{\text{Pre Then}}$ and $r_{\text{Post Then}}$ & $r_{\text{Post Pre}}$, Williams's test[135] to compare correlations of 2 paired/dependant samples is used to calculate $t_{(r_{\text{Post Then}})(r_{\text{Pre Then}})}$ and $t_{(r_{\text{Post Then}})(r_{\text{Pre Post}})}$ [15]. γ change exists if the following 2 conditions are met:

a) $r_{\text{Post Then}}$ is substantially greater than $r_{\text{Pre Then}}$

b) $r_{\text{Post Then}}$ is substantially greater than $r_{\text{Post Pre}}$

2. *Using Standard Deviation*:

Pre, **Post**, and **Then** Standard Deviations are calculated for every participant, yielding s_{Pre}, s_{Post}, and s_{Then} respectively. Morgan-Pitman test[136] to compare variances of 2 paired/dependant samples is used to calculate $t_{(s_{\text{Post}})(s_{\text{Then}})}$, $t_{(s_{\text{Pre}})(s_{\text{Then}})}$, and $t_{(s_{\text{Pre}})(s_{\text{Post}})}$. γ change exists if the following conditions are met:

a) s_{Post} is not different from s_{Then}

b) s_{Post} is different from s_{Pre}

c) s_{Then} is different from s_{Pre}

The highest level of γ change happens when both correlation and standard deviation methods to detect γ change occur concurrently [28]. If a participant does not show any signs of γ change, we start detecting β or α change.

To test for β or α change, mean values of **Pre**, **Post**, and **Then** are calculated for every participant, yielding $\overline{x}_{\text{Pre}}$, $\overline{x}_{\text{Post}}$, and $\overline{x}_{\text{Then}}$ respectively. Student's t-Test[137] to compare means of 2 paired/dependant samples is used to calculate $t_{(\text{Then})(\text{Pre})}$ and $t_{(\text{Then})(\text{Post})}$. If $t_{(\text{Then})(\text{Post})}$ is greater than $t_{(\text{Then})(\text{Pre})}$, descriptively speaking there is more evidence of α change than β change, and vice versa [28]. Following the practice of [32], we have focused only on the size to compare $t_{(\text{Then})(\text{Pre})}$ to $t_{(\text{Then})(\text{Post})}$.

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[135] To apply Williams's Test to test the difference between 2 dependent correlations sharing 1 variable/2 "paired" correlations, we used the R (The R project for statistical computing software environment https://www.r-project.org) command: r.test {package: psych} (http: //www.personality-project.org/r/html/r.test.html).

[136] To apply Morgan-Pitman test to test for equal variance of 2 dependent samples, we used R command: var.test {package: PairedData} (http://artax.karlin.mff.cuni.cz/r-help/library/PairedData/html/var.test.html).

[137] To apply Student's t-Test to compare means of 2 paired samples, we used R command: t.test {package: stats} (https://stat.ethz.ch/R-manual/R-patched/library/stats/html/t.test.html).

Terborg and his colleagues [28] emphasised on that t-statistics on the individual level analysis should generally be judged descriptively. Although the tests used to compute these statistics are for dependant/paired samples, which is the case, the inter-independency or independency condition inside each participant's **Pre**, **Post**, and **Then** samples is not met. Simply, inside each of them all data points come from the same participant [28].

C.3 Results and Discussion

C.3.1 Results of the Expert Opinion Poll

Our ILE was found easy-to-use by 67% of our poll of experts. The same percentage thinks that this ILE could be used in decision-making; its target audience could be decision-makers in general, and particularly decision-makers within disabled people organisations. All the experts of our expert opinion poll agreed on that the ILE could support targeted discussions among citizens, organisations, policymakers about the employment problem of disabled people. Also, using the ILE to raise awareness and in advocacy campaigns were suggested by the experts. 67% of the experts agreed that the ILE could be used to reconnect ordinary people with disabled people employment problem, and in that regard, they suggested using this ILE and its results in seminars, public articles, election campaigns, and TV programmes, both on central and local levels. In conclusion, 67% of the experts agreed that the ILE is useful in general.

C.3.2 Results of the EDUEgypt Experiment

Participant P5 was removed from the analysis because of showing no variance in her **Post** sample ($s^2_{\text{Post}} = 0$). As mentioned above, the analysis starts by detecting γ change. This is done via correlation and standard deviation comparisons. The left half of Table C-4 shows the needed correlation values in addition to the t-statistics calculated to compare them. The t-statistic columns at the left half of table prove that $r_{\text{Post Then}}$ is substantially greater than $r_{\text{Post Pre}}$ and $r_{\text{Pre Then}}$ for participants P1, P10, and P11, consequently showing γ change. The t-statistics columns on the right half of the same table cannot at all prove that s_{Post} is not different from s_{Then}, while both are different from s_{Pre} for any participant, and consequently no γ change was detected based on standard deviation.

After ignoring participants showing γ change, from β and α change detection procedure, Table C-5 shows that P2, P3, P4, P6, and P7 have smaller values of $t_{(\text{Then})(\text{Post})}$ compared to $t_{(\text{Then})(\text{Pre})}$ denoting β change for these participants. Accordingly partici-

pants P8, and P9 have exhibited α change. Table C-6 show the overall α, β, and γ changes detected for all participants in comparison to their answers about mathematical modelling and system dynamics knowledge. Clearly, there is no association between these variables and the detected α, β, or γ changes.

C.3.3 Results of the UiA Experiment

The t-statistics columns at the left half of Table C-7 prove that $r_{\text{Post Then}}$ is substantially greater than $r_{\text{Post Pre}}$ and $r_{\text{Pre Then}}$ for participants P1, P5, P7, and P8, consequently showing γ change. The t-statistics columns on the right half of the same table cannot at all prove that s_{Post} is not different from s_{Then}, while both are different from s_{Pre} for any participant, and consequently no γ change was detected based on standard deviation.

After ignoring participants showing γ change, from β and α change detection procedure, Table C-8 shows that P3, P9, and P10 have smaller values of $t_{(\text{Then})(\text{Post})}$ compared to $t_{(\text{Then})(\text{Pre})}$ denoting β change for these participants. Therefore, participants P2, P4, and P6 have exhibited α change. Table C-9 show the overall α, β, and γ changes detected for all participants in comparison to their answers about mathematical modelling and system dynamics knowledge. We could find weak associations between the mathematical modelling knowledge on one side, and the detected α and β changes on the other side, with phi coefficient of 0.36 and -0.53 respectively [34].

C.3.4 General Discussion

The expert opinion poll provided us with a qualitative measure to assess the ILE and consequently the model, whereas the 2 experiments conducted with users from 2 different backgrounds and different geographical areas provided us with a quantitative measure. Our expert opinion poll results show that 67% of the experts think that the ILE achieves its intended goals. Meanwhile, 33% of the participants who were included the analysis of both experiments have shown a change in their understanding and perceptions of the system's causal relationships and policy options. Moreover, 38% have redefined/recalibrated the standards they use to assess or evaluate these relationships and policy options. In total, 71% of the participants have redefined certain knowledge as a result of using the ILE, achieving the ILE's intended goals.

From an internal validity [24] point of view, to minimise testing validity threat, in all cases we have kept the questionnaires as merely Likert-scale items, and emphasised to participants that there is no right or wrong answer, they need to report what they

thought/believed. Furthermore, we made sure that all participants have fully understood the questionnaire items since the pre-test, to account for any misunderstanding that could be automatically clarified during the post-test solely because of repetition. The same questionnaire was administered during pre- and post-test sessions to account for any instrumentation validity threat. Moreover, to eliminate experimenter bias, we have chosen self-report questionnaire type, and kept the whole experiment computerised without any human rater interactions, except when help to clarify any vagueness was needed.

To account for possible history validity threat, participants were asked to report their prior knowledge of mathematical modelling and system thinking/dynamics. Furthermore, the experiment time was limited to almost 1 hour, eliminating maturation or mortality validity threats. Nevertheless, we have to admit that the research suffered from selection validity threat due to the availability of participants as previously mentioned.

Furthermore, from the external validity [35] perspective, although participants of both experiments were few and limited to university students, they were from 2 different backgrounds and different geographical areas. Yet, other experiments with different samples are necessary. Furthermore, longer periods between pre-test, treatment, and post-test should be examined. Other sets of questionnaire items describing the model's causal relationships and policy option should be used in other experiments too.

Table C-4: γ change detection – EDUEgypt Experiment

	$r_{\text{Post Then}}$	$r_{\text{Pre Post}}$	$r_{\text{Pre Then}}$	$t_{(r_{\text{Post Then}})(r_{\text{Pre Post}})}$	$t_{(r_{\text{Post Then}})(r_{\text{Pre Then}})}$	**γ change detected**	s_{Post}	s_{Then}	s_{Pre}	$t_{(s_{\text{Post}})(s_{\text{Then}})}$	$t_{(s_{\text{Pre}})(s_{\text{Post}})}$	$t_{(s_{\text{Pre}})(s_{\text{Then}})}$	**γ change detected**
P1	0.81^{***}	0.46^{*}	0.57^{**}	2.21^{**}	1.40^{*}	Yes	1.11	1.29	1.26	-0.92	-0.52	-0.09	--
P2	0.51^{**}	0.88^{***}	0.44^{*}	-2.39^{**}	0.52	--	1.40	1.31	1.49	0.29	-0.43	0.51	--
P3	0.18	0.17	0.21	0.04	-0.07	--	0.46	0.74	0.62	-1.85^{*}	-1.11	-0.69	--
P4	-0.19	-0.23	-0.35	0.08	0.38	--	0.83	0.90	1.06	-0.31	-0.92	0.63	--
P5[X]	--	--	-0.08	--	--	--	0.00	0.35	1.01	--	--	4.59^{***}	--
P6	0.28	0.02	0.22	0.74	0.16	--	0.99	0.41	1.26	3.71^{***}	-0.89	5.04^{***}	--
P7	0.22	0.20	0.49^{*}	0.08	-0.85	--	0.52	0.51	0.52	0.07	0.00	0.08	--
P8	0.47^{*}	0.27	0.49^{*}	0.76	-0.08	--	0.41	0.52	0.51	-0.91	-0.76	-0.08	--
P9	0.31	0.05	0.31	0.83	0.01	--	1.36	0.59	1.40	3.50^{***}	-0.13	3.68^{***}	--
P10	0.46^{*}	0.88^{***}	0.76^{***}	-5.74^{***}	-4.29^{***}	Yes	0.52	1.59	1.05	-5.60^{***}	-5.85^{***}	-2.38^{**}	--
P11	0.96^{***}	0.64^{***}	0.62^{***}	3.80^{***}	4.15^{***}	Yes	0.59	0.38	0.92	5.68^{***}	-2.10^{*}	4.61^{***}	--

* P < 0.10 ** P < 0.05 *** P < 0.01

[X] Participant removed because of showing no variance in Pre, Post, and/or Then

Table C-5: α and β change detection – EDUEgypt Experiment

	$\overline{x}_{\text{Post}}$	$\overline{x}_{\text{Then}}$	$\overline{x}_{\text{Pre}}$	$t_{(\text{Then})(\text{Post})}$	$t_{(\text{Then})(\text{Pre})}$	**β change detected**	**α change detected**
P1[G]	3.67	3.67	3.80	0.00	0.43	--	--
P2	3.40	3.00	3.73	1.15	1.91*	Yes	--
P3	4.07	4.13	4.33	-0.32	0.90	Yes	--
P4	3.60	3.67	3.87	-0.19	0.48	Yes	--
P5[X]	4.00	4.87	3.80	-9.54***	-3.76**	--	Yes
P6	4.13	4.20	3.80	-0.27	-1.25	Yes	--
P7	4.47	4.60	4.47	-0.81	-1.00	Yes	--
P8	4.20	4.53	4.40	-2.65**	-1.00	--	Yes
P9	3.53	3.93	3.60	-1.19	-0.96	--	Yes
P10[G]	3.87	3.67	4.33	0.54	2.47**	--	--
P11[G]	3.93	4.00	3.87	-1.00	-0.69	--	--

* P < 0.10 ** P < 0.05 *** P < 0.01

[X] Participant removed because of showing no variance in Pre, Post, and/or Then

[G] γ change detected

Table C-6: α, β, and γ change results vs participants' properties – EDUEgypt Experiment

	Knowledge of Math Modelling	**Knowledge of System Thinking/Dynamics**	**γ change detected**	**β change detected**	**α change detected**
P1	--	--	Yes	--	--
P2	--	--	--	Yes	--
P3	--	--	--	Yes	--
P4	--	--	--	Yes	--
P5[x]	--	--	--	--	--
P6	--	--	--	Yes	--
P7	--	--	--	Yes	--
P8	--	--	--	--	Yes
P9	--	--	--	--	Yes
P10	--	--	Yes	--	--
P11	--	--	Yes	--	--

[x] Participant removed because of showing no variance in Pre, Post, and/or Then

Table C-7: γ change detection – UiA Experiment

	$r_{\text{Post Then}}$	$r_{\text{Pre Post}}$	$r_{\text{Pre Then}}$	$t_{(r_{\text{Post Then}})(r_{\text{Pre Post}})}$	$t_{(r_{\text{Post Then}})(r_{\text{Pre Then}})}$	**γ change detected**	s_{Post}	s_{Then}	s_{Pre}	$t_{(s_{\text{Post}})(s_{\text{Then}})}$	$t_{(s_{\text{Pre}})(s_{\text{Post}})}$	$t_{(s_{\text{Pre}})(s_{\text{Then}})}$	**γ change detected**
P1	0.95^{***}	0.43	0.46	4.31^{***}	3.92^{***}	Yes	0.55	0.90	0.96	-5.41^{***}	-2.12^{*}	0.25	--
P2	0.43	-0.11	0.45	1.94^{**}	-0.05	--	0.75	0.95	0.93	-0.89	-0.71	-0.11	--
P3	0.39	0.02	0.28	1.05	0.27	--	1.12	0.95	1.01	0.56	0.32	0.21	--
P4	0.74^{***}	0.59^{**}	0.57^{**}	0.77	0.90	--	0.85	1.39	1.13	-2.48^{**}	-1.15	-0.84	--
P5	0.80^{***}	0.14	-0.16	2.09^{**}	4.11^{***}	Yes	1.04	1.01	1.12	0.17	-0.24	0.34	--
P6	0.78^{***}	0.34	0.52^{*}	2.23^{**}	1.18	--	0.88	0.77	0.78	0.71	0.43	0.04	--
P7	0.95^{***}	0.78^{***}	0.83^{***}	2.94^{***}	1.94^{**}	Yes	1.20	1.19	0.99	0.05	1.03	-1.14	--
P8	1.00^{***}	0.60^{**}	0.60^{**}	8.66^{***}	8.66^{***}	Yes	0.80	0.80	0.99	n/a	-0.87	0.87	--
P9	0.55^{**}	0.63^{**}	0.53^{**}	-0.36	0.06	--	0.73	0.85	0.91	-0.66	-0.99	0.26	--
P10	0.69^{***}	0.55^{**}	0.75^{**}	0.88	-0.32	--	1.15	1.14	1.04	0.04	0.40	-0.46	--

* P < 0.10 ** P < 0.05 *** P < 0.01

Table C-8: α and β change detection – UiA Experiment

	$\overline{x}_{\text{Post}}$	$\overline{x}_{\text{Then}}$	$\overline{x}_{\text{Pre}}$	$t_{(\text{Then})(\text{Post})}$	$t_{(\text{Then})(\text{Pre})}$	**β change detected**	**α change detected**
P1[G]	3.85	3.85	3.38	0.00	-1.72	--	--
P2	3.31	3.08	3.23	0.90	0.56	--	Yes
P3	3.08	3.08	3.77	0.00	2.11*	Yes	--
P4	3.69	3.38	3.46	1.17	0.23	--	Yes
P5[G]	3.38	3.77	3.62	-2.13**	-0.34	--	--
P6	3.46	3.62	3.54	-1.00	-0.37	--	Yes
P7[G]	3.54	3.38	3.85	1.48	2.52**	--	--
P8[G]	3.85	3.85	3.85	n/a	0.00	--	--
P9	3.23	3.31	3.00	-0.37	-1.30	Yes	--
P10	3.00	3.15	3.62	-0.62	2.14**	Yes	--

* P < 0.10 ** P < 0.05 *** P < 0.01

[G] γ change detected

Table C-9: α, β, and γ change results vs participants' properties – UiA Experiment

	Knowledge of Math Modelling	**Knowledge of System Thinking/Dynamics**	**γ change detected**	**β change detected**	**α change detected**
P1	Yes	Yes	Yes	--	--
P2	Yes	--	--	--	Yes
P3	--	Yes	--	Yes	--
P4	--	Yes	--	--	Yes
P5	--	--	Yes	--	--
P6	Yes	--	--	--	Yes
P7	Yes	--	Yes	--	--
P8	--	--	Yes	--	--
P9	--	--	--	Yes	--
P10	--	--	--	Yes	--

C.4 Conclusion

In Norway, the unemployment rate of disabled people is unchanged since 2000, making the country to perform less compared to the neighbouring countries, despite the repeated governmental promises. These low rates prevail even under the protection of anti-discrimination law and high governmental spending on disabled people employment efforts compared to any other country. To increase disabled people employment probability, the Norwegian government has introduced different vocational rehabilitation programmes. Unfortunately, these programmes suffer from many problems. On the contrary Telenor's small-scale Open Mind programme is a very successful rehabilitation programme.

"Disabled People from Welfare to Jobs" is a SD model that was inspired by the idea of operationalising Open Mind-like programme country-wide. We have developed an ILE to present this model. The model is intended to support more targeted discussions among individual citizens, disability organisations, and policy makers, and to contribute in linking ordinary people with policymaking and rendering the decision-making processes easier to comprehend. This requires the model to be able to change how its users think and take decisions as well as to change their understanding, perceptions, and accordingly attitudes. Our goal was to test whether this model is really capable of doing what it is intended to or not. For that, we have conducted expert opinion poll, and 2 experiments with the ILE.

67% of the expert of our expert opinion poll thinks that the ILE achieves its intended goals. Furthermore, we have conducted α, β, and γ change analysis on the results of the 2 experiments, on the individual level. 33% of the participants who were included the analysis of both experiments has shown a change in their understanding and perceptions of the system's causalities and policy options. Meanwhile, 38% have redefined /recalibrated the standards they use to assess or evaluate these relationships and policy options. In total, 71% of the participants have redefined certain knowledge as a result of using the ILE, or have their mental models changed, achieving the ILE's intended goals.

In this paper we have also provided a methodological contribution. We have developed a generic reusable ILE framework, and provided instructions on how it could be used by others in creating their ILEs. Furthermore, we have adapted the α, β, and γ change typology and the retrospective accounts method to test the effect of using an ILE on its users. We have also introduced our suggested approach to create the questionnaires needed to apply the α, β, and γ change and the retrospective accounts method in testing

an ILE effect on its users, as well as our suggested steps and statistical tests needed in conducting the statistical analysis for the retrospective accounts method.

As a final point, applying α, β, and γ change analysis to test the effect of using SD based ILE was easy and straight forward. However, more experimentation with larger samples, ideally including control groups, to test for group changes in addition to individual changes, over longer time spans, and longer questionnaire seems to be a very promising and highly recommended future research. Furthermore, comparing the α, β, and γ change results with results from other mental model change measurement methods more common among SD practitioners is a very important validation requirement for the method in the SD field.

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D A Survey of Current Measurement Methods for eGovernment User-satisfaction

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Abstract: *A survey on eGovernment user-satisfaction measurement methods was conducted to enable a comparison among them and to facilitate a discussion on good practices. The collected information is related to the methodology properties, tools, followed practices, implementation stage and challenges. The main findings are that the surveyed methods rarely refer to any established relevant standards, they are not regularly updated, and most of them do not have an open process for maintenance. We also note that software vendors are mostly not included in the intended group of users of the measurement results. A revision of methods and their maintenance processes can increase their accountability and enable more efficient use of measurement results for real eGovernment improvements.*

Keywords: eGovMoNet; eGovernment; measurement; user-satisfaction;

D.1 Introduction

eGovernment user-satisfaction measurement frameworks are inconsistent, fragmented, and dispersed at the EU country level [1–3]. A European project called eGovMoNet[138] was carried out to facilitate a change to this situation. The project was co-funded by the European Commission in the period from 2008-05-01 to 2010-05-01. The network covered close to 50 members from academia, industry and government, using, deploying or developing eGovernment measurement methods. The partner countries included Belgium, Denmark, Germany, Greece, Hungary, Italy, Norway, Slovakia, Spain, Sweden, The Netherlands, and UK.

Collection of good practice cases in eGovernment is a recognised way to drive further development and adoption of innovation in the public sector. The network addressed the heterogeneity in measurement practices that prevents more efficient identification of good practices. To this end the network elaborated on:

[138] The eGovMoNet was co-funded by the European Commission, under the CIP project number 224998. More information about the network is available at http://www.egovmonet.eu

- A clear base line of the state of art in eGovernment impact and user satisfaction measurement, including both methods and tools.
- Comparisons of existing measurement frameworks to identify potential for development towards harmonisation among them.

The eGovMoNet project endeavoured to accomplish its objectives over five events, project gathered eGovernment measurement practitioners, researchers and users in a sequence of events to cover a broad range of methodological issues as well as reviews of the current practices. The network discussions were facilitated by a template prepared for coherent description of measurement efforts, including used tools, methods, as well as innovative practices. This template was used by the network partners to describe and evaluate the national efforts in the areas of user satisfaction and impact measurement.

The work was built on the experience from measurement frameworks such as eGEP,[139] UWEM,[140] the annual EU measurement of 20 key services, national measurement efforts, such as the German WiBe approach, the Belgian Fed-eView approach, the British CJIT approach, and the Norwegian Difi web quality evaluations. The project also drew on initiatives such as other EU-funded eGovernment Bench-learning Pilots and the studies on measurement of user satisfaction and impact in the EU27 [4], [5], as well as national benchmarking projects, notably the eGovMon project in Norway.[141]

The project developed a questionnaire to facilitate the comparison of descriptions of both eGovernment user-satisfaction and impact measurement frameworks, including descriptions of the used methods and tools, followed practices, implementation stages, and challenges. Good implementations were shared and actively promoted both via the network's dissemination channels, such as the eGovMoNet events, the project web page, newsletters, and external channels, especially the ePractice community portal.[142] Furthermore, by using this questionnaire, the features in common and the differences among the methods were identified to a certain extent, aiming at supporting steps towards converging practices in a collaborative process.

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[139] eGEP eGovernment : http://www.rso.it/egep, co-funded by the European Commission, contract Nr. 29173.

[140] UWEM, Unified Web Evaluation Methodology: http://www.wabcluster.org/uwem, co-funded by the European Commission, contracts IST-004526, for the EIAO project, IST-004275 for the BenToWeb project, and IST-004754 for the Support-EAM project.

[141] eGovMon, eGovernment Monitor: http://www.egovmon.no, co-funded by the Research Council of Norway, VERDIKT program, contract 183392.

[142] The project ePractice community portal: http://www.epractice.eu/community/egovmonet

In this paper we will summarise the main properties of the measurement methods as collected in the questionnaires filled by members of the eGovMoNet in a survey dealing with user-satisfaction measurement methods.[143]
The remainder of the paper is organised as follows: The next section gives a brief overview of the sample, followed by a section exploring the results of the survey. Finally, the paper concludes with the main findings.

D.2 Sample Overview

The sample is a convenience sample [6]. It was based on the methodologies represented among the eGovMoNet partners who filled the questionnaire to describe specific eGovernment user-satisfaction measurement methods as used in their respective countries. Table D-1 lists the measurement methods collected by this questionnaire.

Table D-1: Collected User-satisfaction Measurement Methods

Method name	Responsible organisation	Country
Fed-eView/Citizen	Belgian government the Federal Public Service ICT (FEDICT)	Belgium
UWEM[144]	Katholieke Universiteit Leuven	Belgium
Agios Stefanos Municipality	Agios Stefanos Municipality	Greece
Mystery User Methodology	Observatory for the Greek Information Society	Greece
Regione Emilia-Romagna	Regione Emilia-Romagna	Italy
Slovakia	n.a.	Slovakia
Slovenia	• Ministry of Public Administration • Institute for Informatization of Administration at Faculty of Administration, University of Ljubljana • eCenter at Faculty of Organizational Sciences, University of Maribor	Slovenia
Technosite	Observatorio de Infoaccesibilidad de Discapnet (Disc@pnet InfoAccessibility Observatory)	Spain
Business Link	Central Government	UK
Directgov	Central Government	UK

[143] For reference the filled questionnaires are available at: http://ws.egovmonet.eu/WP1/mp1/templates-v1

[144] Information about UWEM measurement method based on a questionnaire filled by the Katholieke Universiteit Leuven from the second eGovMoNet collected wave (impact measurement methods survey) available at: http://ws.egovmonet.eu/WP3/Template_impact was added to this survey. Some pieces of information dealing with user-satisfaction were added to the answers of that questionnaire by the team at the University of Agder.

The questionnaire was prepared through successive work group discussions. The questionnaire form has 99 questions. One question aimed at retrieving identification information, 10 requiring responses limited to yes or no, 15 having suggested –but not limited to– choices, and 73 asking for details in their responses.
The questionnaire responses were coded by the first author into categorical variables. Around 50% of the questions were answered by nearly all respondents. These questions were considered in the analysis, while the rest were discarded since they suffered high rates of missing data. The discarded questions were asking for more details e.g. about usage and results, scope limitations, and required resources. As can be expected the more detailed questions are more often left unanswered than those requiring a simpler answer.

D.3 Survey Results

This section explores the results of the eGovernment measurement methods covered by the eGovMoNet user-satisfaction measurement methods survey. The following subsections describe the general properties of the measurement methods, the intended use of their results, their deployment properties and aspects of their maintenance process.

D.3.1 General Properties of Measurement Methods

The majority of the respondents claim that their measurement methods are capable of giving the same results if two independent measurements of the same measurement object were conducted (Repeatability of measurement results). Moreover, most of the methods results are size independent which implies that the measurement methods cope with measuring different sizes of eGovernment applications (Independence of size). It is also possible to compare the measurement results over time for most of the methods to identify trends (Stability of measurement results over time). Additionally most of the methods include indications of their results accuracy (Accuracy).
Apparently most of the surveyed methods have good general properties, however, only a minority of the methods refers to established standards such as those developed by WAI/W3C (Degree of standardization), which by no means helps in decreasing the heterogeneity in measurement practices. All results of general properties of surveyed methods are shown in Figure D-1.

D.3.2 Intended Use of Measurement Results

D.3.2.1 Targeted Changes

Nearly all surveyed methods were designed to promote targeted changes on the implementation level. The majority of them promote targeted changes on the organisational procedures level. Only targeted changes on the policy level come with lower score among the surveyed methods. Figure D-2 shows the results on this level. Moreover, Figure D-3 shows that 60% of surveyed methods are intend to support strategic decision in general. Half of these 60% are to specifically select projects to invest in.

D.3.2.2 Intended Users of Measurement Results

While policy makers, website owners and developers are the highest intended users of the surveyed methods results, software vendors are mostly not intended to use measurement results. In spite of the fact that software vendors are key players when it comes to features and quality of the provided service, for example the accessibility level of eGovernment websites [7]. Intended users of the measurement results are shown in Figure D-4.

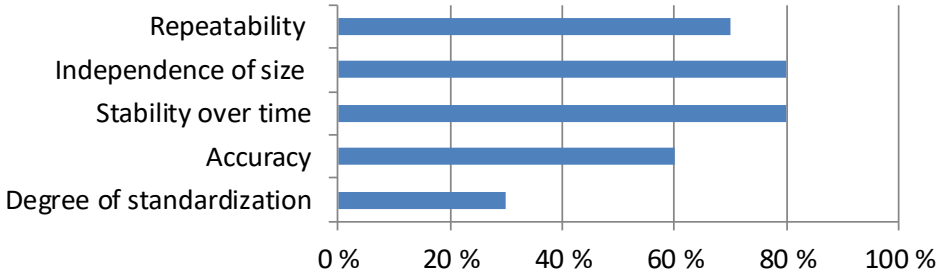

Figure D-1: General properties of surveyed methods

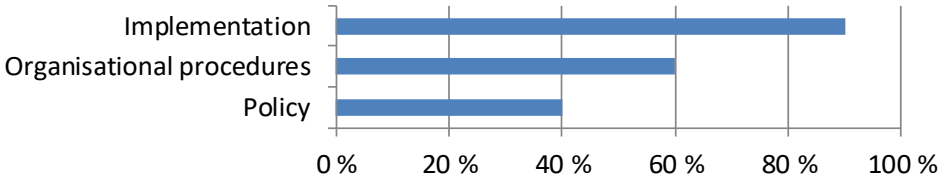

Figure D-2: Targeted changes levels of surveyed methods

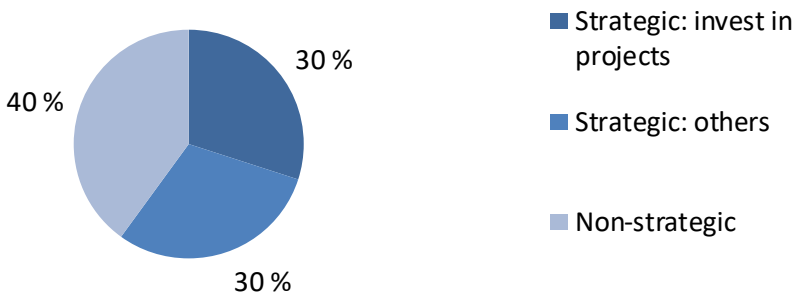

Figure D-3: Is measurement intended to support strategic decisions?

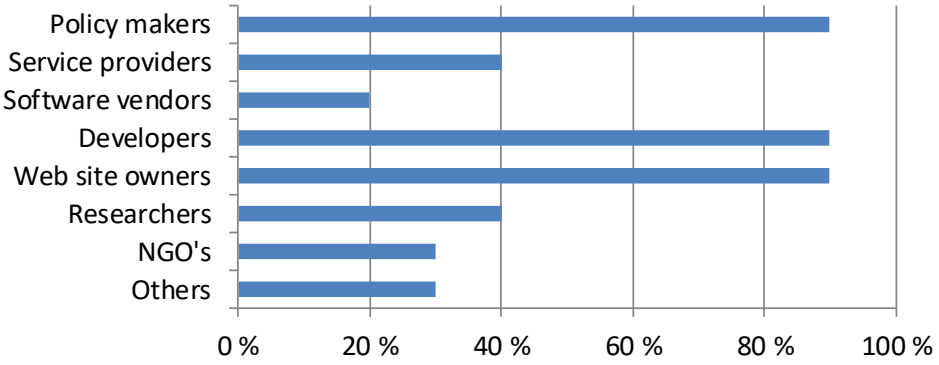

Figure D-4: Intended users of measurement results

D.3.2.3 Reasons for Measurements

In addition to user satisfaction measurement, surveyed methods have other reasons. All the methods aim at assessing and evaluating current situation. Benchlearning, strategic or operational objectives and measure impact of policies come in the second rank.

Figure D-5: Reasons for measurements

Figure D-5 shows reasons for measurements. Continuing improvement is the highest ranked reason behind assessment and evaluation of current situation of measured objects for most of the methods. On the other hand, irrespective to its importance, identifying bottlenecks is not frequent as shown in Figure D-6.

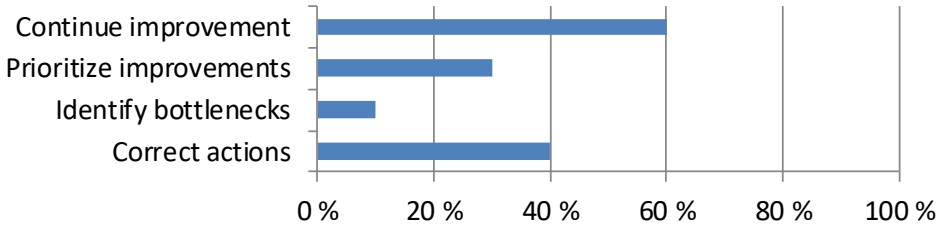

Figure D-6: Reasons to assess and evaluate current situation

D.3.3 Deployment Properties of Measurement Methods

D.3.3.1 Who Carries out Measurement?

For neutrality some measurement methods require independence between those who carry out measurement and the measurement subject [8]. 60% of the surveyed methods are carried out by merely third parties. Other combinations include third parties, measuring and measured organisations. 40% of the surveyed methods don't require training evaluators, and none of the methods requires the evaluators to possess any kind of certificates to carry out the evaluation process.

D.3.3.2 How is Measurement Carried out?

40% of surveyed methods are carried out merely using manual methods, the rest are carried out using combinations of automatic and manual methods. Although fully automated methods have advantages over methods involving manual components, none of the surveyed methods is carried out in fully automatically. The unavailability of fully automated methods restricts the possibility of conducting frequent large scale measurements, in addition to vulnerability to human effect [9]. The manual methods in general consist of experts' opinions and users' feedback. 30% of the methods use merely users' feedback, while the rest uses a combination of experts' opinions and users' feedback.

On-line methods to collect opinions and feedbacks like web questionnaires, computer aided web interviewing CAWI, crawler technologies are slightly more common than off- line methods like phone calls, computer assisted telephone interviewing CATI, face to face interviews or focus groups. 20% of the surveyed methods use pure on-line

methods to collect users and non-users opinions, and 10% use pure off-line methods, while 50% of the methods use both on-line and off-line methods. Manual sampling is more popular than automatic sampling, other than 20% of the surveyed methods which didn't report using a sampling method, all the rest 80% use manual sampling, half of them combine manual with automatic sampling.

D.3.3.3 When to Measure?

In general measurements could be conducted in one of three times through the project life 'ex-ante', where ideas to be implemented before starting implementation are the focus, 'ex-post', where project outcomes are the focus [10] or 'In between'. Figure D-7 shows that 'ex-post' measurements are far more popular among the surveyed methods, which is logic for user-satisfaction measurements. However, more 'ex-ante' and 'in between' measurements are expected to save money, time and effort by avoiding implementing services that users are not interested in and by implementing services in ways that will make these services user-satisfactory.

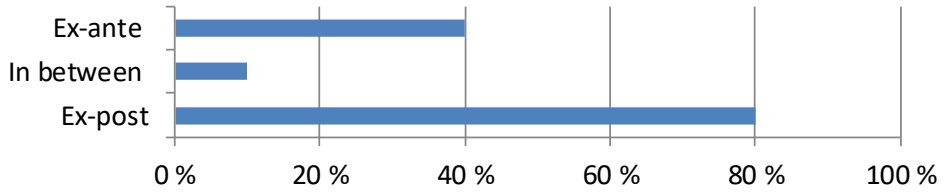

Figure D-7: Measurement timing

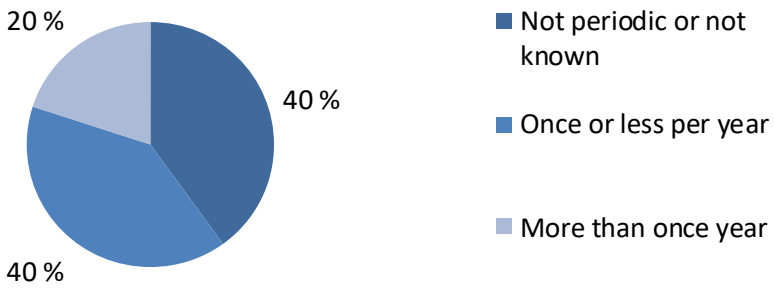

Figure D-8: Measurement periodicity

40% of the surveyed methods are not periodic (or not known) at all, once or less per year periodicity are more common among the rest; leaving only 20% of the surveyed methods to have periodicity of more than once per year. Clearly, higher measurement

periodicity can track changes in users' needs in better way. Measurement periodicity is shown in Figure D-8.

D.3.3.4 Results of Measurement Methods

As shown in Figure D-9, 60% of the surveyed methods result in combinations of qualitative and quantitative indicators, while qualitative scores are more common among the rest. Figure D-10 shows the properties of result reports of the surveyed methods. Nearly all surveyed methods have their results available to external bodies (Availability of results). Transparency of measurements (Transparency) is among the highest ranked results as well. Possibility of re-computing score by a third party (Repeatability by a third party) and having different reports to address different stakeholders (Multi-view) – although still having good results – are the lowest ranked properties of measurement reporting.

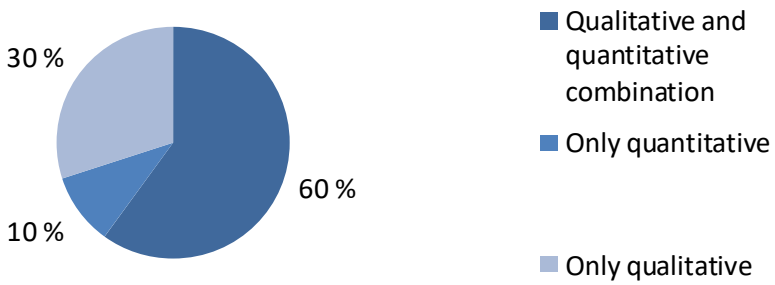

Figure D-9: Resulted score or indicators

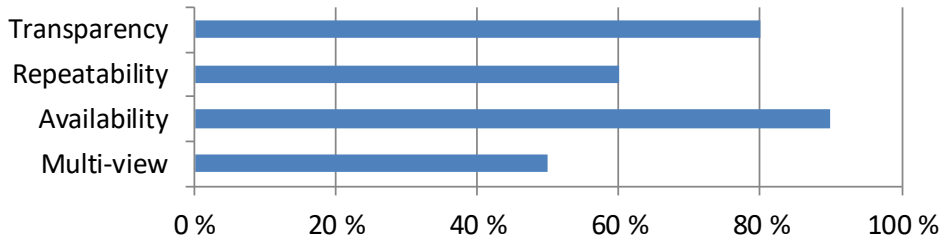

Figure D-10: Properties of measurement results report

D.3.4 Maintenance of Measurement Methods

As shown in Figure D-11, only with one exception the surveyed methods do not have an open process nor an open method document license like for example, Creative commons share alike. Only half of the surveyed methods have organisations responsible for maintenance process, however, in an answer to a question about whether the

method is regularly updated or not (method sustainability which is continuity of improvement, evolving methodology), only 30% of the respondents answered positively. Furthermore, only 20% of the methods have a change management process to collect comments e.g. from those using the method or those responsible for subjects being measured.

In a fast changing field like eGovernment, measurement methods need to be regularly updated. A working understanding of what is measured and how the measurement is carried out may be essential to make efficient use of the results. However the results show that measurement methods are generally not regularly updated nor maintained in a transparent way.

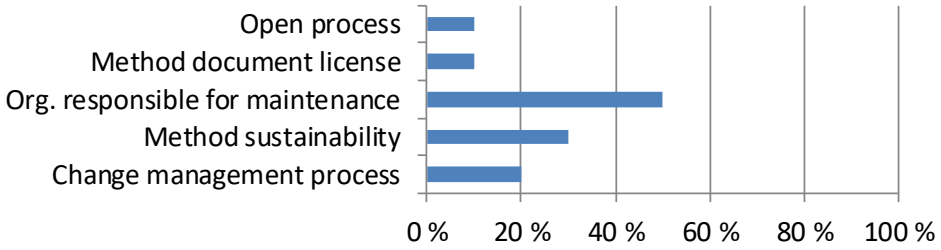

Figure D-11: Maintenance of measurement methods

D.4 Concluding Remarks

The survey of user-satisfaction measurement methods is very important tool in achieving the eGovMoNet objectives. However, a wider survey like [11] is required since only 9 responses -not counting the UWEM questionnaire filled by the Katholieke Universiteit Leuven- from merely 7 countries are few compared to the 27 EU member states. Nevertheless, the analysis shows interesting results.

The surveyed methods have not been standardised through any of the national or international standardisation organisations. This by no means helps in decreasing the heterogeneity in measurement practices. Although there are established relevant standards, e.g. concerning usability or accessibility, the measurement methods rarely refer to them.

Software vendors are mostly not included in the intended group of users of the measurement results. In spite of the fact that software vendors are key players when it comes to features and quality of the provided service [7]. Assessment and evaluation of the current situation of measured objects to identify bottlenecks is not carried out frequently.

There is a great need for fully automated measurement methods, which are vital for conducting frequent large scale measurements. 'Ex-post' measurements are far more popular among the surveyed methods. Although, 'ex-ante' and 'in between' measurements are expected to save money, time and effort, by avoiding implementing services that users are not interested in and by implementing services in ways that will make these services more user-satisfactory.

Only with one exception the surveyed methods have neither open process nor open method document license like for example, Creative commons share alike. Moreover, the surveyed methods are generally not regularly updated or maintained in a transparent way.

D.5 Acknowledgment

The findings in this paper are all derived from the results of the collaboration in the eGovMoNet project, involving researchers, practitioners and users. For more details on eGovMoNet see also the ePractice community [3], and the web site of the network.

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E A Survey of Current Measurement Methods for eGovernment Impact

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Abstract: *A survey on eGovernment impact measurement methods was conducted by the eGovMoNet project to enable a comparison among them and to facilitate a discussion on good practices. The collected information is related to the methodologies covering their properties and associated tools, practices, implementation stage and challenges. The main findings from the analysis based on the results compiled by this survey are that more effort is needed to standardise more measurement methods and to increase the accuracy of the measurement results. Also the ways in which measurements can support strategic decisions and support policy makers need more focus. Identifying bottlenecks and prioritise improvements are not frequent among surveyed methods. The majority of the surveyed methods do not have an open process, change management process or an open method document license. Only half of the surveyed methods are regularly updated and maintained in a transparent way.*

Keywords: eGovMoNet, eGovernment, measurement, impact

E.1 Introduction

In this paper we will summarise the main properties of the measurement methods, as described in the questionnaires filled by members of the eGovMoNet project[145] in the second collected wave dealing with impact measurement methods.[146] The remainder of the paper is organised in three parts; a brief overview of the questionnaire and the sample, the results of the survey, and finally the paper concludes with a discussion on the main findings.

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[145] The eGovMoNet, Thematic Network was co-funded by the European Commission, under the CIP project number 224998. Project period: 2008-05-01 to 2010-05-01. The network has close to 50 members who have signed up as partners and are using, deploying or developing eGovernment measurement methods from Belgium, Denmark, Germany, Greece, Hungary, Italy, Norway, Slovakia, Spain, Sweden, The Netherlands and UK. Moreover, the eGovMoNet ePractice community counts well over 300 members across Europe. More information about the network is available at: http://www.egovmonet.eu

[146] The filled questionnaires are available at: http://ws.egovmonet.eu/WP3/Template_impact

E.2 Questionnaire and Sample Overview

The eGovMoNet questionnaire is intended to support the description of eGovernment measurement methods to share the current practices and the experience deploying them. Using this questionnaire, the features in common and the differences among the methods may be identified, to support steps towards converging practices in a collaborative process. The questionnaire was prepared through successive work group discussions. The questionnaire form has 103 questions, one question to retrieve identification information, 10 requiring responses limited to yes or no, 18 having suggested – but not limited to – choices, and 74 asking for details in their responses. The sample is a convenience sample [1], where the eGovMoNet partners filled the questionnaire to describe specific eGovernment impact measurement methods as used in their respective countries.[147]

The questionnaire responses were coded by the first author into categorical variables. Around 57% of the questions were answered by nearly all respondents. These questions were considered in the analysis, while the rest were discarded since they suffered high rates of missing data. The discarded questions were asking for more details e.g. about usage and results, scope limitations, and cost. As can be expected the more detailed questions are more often left unanswered than those requiring a simpler answer.

E.3 Survey Results

This section explores the results of the eGovernment measurement methods covered by the eGovMoNet impact measurement methods survey. The following subsections describe the general properties of the measurement methods, the intended use of their results, their deployment properties, experience from using them and their maintenance.

E.3.1 General Properties of Measurement Methods

The majority of the respondents claim that their measurement methods are capable of giving the same results if two independent measurements of the same measurement object were conducted (Repeatability of measurement results). Moreover, most of the methods measurement results are size independent which implies that the methods are able to cope with measuring different sizes of eGovernment applications (Independ-

[147] Please note that the eGovMoNet partners represent 12 countries and does not cover all EU member states.

ence of size). It is also possible to compare the measurement results over time for most of the methods to identify trends (Stability of measurement results over time).

Apparently most of the surveyed methods have good general properties, however, only 50% of the methods refers to established standards such as those developed by WAI /W3C (Degree of standardization). In addition, merely 40% of the surveyed methods include indications of their results accuracy (Accuracy). Apparently more effort is needed in both directions. All results of general properties of surveyed methods are shown in Figure E-1.

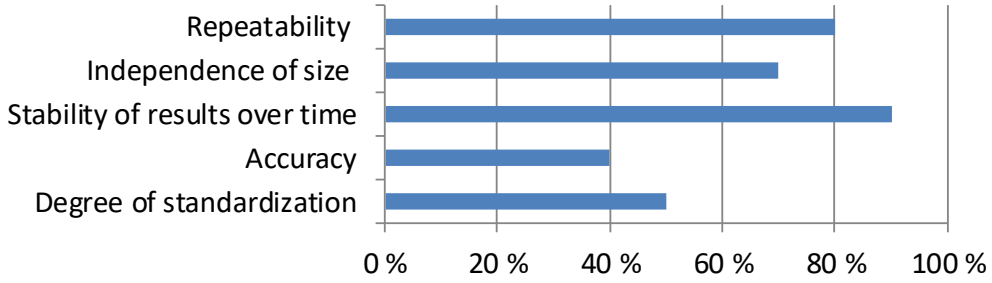

Figure E-1: General properties of the surveyed methods

E.3.2 3.2. Intended Use of Measurement Results

E.3.2.1 Support Strategic Decision or Promote Targeted Change?

All surveyed methods are intended to support strategic decisions. While as shown in Figure E-2, merely 60% of the methods are intended to support strategic decisions. The majority of methods were designed to promote targeted changes on both implementation and organisational procedures levels. Only targeted changes on the policy level come with lower score among the surveyed methods. Figure E-3 shows these results. Moreover, Figure E-4 shows that delivering better services, improving efficiency of governments and monitoring effectiveness & justifying expenditure are the highest ranked purposes to conduct the measurements.

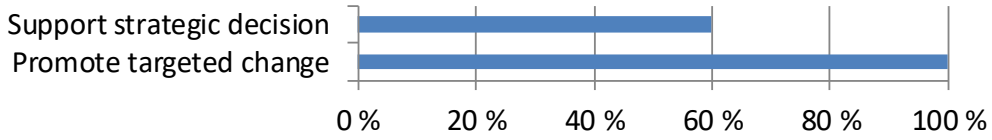

Figure E-2: Support strategic decision or promote targeted change?

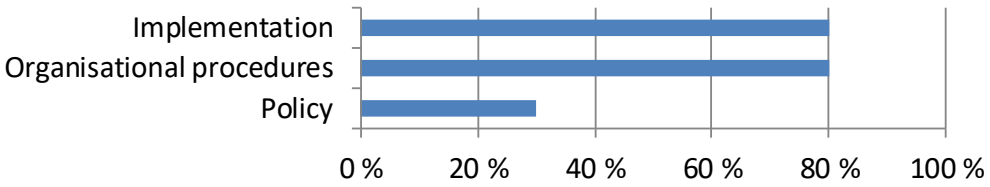

Figure E-3: Targeted changes level

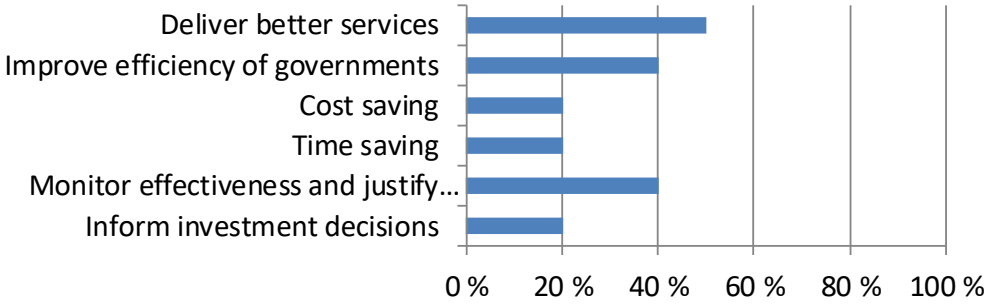

Figure E-4: Purpose of conducting measurements

E.3.2.2 Intended Users of Measurement Results

Policy makers and service providers are the highest rank intended users of the surveyed methods measurement results. Software vendors, developers, website owners and researchers come in the second position of intended users of measurement results. The lowest ranked intended users are Non-Governmental Organizations (NGOs) and other users like project managers and middle level government officials inside the administrations involved as shown in Figure E-5.

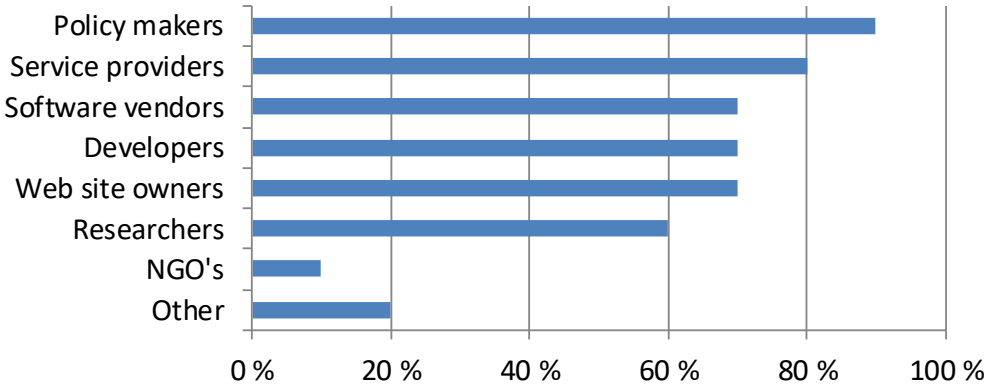

Figure E-5: Intended users of measurement results

E.3.2.3 Reasons for Measurements

In addition to measuring impact on the macro level, on the micro level surveyed methods have other elaborated reasons. Majority of methods aims at benchlearning, identifying good practices in addition to strategic or operational objectives. Assessing and evaluating the current situation, measuring impact of policies and justifying expenditure come in the second rank. Figure E-6 shows all the micro reasons to conduct the measurements.

Assessment and evaluation of current situation of measured objects have different reasons too. 40% of the surveyed methods refer to continuing improvement. On the other hand, irrespective to its importance, identifying bottlenecks and prioritise improvements are not frequent as shown in Figure E-7.

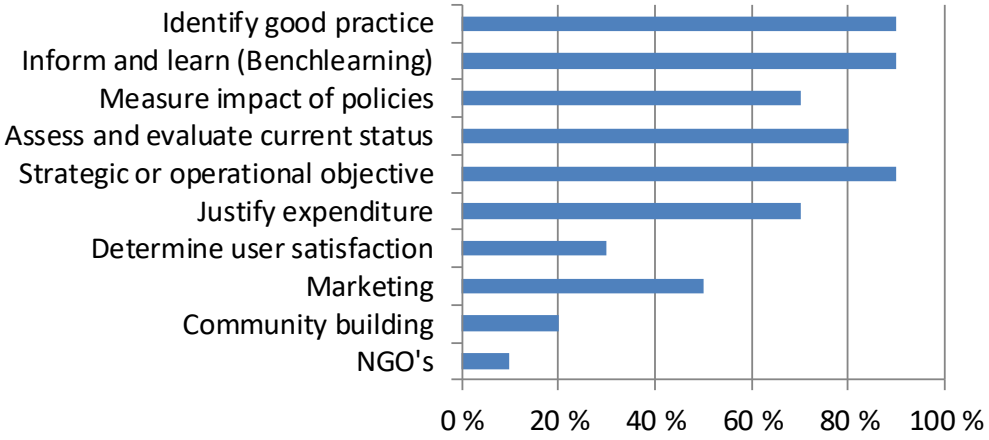

Figure E-6: Reasons of measurements

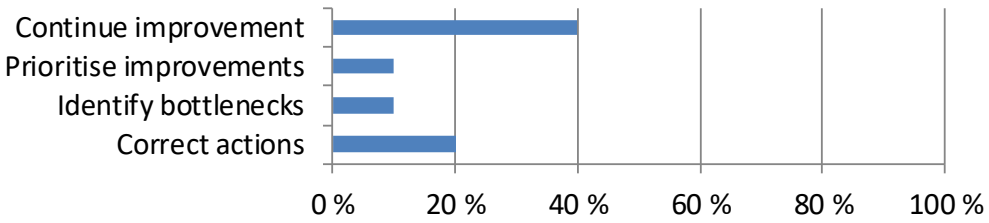

Figure E-7: Reasons to assess and evaluate current situation

E.3.3 Deployment Properties of Measurement Methods

E.3.3.1 Who Carries Out Measurement?

To avoid biased assessment the measurements should ideally be carried out by persons who are independent of the measurement subjects [2]. However, 40% of the surveyed

methods involve the measured organisations in carrying out the measurements as shown in Figure E-8. Furthermore, 60% of the surveyed methods don't require training evaluators, and none of the methods require the evaluator to possess any kind of certificate to carry out the evaluation process.

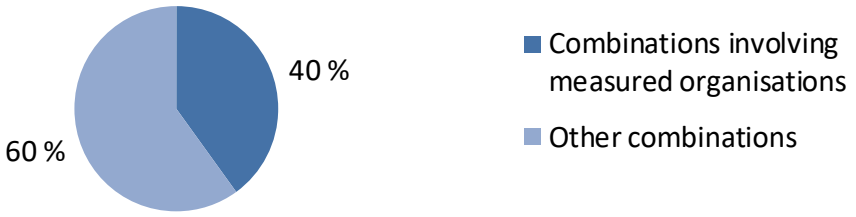

Figure E-8: Who carries out measurement?

E.3.3.2 How Is Measurement Carried Out?

50% of surveyed methods are carried out using merely manual methods, the rest are carried out using combinations of automatic and manual. Although fully automated methods have advantages over methods involving manual components, none of the surveyed methods is carried out fully automatically. The unavailability of fully automated methods restricts the possibility of conducting frequent large scale measurements [3], [4], in addition to vulnerability to human effect [4].[148]

The manual methods in general consist of experts' opinions and users' feedback. Figure E-9 shows that 30% of the methods use purely users' feedback. 20% use merely experts' opinions. While the rest use combinations of both experts' opinions and users' feedback.

Figure E-10 shows that off-line methods to collect opinions and feedbacks like phone calls, Computer Assisted Telephone Interviewing (CATI), face to face interviews or focus groups are more common than on-line methods such as web questionnaires, Computer Aided Web Interviewing (CAWI), crawler technologies. Furthermore, 40% of the surveyed methods employ pure manual sampling, while other 40% employ combination of manual and automatic sampling. The rest, 20% did not declare a sampling type as shown in Figure E-11.

[148] It is worth pointing out that UWEM 1.2 methodology – as an example – has 141 test [3], only 26 of them are fully automatable [4]. Apparently, achieving fully automated electronic service testing is not a simple task.

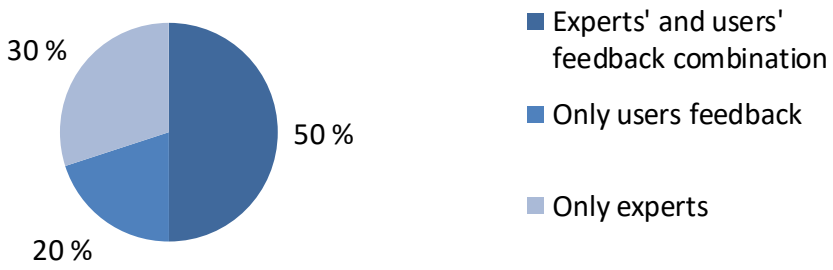

Figure E-9: Manual methods

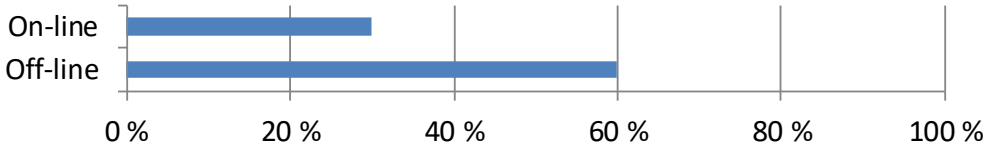

Figure E-10: Methods of collecting users and non-users opinions

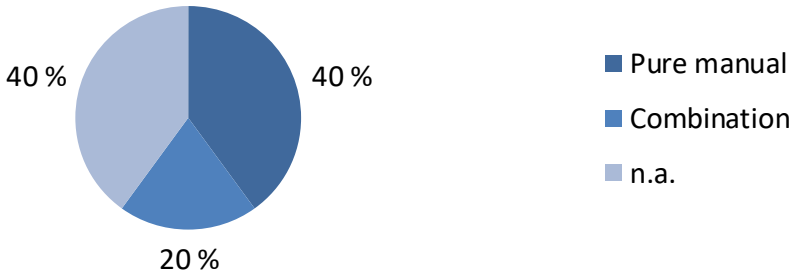

Figure E-11: Sampling type

E.3.3.3 What Part of the Value Chain Is Being Measured?

Different parts of the value chain are being measured by different surveyed methods. As shown in Figure E-12, measuring outputs or intermediate benefits like reduced avoidable contact, migration of content and transactions, etc. are more common compared to impact of the services or end benefits like savings, user-satisfaction, etc. Inputs or lead indicators like web usage, scale of cross sell, etc. are the lowest ranked measured parts of value chain.

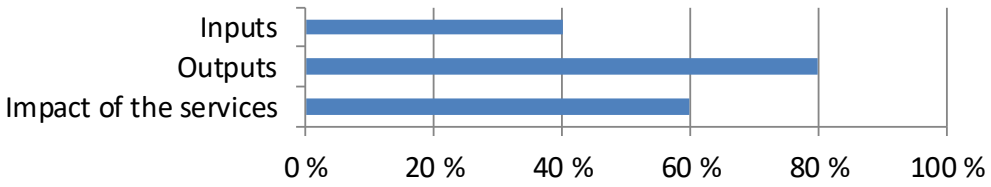

Figure E-12: Measured parts of the value chain

E.3.3.4 When to Measure?

In general measurements could be conducted in one of three phases through the project life 'ex-ante', where ideas to be implemented before starting implementation are the focus, 'ex-post', where project outcomes are the focus [5] or 'In between'. Moreover, Figure E-13 shows that 'ex-post' measurements are far more popular among the surveyed methods, which is normal for impact measurements. 'Ex-ante' measurements come in the second rank still with a high percentage, which is good since it is expected to save money, time and effort by avoiding implementing services that will not have the required impact. However, more 'in between' measurements are really needed to avoid implementing services in ways that will not lead to the envisioned impact.

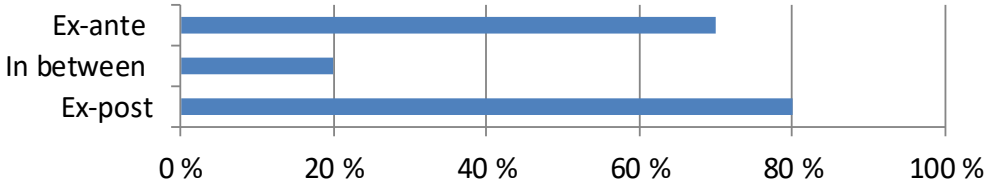

Figure E-13: Measurement timing

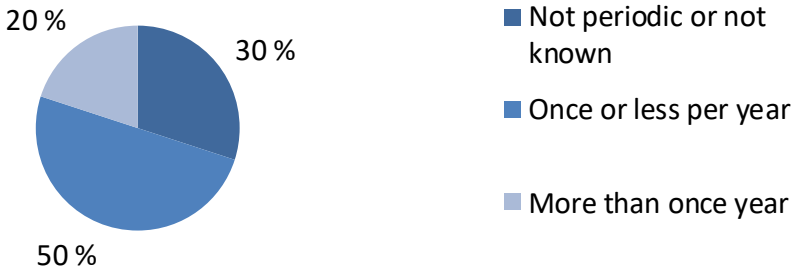

Figure E-14: Measurement periodicity

Figure E-14 shows that 30% of the surveyed methods are not periodic (or not known) at all, once or less per year periodicity are far more common among the rest; leaving only 20% of the surveyed methods to have periodicity of more than once per year. Clearly, higher measurement periodicity can track changes in users' needs in better way.

E.3.3.5 Results of Measurement Methods

50% of the surveyed methods result in pure quantitative indicators. The rest of the methods result in combinations between quantitative and qualitative indicators.[149]

Figure E-15 shows properties of result reports of the surveyed methods. 70% of the surveyed methods have their results available to external bodies (Availability). 60% of the surveyed methods provide the possibility of re-computing score by a third party (Repeatability) and have different reports to address different stakeholders (Multi-view). Unfortunately, transparency of measurements is the lowest ranked property of measurement reporting. In fact only one method reported that its raw data is made available.

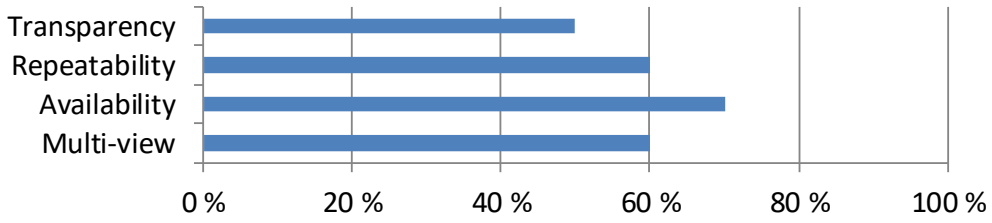

Figure E-15: Properties of measurement results report

E.3.4 Experience from Using Measurement Methods

Procedure changes as improvements in eGovernment services because of measurement results were reported by 40% of the surveyed methods. While, policy changes come in the second rank with 30%. Only 10% of the surveyed methods reported software changes as shown in Figure E-16.

[149] One of the surveyed methods responded to that question by n.a.

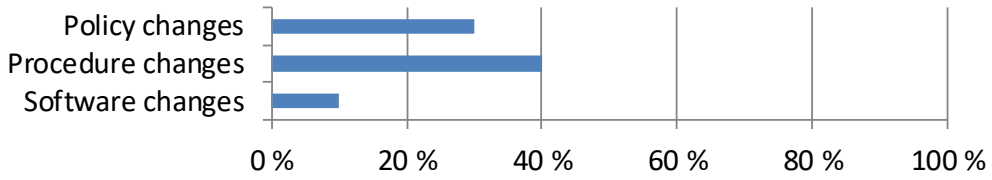

Figure E-16: Improvements because of measurement results

E.3.5 Maintenance of Measurement Methods

As shown in Figure E-17, only 20% of the surveyed methods were reported to have open process and 10% have method document license like for example, creative commons share alike. Merely 30% of the surveyed methods have organisations responsible for their maintenance processes, consequently they are regularly updated (method sustainability which is the continuity of improvement and evolving). Furthermore, 20% of the methods have change management processes to collect comments, e.g., from those using the method or those responsible for subjects being measured.

In a fast changing field like eGovernment, measurement methods need to be regularly updated. A working understanding of what is measured and how the measurement is carried out may be essential to make efficient use of the results. However results show that measurement methods are generally neither regularly updated nor maintained in a transparent way.

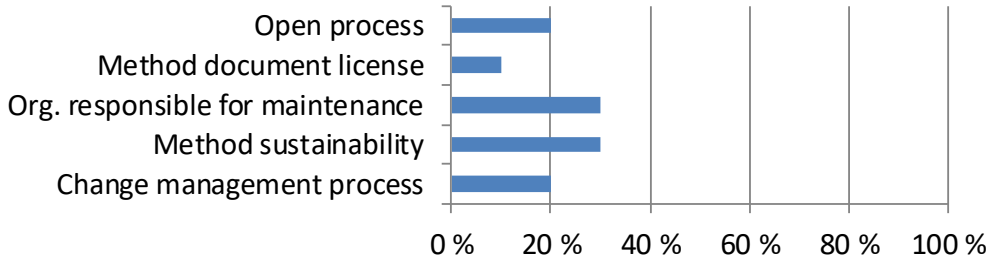

Figure E-17: Maintenance of methods

E.4 Conclusions

The survey of impact measurement methods is very important in achieving the eGovMoNet goal. A wider survey like [6] is required since merely10 responses to the questionnaire from only 9 countries are few in comparison to 27 state countries in the EU. However, the analysis has uncovered some interesting results.

More effort is needed in standardising more measurement methods as well as in quality of measurements in terms of accuracy. Half of the surveyed methods do not relate to any open standards as established by national or international standardisation organisations. A development to more use of standards would help in improving the comparability between in measurement practices and measurement results. Less than half of the surveyed methods include indications of their results accuracy.

Supporting strategic decisions and targeting changes on the policy level need more attention. Identifying bottlenecks and prioritise improvements are not frequently addressed among the surveyed methods. Although the surveyed methods are intended to measure impact, they focus more on just output not impact of the services.

'Ex-post' and 'ex-ante' measurements are far more popular among the surveyed methods. Although, 'in between' measurements are expected to save money, time and effort, by implementing services in ways that should lead to the envisioned impact.

The majority of the surveyed methods do not have an open development process, change management process or open method document license like for example, Creative commons share alike. Only half of the surveyed methods are regularly updated and maintained in a transparent way.

E.5 Acknowledgements

The findings in this paper are all derived from the results of the collaboration in the eGovMoNet project, involving researchers, practitioners and users. For more details on eGovMoNet see also the ePractice community see [7], and the web site of the network.[150]

E.6 References

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F Accessibility of Norwegian Municipalities Websites: A Qualitative System Dynamics Approach

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Abstract: *Access to all public websites is crucial to assuring equal opportunities for all citizens to participate in society. Several studies have been carried out to analyse the accessibility of websites. However, we have not been able to find any studies on the factors (other than technical) affecting website accessibility. The purpose of this paper is therefore to explore different factors prior to the web page development that may have an influence on the accessibility of municipal websites in Norway. This is achieved through reviewing relevant literature and performing a set of in-depth interviews with web-masters and web-editors from various Norwegian municipalities. The findings from these sources were compiled into a Causal Loop Diagram.*
Several leverage points to enhance public websites accessibility were discovered by exploring the Causal Loop Diagram:

- *Increasing the budget devoted to the workforce, paying more attention to the selection process while recruiting and retaining the experienced workforce members.*
- *Keeping the desired development rate at a level lower than the capacity of the available workforce.*
- *Training the workforce in HTML and WCAG, in addition to updating technology, are possible long-term investments.*

Keywords: Accessibility, Web-accessibility, eGovernment, Public Websites, and Qualitative System Dynamics.

F.1 Introduction

Accessibility of a website refers to the ability of all people to use this website irrespective of their disabilities or the terminals they use to access internet [1]. Websites should be designed in a way that complies with certain set of rules and guidelines to be accessible. It is an important aspect of websites in general, and of public websites in particular, to be able to serve all citizens equally. For example if a webpage is designed to receive the user's input merely through mouse clicks, then people with disabilities pre-

venting them from using a mouse or people using e.g. mobile phones to browse the internet will not be able to use this webpage.

Web-accessibility can be assessed in terms of compliance with a set of accessibility metrics defined by specific guidelines like Web Content Accessibility Guidelines WCAG 1.0, WCAG 2.0 [1], and ISO 9241-20 [2]. Furthermore, it may be evaluated quantitatively using methodologies like Unified Web Evaluation Methodology[151] UWEM [3].

Many research projects have addressed evaluation of public websites accessibility, for instance [4]–[6]. In addition governments carry out benchmarking and pass laws to increase public websites accessibility. In Norway, the Agency for Public Management and eGovernment DIFI is responsible for an annual evaluation of governmental websites [7]. Web-accessibility is one of three indicators measured by DIFI to encourage governmental agencies to increase the accessibility of their websites.

In 2008, the United Nation's eGovernment Development Index for Norway was 0.8921, ranking the country third in the entire world [8]. However, from an accessibility point of view, the Norwegian public websites achieved an average score of 54% in the same year according to DIFI [7], leading to two pressing questions: why is this so and how to fix the situation. System analysis is a promising tool used in the search for answers.

Although a public website as an Information System consists of people or human resources component (website editors, web-masters, vendors' developers … etc.), besides the IT technical components (data, hardware, software and telecommunications … etc.) [9], we have not been able to find studies focusing on other factors than technical ones affecting website accessibility.

Motivated by this, the paper seeks to explore the different factors and cause-effect relationships governing the processes having an impact on the accessibility of Norwegian municipal websites. The results are based on a set of in-depth interviews with webmasters and web-editors from different Norwegian municipalities in addition to related literature. The identified relationships have subsequently been compiled into a Causal Loop Diagram.

The remainder of this paper is organised as follows: The first section gives a brief introduction to the applied methodology and an outline of the sources of information

[151] Number of failed web accessibility tests divided by number of all tests applied per webpage or per website when evaluating a webpage or a website respectively.

used. The subsequent section explores the system's Causal Loop Diagrams. Finally, the paper discusses the findings.

F.2 Methodology

To convey the main results of this paper and make it easy to explore the causalities, loops, and feedback effects in the system, a qualitative System Dynamics graphical tool called the *Causal Loop Diagram* or *Influence Diagram* was chosen.
Follows a brief on the idea and notation of Causal Loop Diagram and the information sources employed to construct them.

F.2.1 Causal Loop Diagram

Causal Loop Diagram is a tool used to visualise variables relationships and feedback effects of systems. An example of a Causal Loop Diagram is shown in Figure F-1. The Causal Loop Diagram consists of variable names and arrows among them.

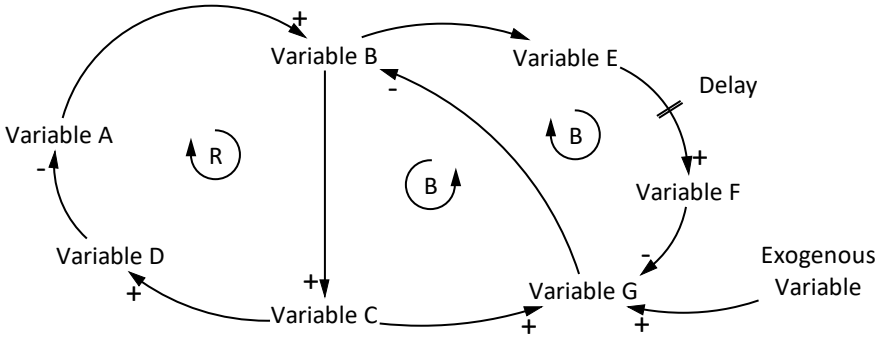

Figure F-1: Causal Loop Diagram example

The arrows between every two variables differ in sign (positive or negative) to express direct or inverse cause-effect relationships between the two variables they connect. Sometimes the arrows are interrupted by two parallel lines to indicate time delay. The arrows can compose circular causality and develop into two different sorts of loops, either ones with exponentially growing/decaying behaviour called reinforcing loops (denoted by R), or loops with goal-seeking behaviour called balancing loops (denoted by B). The interactions among different loops decide the final behaviour of the system [10]–[12].

F.2.2 Information Sources

The source of information to build the Causal Loop Diagram in this paper is a set of in-depth interviews with 7 responsible editors and web-masters from different Norwe-

gian municipalities, namely: Hole, Holmestrand, Grimstad, and Trondheim municipalities.[152]

These in-depth interviews were accompanied by an extensive literature review on management applications from areas possessing similarities to public website development and management, such as software development, web maintenance and online community networks [12]–[17].

F.3 Causal Loop Diagram of Website Accessibility

This section explores the system's Causal Loop Diagrams: the website development process focusing on web-accessibility, workforce focusing on productivity and work quality in terms of the accessibility of developed webpages, workforce training, use of consultants from vendors, the process of updating technology used in building the municipal website, and an overall picture of the system.

F.3.1 Workforce and website accessibility

Web editors are the people responsible for editing the webpages and publishing them on the municipal website. Editors have varying experience and knowledge, accordingly their productivity and the accessibility of their edited webpages vary. Consequently overall website accessibility vary.

Enhancing accessibility of the municipal website is desirable, especially when results in achieving a good ranking on DIFI's annual evaluation. Nevertheless, according to interviewees, website accessibility is not in the municipality's list of priorities, generally implying a limited part of the budget devoted to accessibility. Therefore, probably a short-term accessibility enhancement will lead to a budget cut, or in the best case, stagnation, i.e. a budget devoted to accessibility has an inverse cause-effect relationship with accessibility.

Figure F-2 compiles the cause-effect relationships connecting workforce and website accessibility. To easily explore these cause-effect relationships, we will assume a decrease in the website accessibility. Consequently, the budget devoted to accessibility increases – usually slightly (if any); hence the budget devoted to the workforce increas-

[152] Trondheim municipality is an example of a large municipality (one of the 10 largest in Norway), where the number of website editors exceeds 500 (full-time and part-time), while Hole, Holmestrand and Grimstad are examples of smaller municipalities employing less than 20 active editors (full-time and part-time). The factor that distinguishes Grimstad in this study is that it is in the process of replacing its website with a newer version.

es. Having a larger budget devoted to the workforce would mean an increased hiring rate, decreased turnover or both. All cases lead to an increase in the workforce, thus raising the webpages development rate, which subsequently increases the website size in terms of the number of webpages, increase the quality assurance in terms of re-editing the old inaccessible webpages or both.

More webpages (with some level of inaccessibility) mean less overall website accessibility. This creates an undesirable reinforcing loop R1. On the other hand, more quality assurance means more overall website accessibility. This creates a desirable balancing loop B1.[153]

From another perspective, an increase in the workforce – assuming mild rationality when recruiting and retaining experienced workforce members – enhances the workforce mix, a factor which has the following effects:

- increasing the potential and thereafter actual developed webpage accessibility, creating a desirable balancing loop B2, and
- increasing the potential and thereafter actual productivity, creating another path and strengthening the path from workforce to webpages development rate, and creating another undesirable reinforcing loop R2.

While developing webpages, editors learn. As the webpages development rate increases, learning by doing increases. This produces two effects after a delay:

- increasing website accessibility through increasing the actual developed webpage accessibility, creating 2 desirable balancing loops B4 and B5[154] (both strengthen B2), and
- increasing actual productivity, hence webpages development rate, creating a desirable reinforcing loop R3.

Nevertheless, after a continuance of high webpages development rate, the desirable effects of loops B4, B5 and R3 are weakened by fatigue, leading to two effects:

- decreasing website accessibility by decreasing the actual developed webpage accessibility, creating 2 undesirable reinforcing loops R4 and R5[155] (which weaken B4 and B5), and

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[153] Both hiring and turnover rates transfer the effect from a budget devoted to the workforce in the same direction, thus for the purpose of simplicity, we will consider them as one path.

[154] The path from workforce to webpages development rate is strengthened by another parallel path through workforce mix, potential and actual productivity. This parallel path causes B4 to be strengthened by another desirable balancing loop B5.

- decreasing the actual productivity, hence the webpages development rate, creating an undesirable balancing loop B3 (which weakens R3).

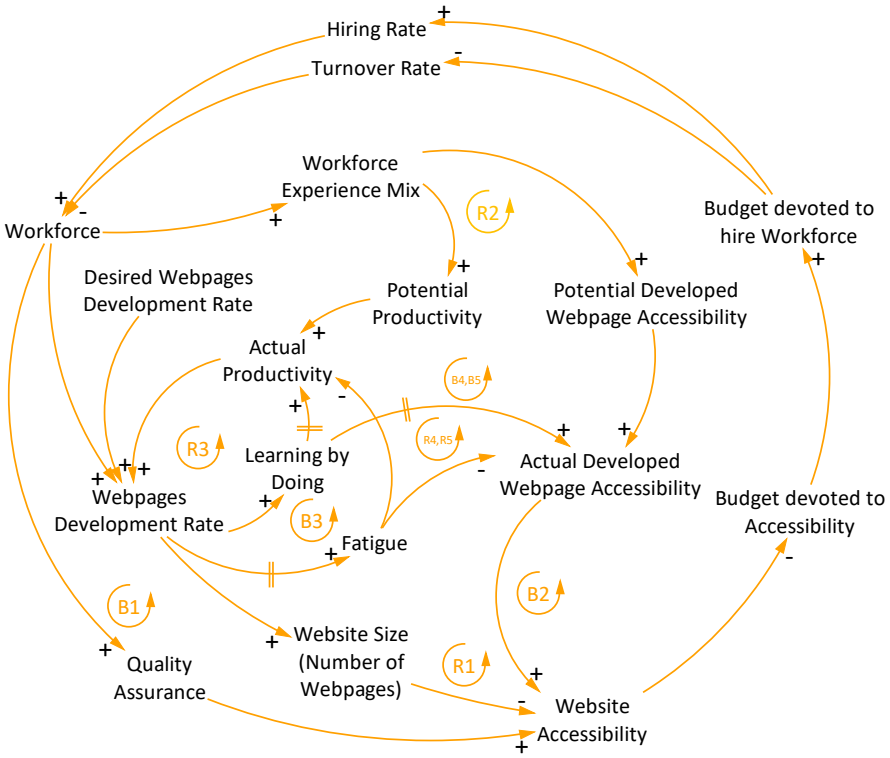

Figure F-2: Workforce management

Given the current workforce management policy, the number of reinforcing loops (with undesirable effect on accessibility) equals the number of balancing loops (with desirable effect on accessibility). Keeping the accessibility on the same level is a delicate process. Nevertheless, many leverage points could be utilized to increase accessibility:

- changing the current budget policy increases the budget devoted to workforce to increase the workforce, hence increasing the production capacity,
- giving more attention to the selection process while recruiting, and retaining the experienced workforce members, to increase the experience mix, and
- keeping the desired development rate lower than the capacity of the available workforce.

The above points would increase the desirable effect through assuring the following:

- devote more development time for quality assurance, accordingly increasing the overall accessibility (empowering loop B1 on the account of R1),

---

[155] The path from workforce to webpages development rate is strengthened by another parallel path through workforce mix, potential and actual productivity. This parallel path causes R4 to be strengthened by another undesirable reinforcing loop R5.

- affect accessibility positively through loop B2 instead of productivity through loop R2, using the same number of workforce individuals because of their better workforce experience mix, and
- increasing the desirable effect of loop B4, B5 and R3, without triggering loops R4, R5 and B3.

Unfortunately, as mentioned earlier, accessibility is not on the priority list, moreover the desired webpage development rate is not usually elastic, strengthening all undesirable loops.

F.3.2 Workforce training

Figure F-3 explores the expected training effects on the accessibility of a municipal website. As budget devoted to training increases, training activity increases; consequently, the actual productivity and the webpage development rate of the workforce increases, if the desired webpages development rate is increased. The same workforce as a group has the ability to develop webpages at a specific level of accessibility. At this specific level of developed webpage accessibility, any increase in webpages development will lead to a decrease in the overall website accessibility. Accordingly, devoting more money to accessibility, thus devoting more money to training again through loop R comprising a vicious circle (undesirable reinforcing loop)!

Although increased training seems to have undesirable effect on accessibility through loop R, this is not true. After a time delay (time to digest the new knowledge) training increases the actual developed webpage accessibility, which increases the website accessibility, creating desirable balancing loop B. Furthermore, keeping the desired development rate at a level lower than the capacity of the available workforce will suppress loop R in favour of loop B.

Moreover, devoting a higher budget to training, given that the selection of training programmes in terms of type, duration and quality is rational, would increase the desirable effect. For example, training for workforce members (especially those recently hired) is limited to providing knowledge about how to build webpages using the publishing tools and templates provided by the vendors. Consequently, web editors hardly know about the Hypertext Markup Language (HTML), although HTML is the most widespread internet browsers language. Moreover, HTML is the language of the techniques provided by the World Wide Web Consortium (W3C) to ensure that webpages conform with their stable WCAG1.0 or new WCAG2.0 [18], [19]. According to experts, examples of the positive effect of HTML knowledge on website accessibility exist. Our interviews results are consistent with that. Out of the interviewed municipalities, only the work-

force in Hole municipality has good knowledge of HTML and WCAG, which enables them not only to develop webpages but also create templates. This knowledge is reflected in their successful current and historical ranks in the annual public websites assessments by DIFI [7]. Further training opportunities are on how to produce webpages in compliance with WCAG, which is estimated to cost NOK 2,385 per person for 3 hours of training including all expenses. Moreover, online courses are expected to be more cost-saving [20].

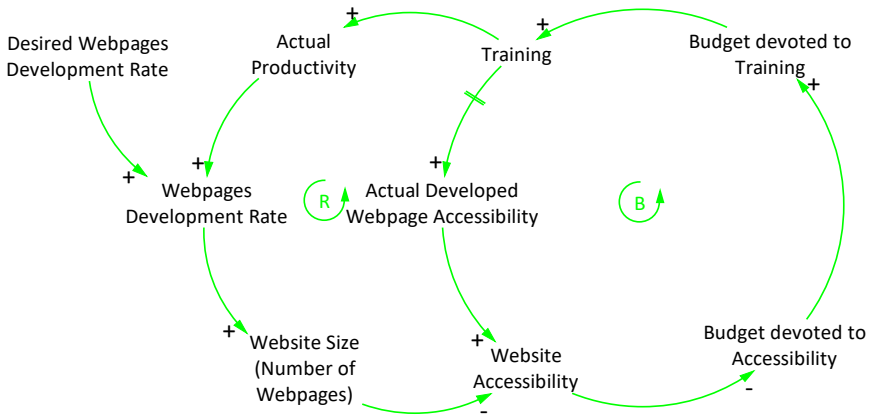

Figure F-3: Workforce training

F.3.3 Consultancies with the vendors

DIFI estimates that one hour of IT development support provided to public agencies by internet publishing solutions vendors costs NOK 1,500 [20]. According to Trondheim municipality, the number of support hours could reach from 900 to 1,200 hours per year.

Fortunately, the loop controlling consultancies with vendors is a balancing loop by its very nature. For instance, Figure F-4 shows loop B, which controls consultancy value. As website accessibility decays, the budget devoted to consultancies with vendors increases, leading to an increase in the resulted number of webpages fixed in terms of accessibility. As the website accessibility increases, the budget devoted to consultancies with vendors is decreased.

Anecdotal evidence indicates that just before the annual public websites assessments by DIFI, some municipalities rush to consult their vendors to fix website problems, aiming at getting a better ranking.

In addition to the high cost, the real problem behind consulting the vendor is that although enhancing the accessibility quickly, the effect is short-term. This is due to the addition of new webpages and templates over time (having the usual accessibility lev-

el), at the same time purging the obsolete ones (which might be the ones fixed by the vendor's developers).

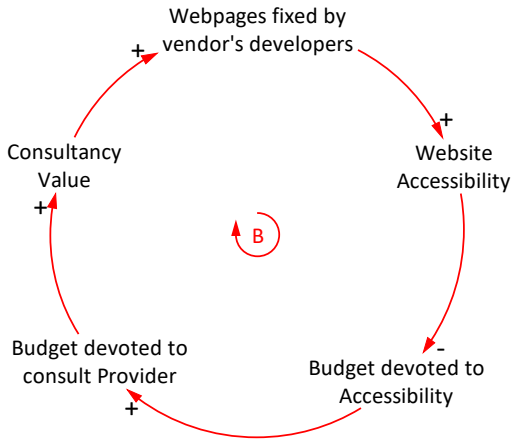

Figure F-4: Consultancies with the vendor

F.3.4 Technology update

The term “technology update” means updating the tools used by the public agencies to build and publish their websites. Technology update enables the website to satisfy its users' evolving needs, as well as comply with the up-to-date IT security requirements. Furthermore, experts in the field claim that using the appropriate web technology greatly affects accessibility. Seen from another point of view, “people clearly link the use of the new technology to better career prospects” [21], implying that keeping technology up-to-date increases the competitiveness of the workplace, and helps municipalities in retaining their experienced employees.

Figure F-5 presents the loops managing the process and decision of technology update. As website accessibility decreases, budget devoted to accessibility (hence to technology update) increases. After fully installing the new technology putting it into operation, actual productivity and webpages development rate increase directly. The immediate response to webpages development rate is an increase in the number of webpages, thus decreasing the accessibility through an undesirable reinforcing loop R. Another delayed response to technology update is an increase in actual developed webpage accessibility, which in turn enhances the accessibility creating a desirable balanced loop B.

Rationality in selecting the new technology in terms of accessibility features, security and stability is the key to achieve the desired effects.

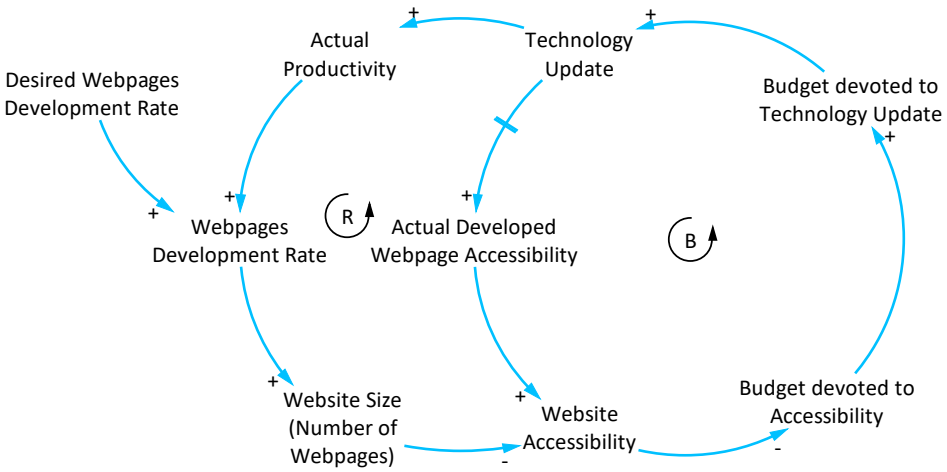

Figure F-5: Technology update

DIFI estimates that 1,500 hours are needed to develop one of the current publishing tools (that can not be totally replaced[156]) to comply with the Authoring Tool Accessibility Guidelines ATAG 1.0 [22]; multiplying this by one hour of development estimated cost NOK 600 (vendor's internal cost), provides a total of NOK 9,000,000 [20]. The value of this investment although looks high, is low when distributed over time between needed successive updates. For example, the W3C took 9 years between publishing ATAG 1.0 in 2000 and ATAG 2.0 (which is still a working draft) in 2009 [23].

F.3.5 Overall picture

Figure F-6 presents all formerly discussed loops combined to form an overall picture of accessibility management in a municipal website. The interactions resulted from joining these loop are very interesting.

Loops of workforce management, training, and technology update empower each other through actual productivity and actual developed webpage accessibility. Both variables are long-term investments that the municipality will continue gaining from for a long time after paying for them. As mentioned earlier, opportunities to enhance accessibility through training one or more of the editors in the use of HTML and WCAG cost the municipality very little. Furthermore, updating the used technology is expected to be fruitful in terms of enhancing actual productivity and actual developed webpage accessibility. In addition, it is expected to enhance the working conditions for employees. Finally, keeping the editors workload on a level suitable to their number and capacities

[156] Cost drops significantly for replacing a publishing tool, according to DIFI's estimates it will cost only NOK 60,000.

will increase the merits of learning by doing, and will suppress the undesirable effect of fatigue on both actual productivity and actual developed webpage accessibility.
Only the loop of consulting the vendor is connected to the rest of the system through the website size (number of webpages) and the budget; as the website size increases, the vendor interacts and fixes some webpages – if requested, accordingly earn some good money.
As mentioned earlier, man hour purchased from the vendors is estimated to cost the municipality NOK 1,500. However, the estimated internal cost for the vendor is only NOK 600 per man hour. It is also estimated that an editor in a municipality costs NOK 240 per hour [20]. These numbers could recommend recruiting in-house developers in big municipalities, and even smaller neighbour municipalities could bear that cost if they group together.
Comparing DIFI's estimated cost of technology update and training to the cost of consultancies per year in a municipality (for example, Trondheim) illustrates the substantial opportunity of this.
Under the budget constraints in the municipalities and in compliance with Norwegian anti-discrimination laws, the central government may take very positive steps regarding training editors from the municipalities, updating technology and putting conditions on vendors supplying public agencies with publishing tools in order to make these tools in compliance with, for example, the latest ATAG.

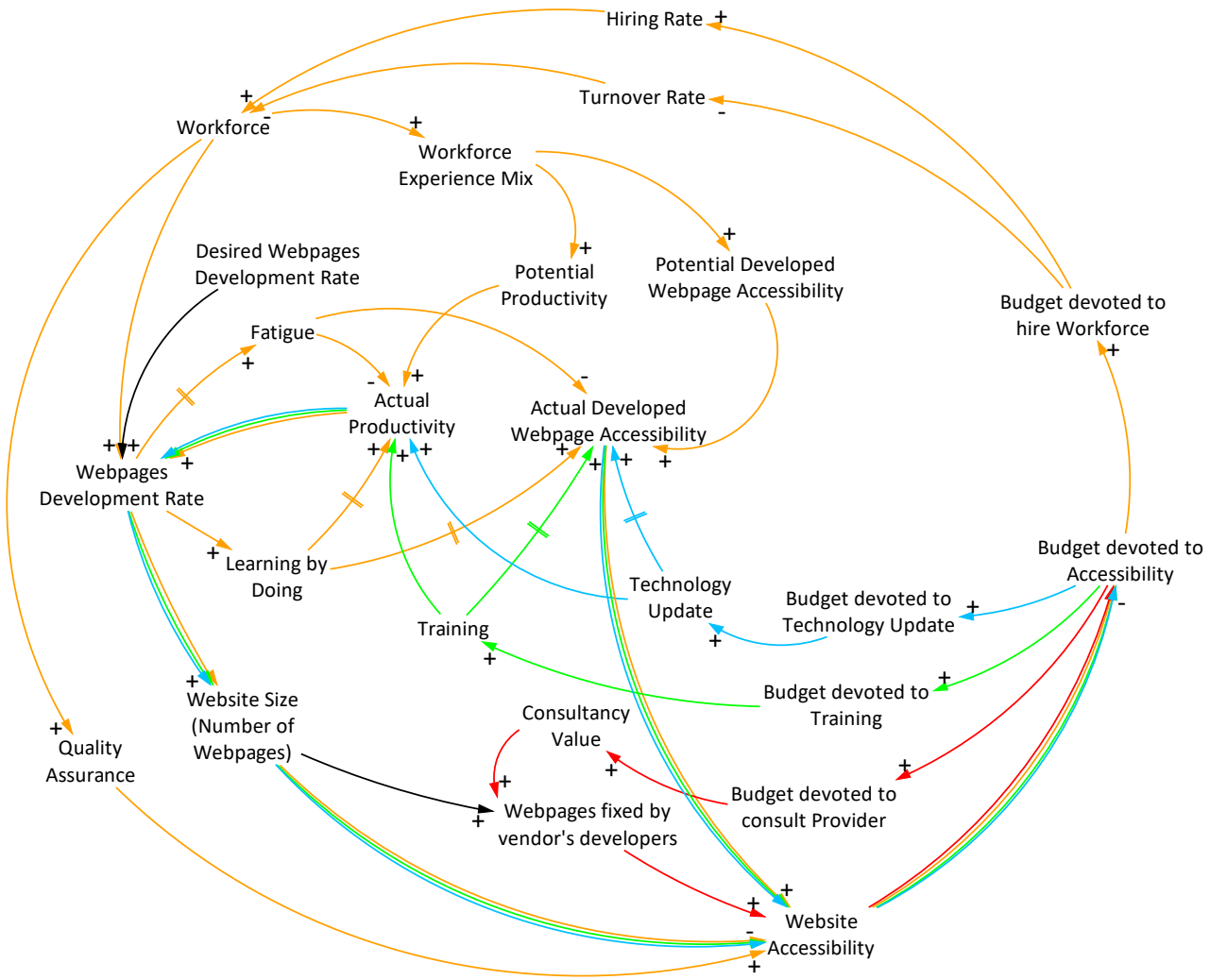

Figure F-6: Overall picture of public website accessibility key variables

F.4 Concluding discussion

The achievement of public website accessibility offers various opportunities for various groups of people, while lack of public website accessibility deprives them not only from these opportunities but also from the services that they should normally receive.

Many leverage points to enhance public website accessibility were discovered by exploring the system's Causal Loop Diagram:

- increasing the budget devoted to the workforce, giving more attention to the selection process while recruiting and retaining the experienced workforce members in order to improve the experience mix, are important factors in enhancing accessibility,
- keeping the desired development rate at a level lower than the capacity of the available workforce, is another important measure that allows more time for quality assurance, empowers the desirable loops, and enhances accessibility, and
- training the workforce in HTML and WCAG, in addition to performing technology update, are long-term investments than consulting the vendors to solve accessibility problems.

In addition, the Causal Loop Diagram can be utilised to enhance the mental models of its users. Moreover, they can be used to explain very useful policies that are based on non-straight forward cause-effect relationships hidden in the system to decision-makers.

Furthermore, this Causal Loop Diagram is a basis for a System Dynamics quantitative simulation model.

F.5 Acknowledgement

The eGovMon project[157] is co-funded by the Research Council of Norway under the VERDIKT program. Project no.: VERDIKT 183392/S10. The results in the eGovMon project and in this paper are all based on the results from project team collaboration including researchers, practitioners and users.

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G Accessibility of Norwegian Municipalities Websites: A Decision Support Tool

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Abstract: *Access to public websites is crucial to assure equal opportunities for all citizens to participate in society. Although, a range of studies to analyse the accessibility of websites have been carried out, we have not been able to find any study evaluating the effect of managerial decisions on the accessibility of websites. This paper presents a demonstrator simulation model, built using System Dynamics methodology. The model focuses on accessibility of Norwegian Municipal websites, and is intended to be used as a decision support tool, mainly for managers responsible for website development and maintenance. To build the underlying model we have used information collected from in-depth interviews with representatives from a group of Norwegian municipalities, and the outcomes of a review of the relevant literature. The paper contains a description of the model structure, and the behaviour from running the model using parameters of two Norwegian municipalities.*

Keywords: Accessibility; Decision Support; System Dynamics; Municipal Websites; Interactive Learning Environment

G.1 Introduction

Accessibility of a website refers to the ability of all people to use a website irrespective of their disabilities or the client devices they use to access internet [1]. Accessibility is an important aspect of websites in general and of public websites in particular, to be able to serve all citizens equally. For example if a webpage is designed to retrieve user input merely through mouse clicks, then people with disabilities preventing them from using a mouse or people using e.g. mobile phones to browse the internet, will not be able to use this webpage.

Web-accessibility can be assessed in terms of compliance with a set of accessibility metrics defined by specific guidelines like Web Content Accessibility Guidelines WCAG (1.0 and 2.0) [1] and ISO 9241-20 [2]. Furthermore, it may be evaluated quantitatively using methodologies like the Unified Web Evaluation Methodology UWEM [3]. Many researches and projects have addressed evaluation of public websites acces-

sibility, for instance [4–6]. In addition governments carry out benchmarking and pass laws to increase public websites accessibility. In Norway, the Agency for Public Management and eGovernment DIFI is responsible for an annual evaluation of governmental websites [7]. Accessibility is one of three indicators measured by DIFI to encourage governmental agencies to increase the accessibility of their websites.

In 2010, the UN eGovernment Development Index for Norway was 0.802, ranking the country sixth in the entire world [8]. However, from an accessibility point of view, the Norwegian public websites achieved an average score of 58% in the same year according to DIFI [7], leading to two pressing questions: why is this so and how to improve the situation.

A public website, as an Information System, consists of people (web-editors, webmasters, developers, consultants, etc.), and procedures, besides telecommunications, software, hardware, and data [9]. When considering the management process and the people component of eGovernment website, many ways could be proposed to enhance its accessibility like consulting experts, replace the Content Management System CMS, recruiting, or training. The expected impact of these measures ranges from slow to fast, cheap to expensive, and short-term to long-term. This diversification and contradiction of properties in addition to the existence of the time factor make the decision of adopting only one way to do the task a challenge. More challenging is how to prioritise limited resources to achieve the best effect on accessibility. A simulation model is a very efficient tool that can be employed to deal with such situation [10].

Motivated by this, the paper seeks to explore the different factors and cause-effect relationships governing the processes having an impact on the accessibility of Norwegian municipal websites. The results are based on a set of in-depth interviews with webmasters and web-editors from different Norwegian municipalities in addition to related literature. The identified structure has subsequently been compiled into a demonstrator System Dynamics SD simulation model.

The demonstrator SD model includes factors –other than just technical– affecting the accessibility of an eGovernment website. It is also accompanied by an easy-to-use GUI, which in addition to decision support tool, also can be used as an Interactive Learning Environment ILE [10]. The model is intended to help the eGovernment websites managers to take more informed decisions, giving them knowledge about the underlying structure of their systems, and about how their actions impact the system and results. Additionally, the model is able to help high level decision makers to think about different ways to enable governmental organisations to enhance the accessibility of their eGovernment websites and in finding more efficient policies. Generally users

of this model will be able to conduct what-if scenarios to test the impact of different proposed solutions on accessibility.

The remainder of this paper is organised as follows: The first section gives a brief introduction to SD. The second section outlines the sources of information used. The third section explores the background and the structure of SD model sectors, in addition to the behaviour of the model application to two different Norwegian municipalities. Finally, the paper concludes.

G.2 System Dynamics

SD is a methodology to build simulation models using computers, to study the behaviour of systems [10], [11]. It is an application of Servomechanism or Information Feedback Systems Theory [11] to almost all kinds of social systems. Like any mathematical modelling methodology [12], SD is an abstraction of the reality into a system of mathematical equations, specifically a system of simultaneous non-linear first order differential equations.

SD classifies variables of a system into merely two main types of variables; the first type is called *Flow* or *Rate*, which accumulates or depletes the other type called *Stock* or *Level* over time. In mathematical notation, a Stock is the integration of a Flow over time, i.e.:

$$Stock = \int_{t_0}^{t} Flow \cdot dt + Stock_0$$

t is time. $Stock_0$ and t_0 are initial values of $Stock$ and t respectively.

Auxiliary variable is another type of variables that may exist in SD model, and contains additional algebraic expressions needed to compute the flows from the other variables in the model. Constants or Parameters may be used in the SD model as well.

Stock and Flow diagram is a graphical representation of SD model. Stocks are distinguished from other variables with rectangles around them. In addition, there are two types of connectors to define relationships between variables, single and double lined arrows to denote information flows and material flows (tangible substances) respectively.

To familiarise the reader with Stock and Flow diagram conventions, Figure G-1 shows a simplification of population dynamics model adapted from [10]. In this model, a *population* stock is increased by a flow of births controlled by *birth rate*, and decreased

by another flow of deaths controlled by *death rate*.[158] Furthermore, two information connectors pass the value of population stock and the environment *carrying capacity* (constant in the model) to an auxiliary variable called *population relative to carrying capacity*. This auxiliary limited by *maximum fractional birth rate* and *minimum fractional death rate* decides the values of *fractional birth rate* and *fractional death rate* respectively. In turn, both as fractions of population determine the values of birth rate and death rate respectively.

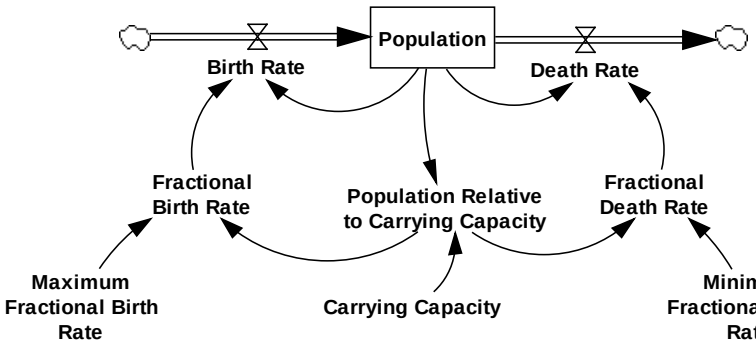

Figure G-1: Example of Stock and Flow diagram (adapted from [10])

G.3 Information Sources

The main source of information to build the model presented in this paper is a set of in-depth interviews with 7 responsible web-editors and web-masters from different Norwegian municipalities, namely: Hole, Holmestrand, Grimstad, and Trondheim municipalities.[159] Another interview was arranged afterwards with Grimstad followed by a phone meeting with Trondheim. Additionally, emails with both municipalities provided us with more information and certain data items. Furthermore, additional data items could be collected from [13–15].

The interviews were accompanied by an extensive literature review on management applications from areas possessing similarities to public website development and management, such as software development, web maintenance and online community networks [10], [16–19], in addition to the SD molecules [20].

[158] A cloud denotes a source or a sink that is outside model boundaries.

[159] Trondheim is an example of a large municipality, where the number of website editors exceeds 500, while Hole, Holmestrand, and Grimstad are examples of smaller municipalities employing less than 20 active editors.

G.4 A Demonstrator SD Simulation Model of eGovernment Website Accessibility

G.4.1 Model Structure

Figure G-2 shows the Conceptual Diagram of the model. The main block is the website, in which components of webpages (articles and templates) are produced, with certain level of accessibility measured in UWEM score. This level of accessibility is affected by workforce, consultancies and technology used.

Based on this structure, the model is separated into sectors. The following subsections explore the Stock and Flow diagrams and the processes inside these sectors.

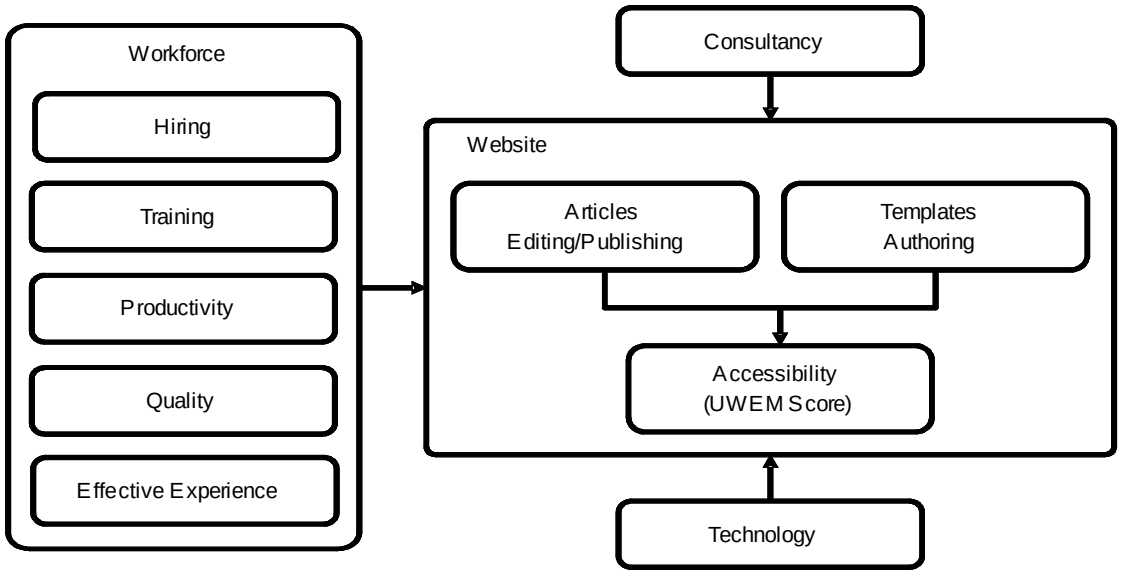

Figure G-2: Model conceptual diagram

G.4.1.1 Articles, Templates, and Accessibility Sectors

A template is the base code for an article, and together they provide the webpage displayed in the internet browser when browsing a website. Accessibility barriers can be part of the article, template, or even the CMS. In the model, the process of editing and publishing articles, and that of authoring templates are depicted in two identical sectors. Figure G-3 compiles the cause-effect relationships governing articles editing and publishing process. [160]

[160] Only one instance of identical sectors will be displayed to save space.

The required articles are edited by editors and main editors,[161] and transferred to published articles stock. Meanwhile, accessibility barriers introduced with every newly added article cause failures of UWEM accessibility tests.[162] Both articles failed tests and all applied tests are accumulated in two different stocks, in coflow dynamics with article publishing rate [17]. The published articles can go through enhancement process to remove some of their existence accessibility barriers.[163]

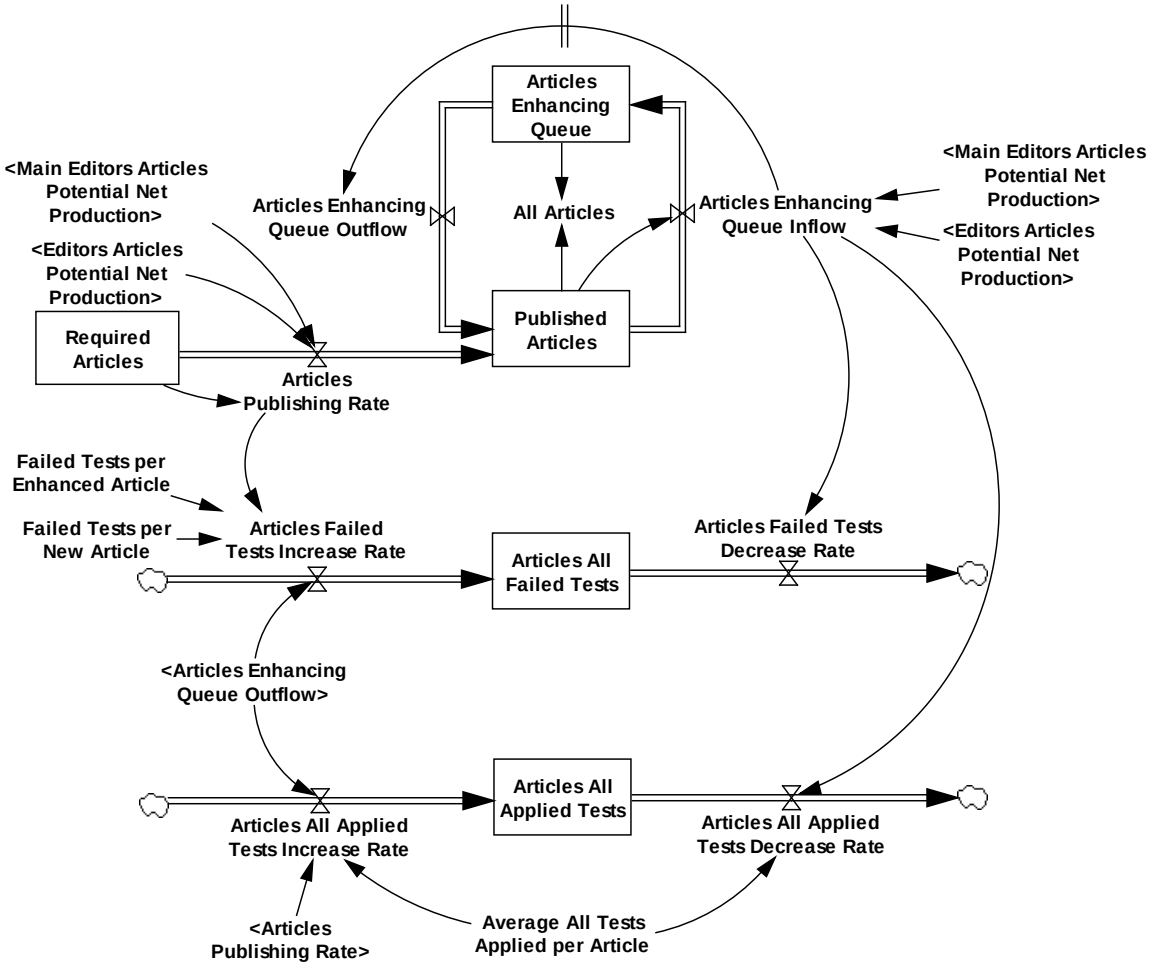

Figure G-3: Dynamics of articles editing/publishing process

UWEM tests can detect barriers in articles, templates, or barriers caused by CMS limitations. In order to compute the values of failed tests and all applied tests related to article, template, and CMS, we need to classify the applied UWEM tests according to their most frequent source of failure. Therefore, we have inspected 3 to 5 randomly se-

[161] Different types of web-editors; refer to Workforce Sector subsection.

[162] Only the set of fully automated UWEM tests are considered in the model.

[163] Templates are authored and can be enhanced by vendors' developers. However in certain municipalities, main editors are able to author templates too e.g. Hole municipality.

lected webpages from 7 Norwegian municipalities as an example,[164] with the help of eGovMon page checker.[165] Based on these inspections, barriers were classified to be related to either articles or templates and CMS. However, these inspection results were not very satisfactory. Obviously the number of inspected pages was too few, in addition to the human error in classification.

For a better classification, we have administered a 7-points Likert-Type scale questionnaire to eGovMon project team experts on the former results [21].[166] In addition, the questionnaire contained objective and subjective measures of expertise of the respondent [22]. These two measures of expertise were used as weights to the responses of the respective respondent following the practice of [22].

Classifying tests failures to CMS limitations requires very thorough knowledge about the CMS. Furthermore, in Norway there are about 57 different CMSs in use [13]. Consequently, the tests failure due to CMS was not part of the questionnaire. However, classification was merely possible in the case of EPiServer™ CMS, because of the existence of a report evaluating EPiServer™ compliance to WCAG 1.0 and ATAG 1.0 [23], which we used in the final classification as our best guess.

The database of eGovMon project [5] keeps records of the barriers identified in the websites of Norwegian municipalities.[167] We have used the final tests failure sources classification criterion with the data extracted from this database to compute values of averages of failed and all applied tests related to articles, templates and CMS separately, which were used afterwards in tuning the model.

Lastly, in the accessibility sector of the model, the UWEM score is calculated as the summation of averages of failed test due to articles, templates, and CMS divided by the summation of averages of all test applied to articles, templates, and CMS [3].

G.4.1.2 Workforce Sector

Editors and main editors are the workforce responsible for editing the webpages and publishing them on the municipal website. They have varying levels of experience; accordingly their productivity and the accessibility of the webpages they edit vary too. The main editors are more experienced and qualified, so that in general their task is to

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[164] Classification would have been easier if we had access to templates.

[165] http://accessibility.egovmon.no/en/pagecheck

[166] Midpoint was removed to have respondents to choose one side (agree or disagree).

[167] eGovMon tool tests webpages of Norwegian public websites against the set of fully automated UWEM tests.

supervise and train the editors. The dynamics of website workforce depicted in Figure G-4 is very similar to workforce dynamics presented in [10], [16], [17].

The main editor job requires qualified people who have certain knowledge about web editing and management. They are hired and leave through a normal hiring process, for example advertising a vacancy. The required number of main editors is decided by the municipality based on needs. In the model, the average hiring or firing time constant equals 11 weeks, which is the average of hiring period suggested in [17] for a senior technical person, and 1 month firing notice. In general, civil servants leave rate is from 5% to 10% [17]. However, through the interviews it was clear that main editors are not changing jobs very often.

Editors are workforce from different municipal departments who have been trained to be web-editors. The policy –especially in big municipalities– is to have at least two or more editors in a department, so that at least an editor capable of publishing material related to that department is available all the time. Furthermore, editors will not be busy with the website all the time. They work in the website as part-timers, while they are still working in their original jobs in the same department with reduced percentages.

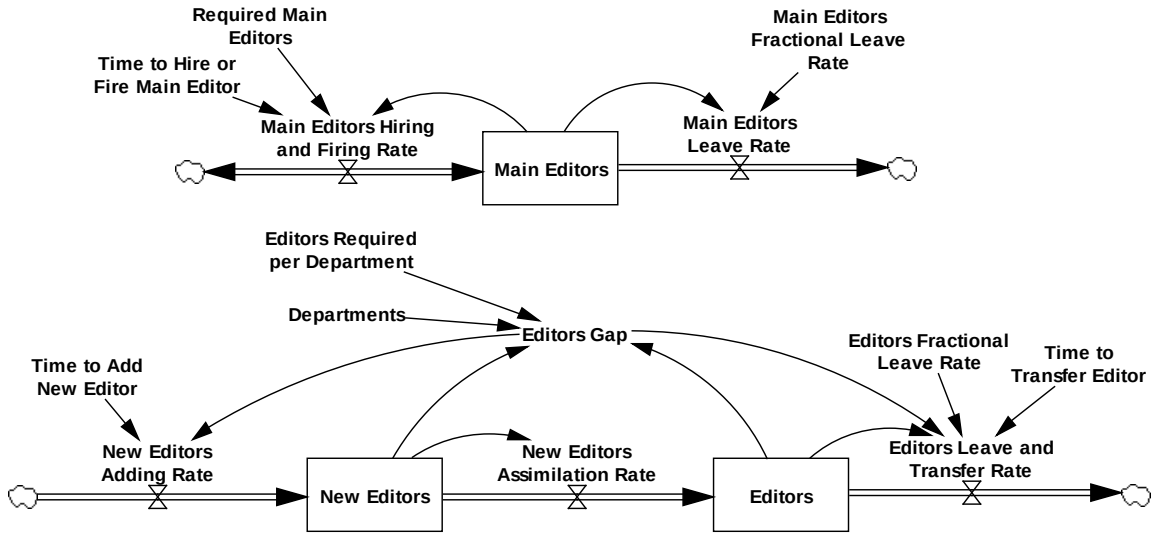

Figure G-4: Website workforce dynamics

It was obvious through the interviews that any employee who is capable of using internet and computers will be qualified to be an editor. Consequently, their hiring process is just controlled by the availability of qualified employees in a department. Also, they will leave normally, or by being transferred to another work or department whenever not needed anymore. Therefore, the time constant to add or transfer an editor is kept as short as 1 week. Moreover, in the interviews, it was very clear that editors leaving rate

is much higher than main editors'. Although in the normal case the leave rate would equal 10% [17].

The editors gap can be positive or negative according to the management policy. When the editors gap is positive implying that the required editors are more than both available editors and new editors –newly recruited editors– together, only new editors adding rate will have a positive value to close the gap. On the contrary, when the gap is negative, referring to excess of editors and new editors together, editors leave and transfer rate will have a positive value. Additionally, new editors need assimilation period before they are capable working editors. Assimilation period includes training by a main editors who have to undertake such training beside other original tasks [16], [17].

Moreover, at least one main editor should be supervising and responding to questions of editors in certain department, constituting staff communication overhead inside this department. This overhead is calculated in the model using SD graphical function version of Brooks' Law [16], [17], however taking team partitioning into consideration [17]. Generally, as received through the interviews, editors from one department don't need to interact with editors from other departments to publish articles.

Editors and main editors overall potential net production is computed by subtracting all the overheads from the overall productivity, taking time fractions dedicated to website into consideration. Furthermore, main editors will divide their time between article production and template production according to management decision too.

G.4.1.3 Training Sector

Both editors and main editors can take training to enhance their performance. According to the interviews, twice or thrice annually, training editors is provided to groups of around 20 for 3 to 5 hours sessions. In other cases main editors take training supplied by the CMS vendor. Unfortunately, training editors –especially those recently hired– is limited to providing knowledge about how to edit and publish an article using the publishing tools. Therefore, editors hardly know about HTML. Even though HTML is the language of the techniques provided by the World Wide Web Consortium W3C to ensure that webpages conform to their WCAG (1.0 or 2.0) [24].

According to experts, examples of the positive effect of HTML knowledge on website accessibility exist. Our interviews results are consistent with that. Out of the interviewed municipalities, only the workforce in Hole municipality has good knowledge of HTML and WCAG, which enables them not only to edit/publish articles but also create templates. This knowledge is reflected in their successful current and historical ranks in the annual public websites assessments by DIFI [7].

In the model, training is suggested for both editors and main editors (separately in articles and templates). Decision switches are provided to enable or disable each type. Training duration, frequency per year, and fraction of employees to be trained are left to model user too.

G.4.1.4 Effective Experience Sector

Workforce effective experiences is measured in weeks person [10]. The model accumulates all effective experiences of all editors and of all main editors (separately in articles and templates) in different stocks, similar to the structure shown in Figure G-5.

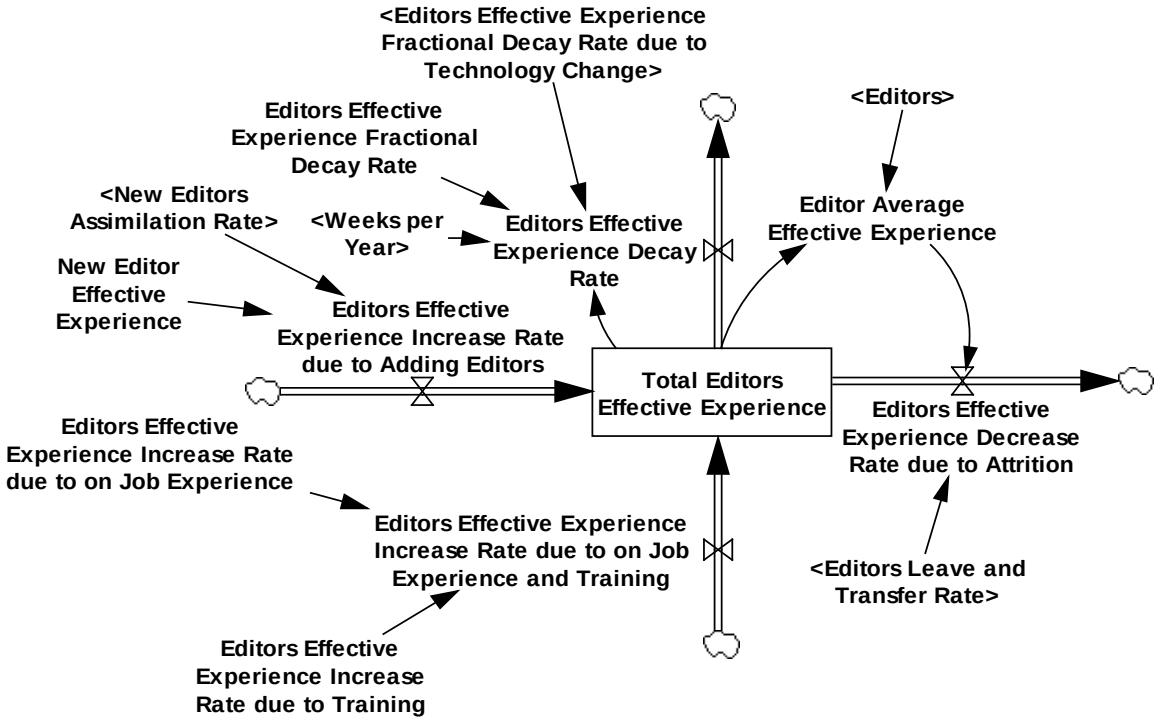

Figure G-5: Editors effective experience

Effective experience stocks are increased by hiring new workforce member and decreased by attrition. Furthermore, these stocks are increased by on job experience and training. The effective experience increase rate due to training value was estimated so that 1 day of training would cause an average of 9% increase in both productivity and quality as estimated in [25]. In general, the effective experience is decreased by regular experience decay rate which equals 10% annually as suggested in [10]. In this sector, the rest of the parameters were arbitrary chosen to reproduce the UWEM score historical data and number of webpages in the website.

G.4.1.5 Workforce Productivity and Work Quality Sector

Editors and main editors effective experience (both in articles and templates separately) affect the productivity and quality of the editors and main editors (both in articles and templates separately) respectively. Non-linear SD graphical functions for both productivity quality were adapted from the productivity and quality SD molecules [20].

G.4.1.6 Consultancies Sector

Municipalities consult their vendors or experts to solve their websites accessibility issues. Anecdotal evidence indicates that just before the annual public websites assessments by DIFI, some municipalities rush to consult their vendors to fix website problems, aiming at getting a better ranking. This is very obvious in the historical data chosen to calibrate the model in the model testing and validation section; which can be seen in Figure G-7.

In the model, a decision switch is provided to control the consultancy process. Moreover, consultancy start time and duration are provided in addition to consultancy frequency per year. In reality not all the consultancy time is devoted to solve accessibility issues in templates, so that the model is equipped with another decision variable to control the consultancy time fraction that will be dedicated to templates and templates enhancement in terms of accessibility.

G.4.1.7 Technology Sector

Updating the technology or the tool used to build and publish the website, enables the website to satisfy its users' evolving needs, as well as comply with the up-to-date IT security requirements. Furthermore, experts in the accessibility field claim that using the appropriate web technology greatly affects accessibility.

The technology update process is reflected in the model as a decision switch that is provided to enable the technology update, in addition to the possibility of choosing the time to start the process. The primary expected effect from updating the technology is removing the barriers related to the CMS totally. However as a side effect, this will disturb the editors' and main editors' learning curves. This was incorporated in the model through decreasing the effective experience steeply, to reproduce behaviour similar to [26].

G.4.1.8 Costs Sector

The accessibility related spending on wages, training, consultancies, and technology update, in addition to the overall spending are calculated for the whole simulation period and for every quarter separately as well.

G.4.1.9 Interactive Learning Environment

The model's ILE has a control panel and a set of dashboards. The control panel contains a set of *slider controls* to enable ILE users to test different what-if scenarios, by changing the parameters of workforce time management, human resources, training of editors and main editors, consultancies, and technology update. The set of dashboards displays graphs depicting results of different scenarios over time. Parts of the ILE are shown in Figure G-6.

The model is licensed under a *Creative Commons Attribution Share-Alike* license, and can be found at:

http://forio.com/simulate/ahmedg/accessibility-of-norwegian-municipalities-websites-a-decision-support-tool

G.4.2 Model Testing and Results

To validate this model, we have used the set of tests suggested in [10]. *Boundary Adequacy* was tested through presenting the model to experts in website accessibility in at least four different occasions related to the eGovMon project. In addition to being presented to representative from municipalities that were involved in the in-depth interviews after giving a brief introduction on Stock and Flow diagrams in all cases. *Structure Assessment* test was conducted through exposing the model in different development stages to criticism by experts in SD in two different occasions.

Dimensional Consistency was fully assured using the unit check feature of Vensim DSS SD software package [27]. While for the *Parameter Assessment*, Matlab numerical computing environment was used to analyse the data retrieved from the eGovMon. Furthermore, we used parameter values whenever available from the municipalities. Other parameters were taken from different text books and published papers. Finally, the rest of the parameters were estimated to tune the results to historical data when the model was fed with data from Grimstad and Trondheim municipalities.

The model has been tested under *Extreme Conditions*, and problems were taken care for manually using Vensim DSS. The model was tested for *Integration Error* and a suitable time step was used.

Sensitivity Analysis was applied using Vensim DSS. The results were totally agreeing with experts' claims and DIFI's [13]. *Behaviour Reproduction* and *Family Member* was both tested using data from Grimstad and Trondheim municipalities, as shown in Figure G-7.

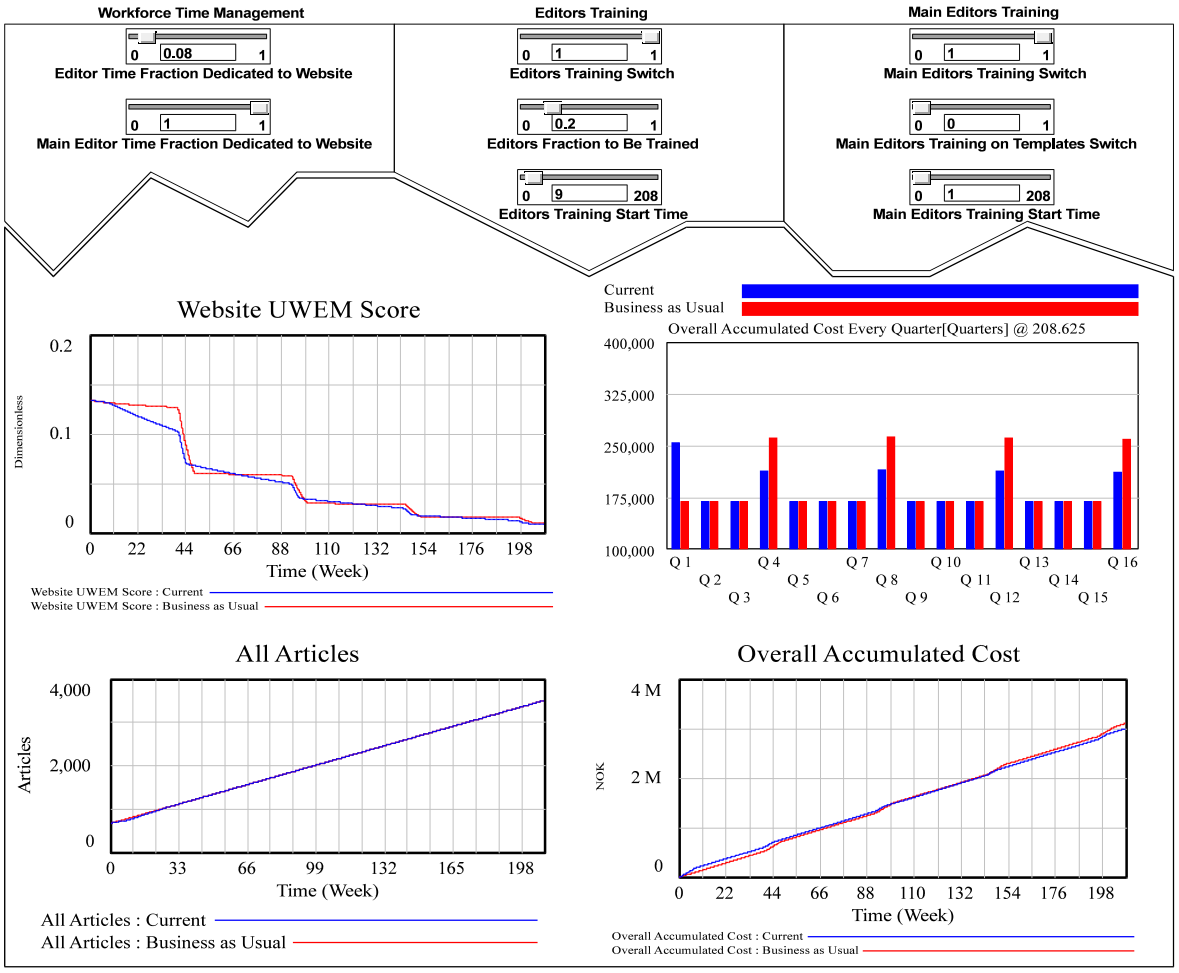

Figure G-6: Parts of the control panel and dashboard of the demonstrator

Nevertheless even after all the precautions that have been taken to guarantee validity of the model, it is still prone to certain validity threats [28]. From *Population Validity* point of view, the interviewed municipalities are few, although they range in size suitably.[168] From *Ecological Validity* point of view, time is a very important factor especially that technology in such a field is changing fast. Furthermore, depending only on the known issues of EPiServer CMS is a very limiting factor.

[168] From population point of view: Trondheim is one of the big 10, Grimstad is more than 10,000 inhabitants, while Hole and Holmestrand are less than 10,000 inhabitants [13].

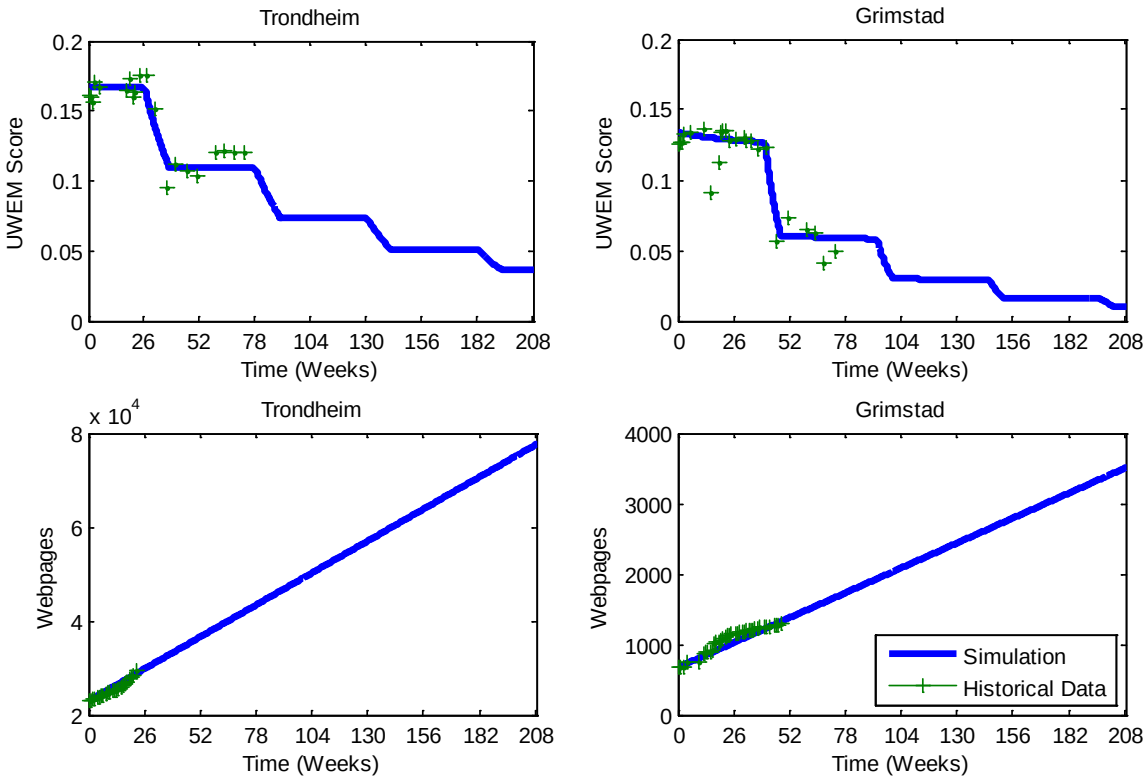

Figure G-7: Model behaviour for Grimstad and Trondheim municipalities

G.5 Conclusion

To conclude, the presented demonstrator SD model incorporates the effects of managerial decisions on the accessibility of Norwegian municipal websites. It is intended to help public websites managers in taking more informed decisions, and to give them knowledge about the underlying structure of their systems. Also, the demonstrator SD model is able to help high level decision makers in finding different ways to enable public organisations to enhance accessibility of their websites.

Both managers and decision makers can use the demonstrator SD model to understand how their policies and decisions interact with the underlying structure of the system to influence system behaviour. Most importantly, the demonstrator SD model enables applying different what-if scenarios, for different sets of policies aiming at achieving optimal policy design. Finally, its easy-to-use GUI enables it to be used as ILE in addition.

G.6 Acknowledgment

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H Experimentation with a System Dynamics Based Interactive Learning Environment: A Case Study of Accessibility of Norwegian Municipalities Websites

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Abstract: *A System Dynamics (SD) simulation model including factors affecting the accessibility of Norwegian municipal websites was encapsulated in an Interactive Learning Environment (ILE). Accessibility is an important aspect of websites generally and public websites particularly. Many ways could be proposed to enhance accessibility, however the impact of selected actions is hard to predict due to diversification and contradiction, in addition to the existence of the time factor. As the SD model promised to be able to change how users think and take decisions, this ILE was tested by users in an experiment. We have conducted α, β, and γ change analysis on the results of this experiment. Results showed that the ILE was successful in changing 50% of its users' understanding and perceptions about the system's causal relations and policy options, and helping 30% redefining the standards they use to assess or evaluate these relations and policy options.*

Keywords: Experimental Design; Alpha, Beta, Gamma Analysis; Accessibility; System Dynamics; Municipal Websites; Interactive Learning Environment

H.1 Introduction

Accessibility of a website refers to the ability of all people to use a website irrespective of their disabilities or the client devices they use to access the Internet [1]. Accessibility is an important aspect of websites in general and of public websites in particular, to be able to serve all citizens equally. For example if a webpage is designed to retrieve user input solely via mouse clicks, people with disabilities preventing them from using a mouse, or people using mobile phones will not be able to use this webpage.

Accessibility of a website can be assessed in terms of compliance with a set of accessibility metrics defined by guidelines like WCAG 2.0 [1] and ISO 9241-20 [2]. It may be evaluated quantitatively such as site score defined in [3]. For more information see [4]. Many studies and projects have addressed evaluation of public websites accessibility, for instance [5], [6]. In addition, governments carry out benchmarking and pass laws to

increase public websites accessibility. In Norway, the Agency for Public Management and eGovernment (DIFI) used to evaluate governmental websites annually [7]. For a long period, accessibility was one of three indicators used to be measured by DIFI to encourage governmental agencies to enhance the accessibility of their websites.

A public website, as an Information System, consists of people (like web-masters, editors, developers, etc.) and procedures, besides telecommunications, hardware, software, and data [8]–[10]. When considering the management process and the people component, many ways could be proposed to enhance its accessibility like consulting experts, replace the Content Management System (CMS), recruiting, and training. The expected impact of these measures ranges from slow to fast, cheap to expensive, and short-term to long-term. These diversifications and contradictions, in addition to the existence of the time factor make the decision of adopting only one way to do the task a challenge. More challenging is how to prioritise limited resources to achieve the best effect on accessibility. A simulation model is a very efficient tool that can be employed to deal with such a situation [11]–[15].

Based on the results retrieved from a set of semi-structured personal interviews with web-masters and editors from different Norwegian municipalities, Abdelgawad, Snaprud, and Krogstie [16] identified various factors and causal relations governing the processes having an impact on accessibility of Norwegian municipal websites, and compiled these relations into a System Dynamics (SD) simulation model titled "eAccessibility of Norwegian Municipalities Websites".[169] This model is intended to work as a decision support tool by helping eGovernment websites' managers to take informed decisions, and decision-makers to find policies that enable governmental organisations to enhance their websites' accessibility.

From another angle, the model is supposed to be able to change how its users think and take decisions. It is allegedly capable of changing their understanding and perceptions about the system's causal relations and policy options, in other words changing their mental models which are the ways they perceive the system. It is more likely that mental models are the basis of the decision taken by managers or decision makers more than the reality of their system [15].

[169] The model is licensed under a Creative Commons Attribution Share Alike license, and available at: http://forio.com/simulate/ahmedg/accessibility-of-norwegian-municipalities-websites-a-decision-support-tool/model/

In this paper, the major problem and consequently the research question we are interested in answering is whether or not this model is really capable of changing its users' understanding and perceptions about the system's causal relations and policy options as it promises. We hypothesise that if the model is capable of doing this, then we can expect that the model can serve as a mean for the websites' managers and decision-makers to take more informed decisions.

To answer this question, we have updated the SD model, developed an Interactive Learning Environment (ILE) to be an interface for the model. Further, we have prepared an online questionnaire tool, and conducted an experiment with users to understand the effect of using the ILE and accordingly the model on them.

The remainder of this paper is organised as follows: the next section will describe the ILE developed for this research. In addition, it will provide a detailed description of the procedure followed to conduct the experiment, including the analysis method. The section that follows will explore and discuss the results of the experiment. The last section concludes the paper.

H.2 Research Methodology

H.2.1 System Dynamics based ILE

An ILE is "software for educational purposes, for supporting the process of learning, where the focus is on learning through the interaction with the computer (human-computer interactivity)" [15]. Our ILE is based on an SD model as its core. Different literature refers to an ILE as management flight-simulator, microworld, business simulator, management simulator, etc. based on certain differences [17], [18]. However, in this paper, we do not differentiate between these terms.

A mental model, in general, could be defined as "a construct of cognitive psychology. Mental models are internal representations of conceptual and causal interrelations among elements that people use to understand phenomena" [19]. The mental model in the SD context is a special case of the mental model, distinguished by the closed-loop concept and being more comprehensive [19]. Davidsen in [20] identified two purposes for developing SD based ILE in general. They aim at either changing their users' mental models for educational purposes, or identifying their users' mental models for research and validation purposes. Our ILE is developed mainly for educational purposes. We have developed it focusing on enhancing its users' mental models.

We have developed a generic reusable ILE framework as a base to develop our ILE. This generic framework can be used by others to develop their ILEs. The ILE frame-

work is web-based. It was built using *Forio.com Epicenter*.[170] The selection of Epicenter, in addition to providing a free service plan, was its capability to directly interface our SD model format,[171] and build a Graphical User Interface (GUI) for the ILE using web technologies HTML, CSS, and JavaScript.

Furthermore, we have used PHP and MySQL to log the users' interactions with the ILE. We wanted to record all policy options chosen by the users while using the ILE, in addition to the outcomes resulting from these choices. Figure H-1 shows the full ILE framework, including an online questionnaire tool that was prepared to deploy a set of questionnaires we prepared to test the ILE effect, as we will show later. We opted for an open source PHP-based tool called Limesurvey.[172] The following two subsections give more details about the client-side and the server-side of the framework.

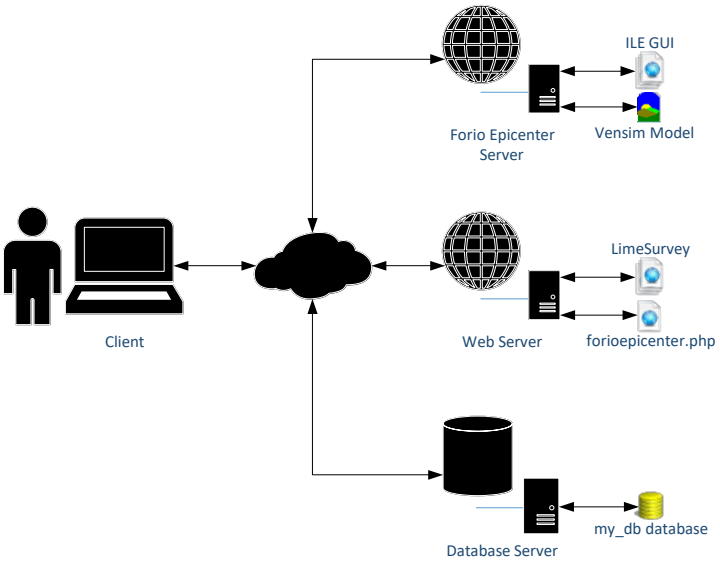

Figure H-1: ILE Architecture

H.2.1.1 Client-Side

The GUI of our ILE was coded using web technologies[173] based on Epicenter as mentioned before. Epicenter is a very powerful tool, having all what is needed to build an ILE. Nevertheless for our interface charts, we have replaced Forio's Polymer-based[174] charts with our JavaScript charts. Our JavaScript code for charts is still based on

[170] Forio's 3rd generation platform for simulation, modelling, and analytics. Available at: http://forio.com

[171] We use Vensim SD modelling software package (http://vensim.com/).

[172] https://www.limesurvey.org

[173] The GUI code is based on Bootstrap (http://v4-alpha.getbootstrap.com/getting-started/accessibility/), and has been adapted to assure accessibility as far as possible.

[174] https://www.polymer-project.org

Forio's charts code, and uses the same powerful open source Forio's Contour library,[175] but in addition, it is capable of showing the results of several scenarios on the same chart.[176] This way the users are able to compare the consequences of different policies. Our JavaScript code for charts is generic, so that others can use it in building their ILEs.

We have used the best practices presented in Sterman [21], [22] to design our ILE's GUI. This GUI has four tabs: Home, Instructions, Control Panel, and Dashboard shown in Figure H-2, Figure H-3, Figure H-4, and Figure H-5 respectively. The Home tab gives a brief introduction to the topic of the ILE, including basic knowledge about website's accessibility and policy options. The Instructions tab puts the user in the context of using the ILE, including specific instructions to guide her/him through the simulation or gameplay. The Control Panel tab has all policy options provided by the ILE to control the simulation, in addition to simulation time progress buttons.

The simulation starts at year 0 and can be progressed year by year or to the end of the simulation at year 6. In the Control Panel, the user can reset the simulation and start a new scenario from the beginning, whether the current scenario reached the sixth year or not. Policy options available are represented by graphical control elements for managing workforce, managing workforce time, training workforce, consulting vendor and upgrading website technology (CMS), for further information on policy options see [23], [16]. The Dashboard tab has charts showing over time behaviour of important simulation variables, needed by the user to stand on the results reflected by her/his policies entered to the Control Panel.[177]

In the first version of the model which we described in [16], we used the "Unified Web Evaluation Methodology (UWEM) score" as an indicator of website accessibility. However, in the second version, which we used inside this ILE described in this paper, the "UWEM score" was replaced with "Site Score" as defined in [3]. This "Site Score" was implemented in the model, and shown on the charts and ILE interface under the name "Website Accessibility Indicator".

[175] https://github.com/forio/contour

[176] The JavaScript file is available at:
https://forio.com/app/ahmedg/eaccessibility/elements/contour-chart.js

[177] The ILE is available at:
https://forio.com/app/ahmedg/eaccessibility/eaccessibility.html

H.2.1.2 Server-Side

The ILE is fully functioning by using solely the client-side, yet, as mentioned above, we wanted to log users' interactions with the ILE, i.e. record the decisions they take, and their results. To accomplish such a task, Epicenter uses Node.js[178] for client-server communications, which then could be logged to a database; however this is limited to paid subscribers. We wanted to have a generic framework that could be used by everyone.

To log users' interactions, we have developed reusable JavaScript snippets[179] and added them to all decision control elements (representing the policy options available by the SD model) and charts available on the client-side GUI. These JavaScript snippets communicate with a PHP file called "forioepicenter.php".[180] We have developed this PHP code to save the values sent by the GUI to MySQL database.[181] Both "forioepicenter.php" and MySQL database were hosted on one of the university servers. [182]

H.2.2 Experimental Procedure

We have conducted our experiment with volunteer students at the University of Agder, on the 8th of September 2015. A couple of weeks earlier we started spreading the invitation for a gameplay session with free pizza in Grimstad campus. In the day of the experiment 17 students showed up. Some faced technical troubles with the experimentation system, and by the end we could extract 12 useful finished surveys. Properties of the participants are presented in Table H-1.

Table H-1: Participants whose Results Were Accepted

Property	Value	%
Age Group	18-24	67%
	25-34	25%
	35-44	8%

[178] https://nodejs.org

[179] The snippets are available inside HTML of the ILE. It could be shown by viewing the page source using any web browser. Furthermore, we have made these snippets generic, and marked them by HTML comment "<!--begin " and "<!--end ", to be easily copied to any other ILE.

[180] forioepicenter.php can be deployed to any server/web hotel supporting PHP. We made it available at:
https://forio.com/app/ahmedg/eparticipation/helper/forioepicenter.php

[181] MySQL database tables needed by forioepicenter.php, can be reproduced at any MySQL using my_db.sql which we made available at:
https://forio.com/app/ahmedg/eaccessibility/helper/my_db.sql

[182] The experiment was conducted at University of Agder.

Property	Value	%
Gender	Male	67%
	Female	33%
Field of Study/Work (specialisation)	ICT	92%
	Mechatronics	8%
Knowledge of Math Modelling	Yes	25%
Knowledge of System Thinking/Dynamics	Yes	17%

The whole experiment session took one hour. For 20 minutes, the experiment supervisor gave a presentation to introduce the topic and the ILE to the participants. The presentation included the terms the participants would experience during the intervention using the ILE. By the end of the presentation, the participants were instructed to connect to the Limesurvey server prepared earlier via their web browsers. In addition to the free pizza that was promised to everyone, the two highest-performing participants were promised a piece of Egyptian pharaonic collectable each.

The testing session started for everyone by answering a pre-test questionnaire. The pre-test questionnaire consists of 10 Likert 5-point scale items (strongly disagree, disagree, neutral, agree, or strongly agree). These Likert items constitute multiple-item scale unidimensional construct as described in [24], designed to test the participants' knowledge about the dynamics of the system in terms of it causal relations and possible policy options.

To build the statements of these Likert items, we have enumerated all model variables affecting the municipal website accessibility. Possible changes in the values of these variables (increase in, decrease in) were combined with different possible resulted changes on the municipal website accessibility (for example: increase after short delay, no effect, immediate decrease, etc.). The final combinations were compiled into full statements about the system, and then ordered according to their importance based on our knowledge of the system, what we wanted to show and test, and how much they are clear while using the ILE. Further, to suit the experiment duration, only 10 of these statements were selected for our Likert items, keeping a balance between reversed and non-reversed statements, and mostly following the recommendations stated in [25]. Finally we polished the wording of the final statements, for example, participants were

asked to report their level of agreement or disagreement with this statement "Upgrading CMS takes long time to show an effect on the value of website accessibility".[183]

The Pre-test questionnaire was supposed to take no more than five minutes; nevertheless it was left to the participants to take as much time as they need. The participants were informed that they can ask the supervisor for help at any time; however we abstained from providing any help that could lead to biases in their answers.

The intervention using the ILE or the gameplay started as the participant ended the Pre-test questionnaire, without the option of going back to the Pre-test questionnaire. The gameplay was limited to 25 minutes. Afterwards all participants were directed automatically to the post-test questionnaire, without the option of going back to the intervention session. This way we were sure that all participants had not used the ILE for more than the designated duration.

The Post-test questionnaire contained exactly the same Likert items used in the Pre-test questionnaire, however after answering how she/he thinks now about each statement after the gameplay, the participant was asked to think back in time before the gameplay, and report how much she/he agreed or disagreed with the same statement based on her /his new understanding. This is called the Retrospective Pre-test or the Then-test [26]. It is very common that participants change their understanding between the Pre-test and the Post-test [27]. The Then-test gives the participant the opportunity to re-answer the Pre-test based on her/his new understanding/ perception after the intervention. In this case, the Post-test and the Then-test have the same base frame of reference [27].

H.2.2.1 α, β, and γ Change

Different SD literature presented methods to measure changes in mental models, or to compare them, for example [28]–[32]. These methods either need a human rater, or require the test subjects to have prior knowledge about certain knowledge elicitation tools, for example, the Causal Loop Diagram. We were interested in a method free from these requirements. Human raters might cause experimenter bias [33], while there was no guarantee that our experiment subjects would have enough knowledge about any knowledge elicitation tools.

In 1976, Golembiewski *et al.* in [34] distinguished between three different types of attitude change as a result of an intervention, namely α, β, and γ. α change refers to an ab-

[183] All the Likert statements are available at: https://forio.com/app/ahmedg/eaccessibility/helper/questionnaires.txt

solute quantitative change [35]. For example, a website manager might "agree" that "Upgrading CMS takes long time to show an effect on the value of website accessibility". After the intervention, this person's level of agreement about the same statement increases to "strongly agree". This is a real change in her/his opinion on a fixed measurement scale, or α change.

β change refers to a measurement scale intervals recalibration, i.e. a redefinition in the measurement standards. For example, a website manager has certain understanding of the values of different agreement levels (strongly disagree, disagree … etc.) regarding the same claim mentioned above "Upgrading CMS takes long time to show an effect on the value of website accessibility". Based on her/his understanding, this website manager indicates that she/he "strongly agrees" with that claim. After the intervention, this website manager finds out that what she/he used to interpret as "strongly agree" means just "agree". Consequently his answer to such a claim would change, although this does not reflect any change in her/his opinion. This is a change in the measurement continuum, or a change in the measurement standard/scale, or β change.

γ change refers to a conceptual change, i.e. a redefinition of the measurement construct [34]. For example, a website manager might have no idea that "Upgrading CMS takes long time to show an effect on the value of website quality" or about that upgrading CMS has any effect on website accessibility at all. After the intervention, this website manager was provided with an understanding of the importance and possible effect of upgrading CMS, i.e. a new conceptual frame of reference, which causes a meaningful answer based on this new understanding, or γ change.

Many methods to assess α, β, and γ changes appeared since 1976, including the method suggested by Golembiewski and his colleagues. According to a comprehensive literature review conducted by Riordan *et al.* [35], there are five major methods to detect α, β, and γ changes:

- Ahmavaara's technique [34]
- Actual-ideal difference measures [36]
- Retrospective accounts [37]
- Confirmatory factor analysis [38]
- Latent growth modelling [39]

Our expectation of the number of the participants volunteering to our experiment was very modest, because of limited participants' availability as well as financial support. Based on that, we have opted for using the Retrospective accounts method, as it is the only method that doesn't require a large sample, in addition to that it can test for α, β, and γ change independently [35]. It is worth mentioning that although we are not aware of any application of this method in assessing SD based ILE effect, using this specific method for that purpose was suggested by Friedman, Cavaleri, and Raphael [40].

H.2.2.2 Retrospective Accounts

As the Post-test and the Then-test questionnaires are answered based on the same understanding/perception as mentioned above; the Retrospective accounts method detects α change by detecting the change between the Post-test and the Then-test. Furthermore, since the Pre-test and the Then-test are basically measuring the same thing based on either two different understandings/perceptions or two differently calibrated measurement scales, γ and β change are detected by detecting the change between the Pre-test and the Then-test [37].

Even though the Retrospective accounts method supports analysis on both group and individual levels, we have chosen to focus solely on the individual level analysis, because of the limited number of participants. After all, group change is the sum of its individuals' change. Sometimes certain individual change could be overlooked by detecting only group changes [24], [41]. Furthermore, "a large amount of change exhibited by only a few individuals may be taken as evidence that the intervention had a group effect" [24].

To apply the Retrospective accounts method to our data, we have followed the practice of Birkenbach [41] in general. Nevertheless, we have opted for following Brodersen and Thornton [24] in detecting γ change first, then remove the participants showing γ change from the process of detecting α and β. According to Porras and Singh [42], when γ change is detected, α and β detection becomes problematic.

Answers to the questionnaire items from the Pre-, the Post-, and the Then-tests of each participant were used as raw data/basic data points [42]. Consequently for every participant, we have compiled three paired samples Pre, Post, and Then. The first step in the analysis is to try detecting γ change per participant. Terborg and his colleagues [37] suggested two methods:

1. Using Correlation

For every participant, correlations between Pre & Then ($r_{\text{Pre Then}}$), Post & Pre ($r_{\text{Post Pre}}$), and Post & Then ($r_{\text{Post Then}}$) are calculated. To test for differences between $r_{\text{Post Then}}$ & $r_{\text{Pre Then}}$ and $r_{\text{Post Then}}$ & $r_{\text{Post Pre}}$, Williams's test[184] for comparing correlations of two paired/dependant

[184] To apply Williams's test to test the difference between two dependent correlations sharing one variable/two "paired" correlations, we used the R (The R project for statistical computing software environment https://www.r-project.org/) command: r.test {package: psych}. More information available at: http://www.personality-project.org/r/html/r.test.html

samples is used to calculate $t_{(r_{\text{Post Then}})(r_{\text{Pre Then}})}$ and $t_{(r_{\text{Post Then}})(r_{\text{Pre Post}})}$ respectively [24]. γ change exists if the following conditions are met:

a) $r_{\text{Post Then}}$ is substantially greater than $r_{\text{Post Pre}}$

b) $r_{\text{Post Then}}$ is substantially greater than $r_{\text{Pre Then}}$

2. Using Standard Deviation

Standard Deviations for Pre (s_{Pre}), Post (s_{Post}), and Then (s_{Then}) are calculated for every participant. Morgan-Pitman test[185] for comparing variances of two paired/dependant samples is used to calculate $t_{(s_{\text{Post}})(s_{\text{Then}})}$, $t_{(s_{\text{Pre}})(s_{\text{Then}})}$, and $t_{(s_{\text{Pre}})(s_{\text{Post}})}$. γ change exists if the following conditions are met:

a) s_{Post} is not different from s_{Then}

b) s_{Post} is different from s_{Pre}

c) s_{Then} is different from s_{Pre}

The highest level of γ change happens when both correlation and standard deviation methods to detect γ change occur concurrently [37]. If a participant doesn't show any signs of γ change, we start detecting β or α change.

To test for β or α change, mean values of Pre, Post, and Then are calculated for every participant, yielding $\overline{x}_{\text{Pre}}$, $\overline{x}_{\text{Post}}$, and $\overline{x}_{\text{Then}}$ respectively. Student's t-test[186] to compare means of two paired/dependant samples is used to calculate $t_{(\text{Then})(\text{Pre})}$ and $t_{(\text{Then})(\text{Post})}$. If $t_{(\text{Then})(\text{Post})} > t_{(\text{Then})(\text{Pre})}$, descriptively speaking, then there is more evidence of α change than β change, and vice versa [37]. Following the practice of [41], we have focused only on the size to compare $t_{(\text{Then})(\text{Pre})}$ to $t_{(\text{Then})(\text{Post})}$.

Terborg and his colleagues [37] emphasised on that t-statistics on the individual level analysis should in general be judged descriptively. Although the tests used to compute these statistics are for dependant/paired samples, which is the case, the inter-independency or independency condition inside each participant's Pre, Post, and Then samples is not met. Simply, inside each of them all data points come from the

[185] To apply Morgan-Pitman test to test for equal variance of two dependent samples, we used R command: var.test {package: PairedData}. More information available at: http://artax.karlin.mff.cuni.cz/r-help/library/PairedData/html/var.test.html

[186] To apply Student's t-test to compare means of 2 paired samples, we used R command: t.test {package: stats}. More information available at: https://stat.ethz.ch/R-manual/R-patched/library/stats/html/t.test.html

same participant [37]. For the reader's convenience, a summary of the symbols and their definitions is shown in Table H-5.

H.3 Results and Discussion

Participant P6 and P11 were removed from the analysis because of showing no variance in their Pre, Post, or Then samples. We started the analysis by detecting γ change. This was done via correlation and standard deviation comparisons as mentioned above. The left half of Table H-2 shows the needed correlation values in addition to the t-statistics calculated to compare them. The t-statistic columns at the left half of the table prove that $r_{\text{Post Then}}$ is substantially greater than both $r_{\text{Post Pre}}$ and $r_{\text{Pre Then}}$ for participants P2, P4, P5, P9, and P12, consequently detecting γ change. The t-statistics columns on the right half of the same table cannot at all prove that s_{Post} is not different from s_{Then}, while both are different from s_{Pre} for any participant, and consequently no γ change was detected based on standard deviation.

After eliminating participants showing γ change, from β and α change detection procedure, Table H-3 shows that P1, P3, and P7 have smaller values of $t_{(\text{Then})(\text{Post})}$ compared to $t_{(\text{Then})(\text{Pre})}$ denoting β change for these participants. Accordingly participants P8, and P10 have exhibited α change.

Table H-4 shows the overall α, β, and γ changes detected for all participants in comparison to their answers about mathematical modelling and system dynamics knowledge, in addition to their field of work or specialisation. We could not find any association between these variables and the detected α, β, or γ changes. The highest phi coefficient calculated was 0.29 between the mathematical modelling and the detected γ [43].

50% of the participants who were included the analysis have shown γ change, reflecting a change in their understanding and perceptions about the system's causal relations and policy options. 30% have redefined/recalibrated the standards they use to assess or evaluate these causal relations and policy options exhibiting β change. In total, 80% of the participants have redefined certain knowledge as a result of using the ILE, achieving the ILE's intended goals.

From an internal validity [33] point of view, to minimise testing validity threat, we have kept the questionnaires as merely Likert-scale items, and emphasised that there is no right or wrong answers, and participants needed to report what they think/believe. Furthermore, we made sure that all participants have fully understood questionnaire items since the pre-test, to account for any misunderstanding that could be automatically clarified during the post-test solely because of repetition. The same questionnaire

was administered during pre- and post-test sessions to account for any instrumentation validity threat. Moreover, to eliminate experimenter bias, we have chosen self-report questionnaire type, and kept the whole experiment computerised without any human rater interactions, except when help to clarify any vagueness was needed.

To account for possible history validity threat, participants were asked to report their prior knowledge of mathematical modelling and system thinking/dynamics. Furthermore, the experiment time was limited to almost one hour, eliminating maturation or mortality validity threats. We have to admit that the research suffered from selection validity threat due to the availability of participants, as previously mentioned merely 17 students participated in the experiment. Nevertheless, this was to a certain extent mitigated by the fact that participation was totally voluntary.

From external validity [44] perspective, participants were few, and limited to university students, yet they are mostly ICT students, who are expected –to some extent– to fill positions like website managers and decision-makers in the future, which are the users' positions originally targeted by the model. Other experiments with different samples are necessary. Longer periods between the pre-test, the treatment, and the post-test should be examined. Other sets of questionnaire items describing the model's causal relations and policy option should be used in other experiments.

H.4 Conclusion

Accessibility is core for delivering usable public websites. Many ways could be proposed to enhance accessibility; however the expected impact of selected actions is hard to predict due to diversification and contradiction, in addition to the existence of the time factor, which makes decision-making a challenge. An SD model includes factors affecting accessibility of eGovernment websites was encapsulated in an ILE. The model is allegedly capable of changing its users' understanding and perceptions about the system's causal relations and policy options, in other words changing their mental models. In this paper, we have answered our research question of whether or not our SD model is really capable of changing its users' understanding and perceptions. Based on the experiment results the model was capable of achieving it promised goals.

In an experimental setting, the ILE was tested with users. We have applied α, β, and γ change analysis on the individual level to the results of this experiment. The results were that the ILE/model was successful in changing its users' understanding and perceptions about the system's causal relations and policy options 50% of the time, and helping them in redefining the standards they use to assess or evaluate these relations and policy options 30% of the time. In total, 80% of ILE users have redefined certain

knowledge as a result of using it, achieving the ILE's intended goals, and answering our research question, provided that we could not find any evidence of the effect of the ILE users' prior knowledge or backgrounds on their ILE results. Based on these results, we recommend using the ILE/model in educating websites managers and decision-makers about their systems.

In this paper we have also provided a methodological contribution. We have developed a generic reusable ILE framework, and provided instructions on how it could be used by others in creating their ILEs. Furthermore, we have adapted the α, β, and γ change typology and the retrospective accounts method to test the effect of using an ILE on its users. We have also introduced our suggested approach to create the questionnaires needed to apply the α, β, and γ change and the retrospective accounts method in testing an ILE effect on its users, as well as our suggested steps and statistical tests needed in conducting the statistical analysis for the retrospective accounts method.

Finally, applying α, β, and γ change analysis to test the effect of using SD based ILE was easy and straight forward. However, more experimentation with larger samples, ideally including control groups, to test for group changes in addition to individual changes, over longer time spans, and longer questionnaire seems to be a very promising and highly recommended future research. Furthermore, comparing the α, β, and γ change results with results from other mental model change measurement methods more common among SD practitioners is a very important validation requirement for the method in the SD field.

H.5 Acknowledgement

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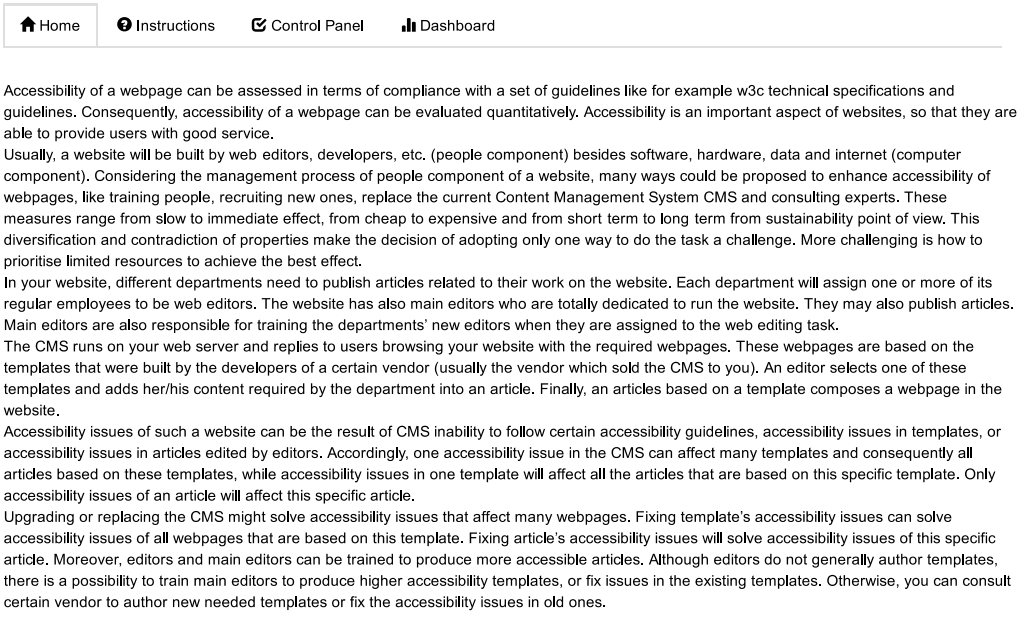

Figure H-2: ILE Home tab

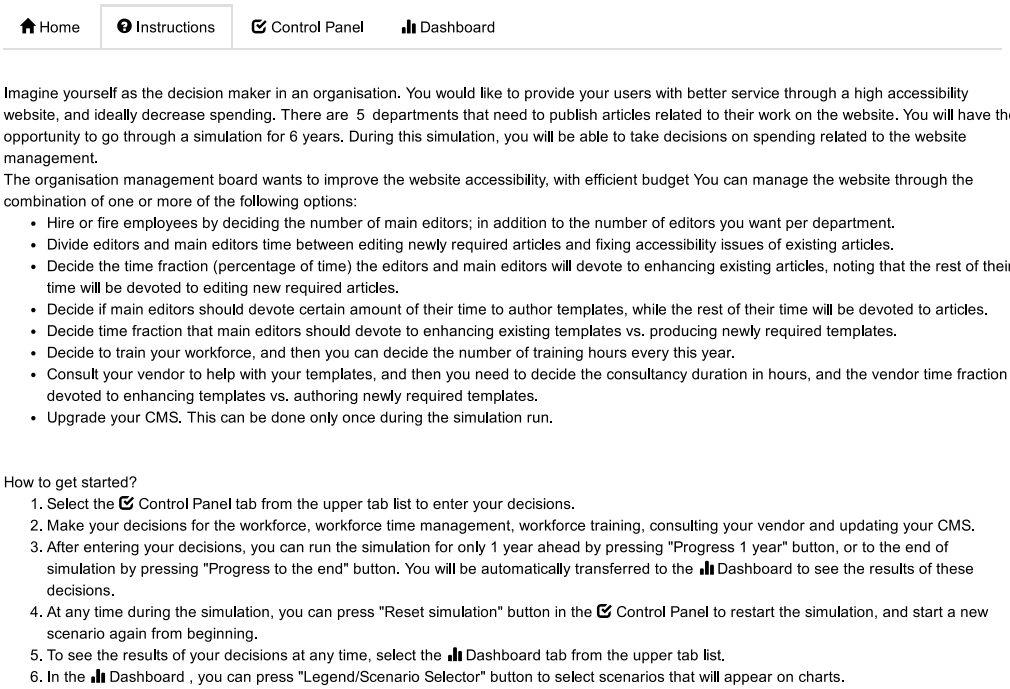

Figure H-3: ILE Instructions tab

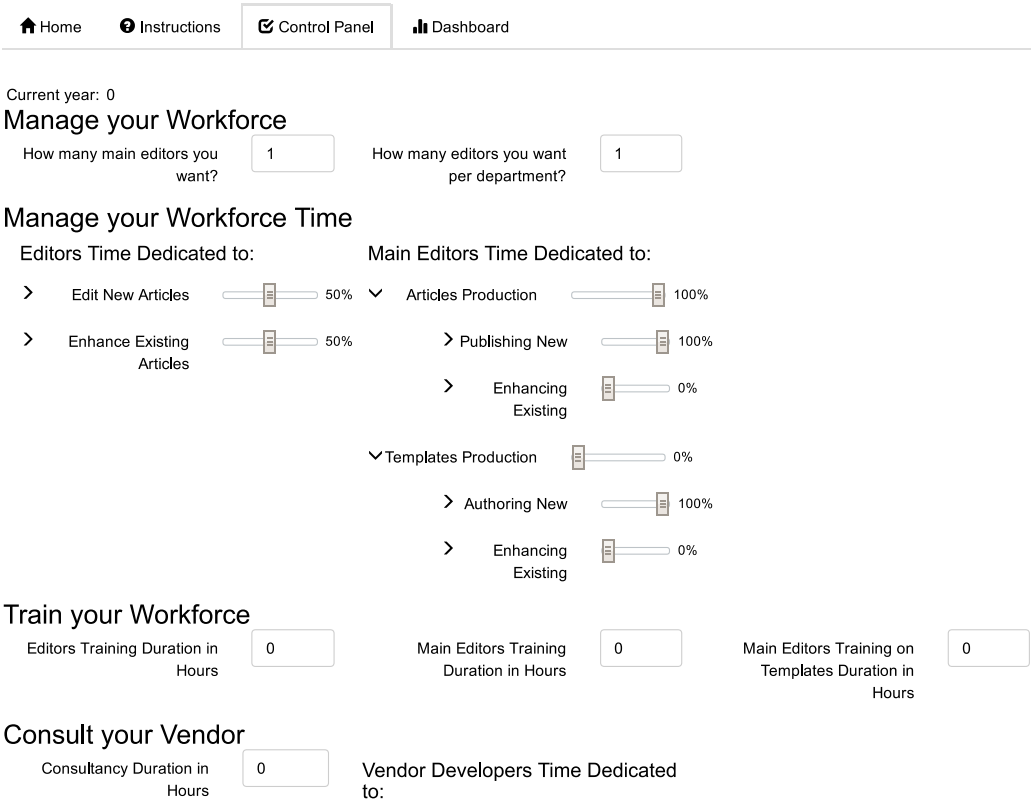

Figure H-4: ILE Control Panel tab

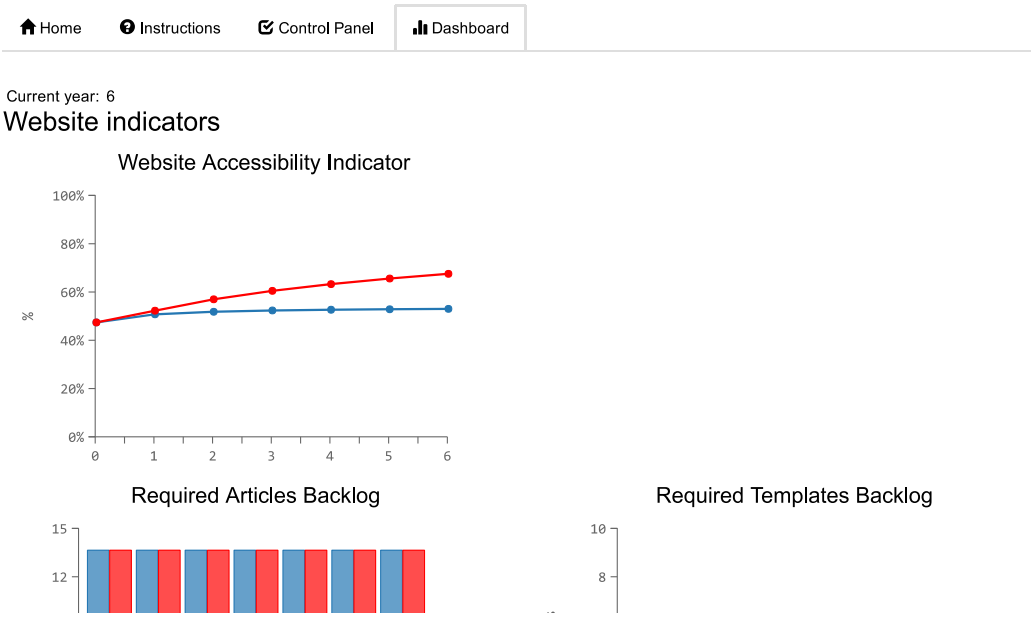

Figure H-5: ILE Dashboard tab

Table H-2: γ change detection

	$r_{\text{Post Then}}$	$r_{\text{Pre Post}}$	$r_{\text{Pre Then}}$	$t_{(r_{\text{Post Then}})(r_{\text{Pre Post}})}$	$t_{(r_{\text{Post Then}})(r_{\text{Pre Then}})}$	**γ**	s_{Post}	s_{Then}	s_{Pre}	$t_{(s_{\text{Post}})(s_{\text{Then}})}$	$t_{(s_{\text{Pre}})(s_{\text{Post}})}$	$t_{(s_{\text{Pre}})(s_{\text{Then}})}$	**γ**
P1	0.62*	0.46	0.56*	0.55	0.20	--	1.29	0.99	1.06	0.94	0.62	0.22	--
P2	-0.59*	0.23	0.08	-2.10**	-1.83**	Yes	1.07	0.53	1.25	2.71**	-0.44	2.77**	--
P3	0.80***	0.60*	0.27	0.82	2.88***	--	1.05	1.05	1.58	0.00	-1.47	1.22	--
P4	1***	0.90***	0.90***	13.50***	13.50***	Yes	0.85	0.85	0.95	--	-0.70	0.70	--
P5	-0.36	0.15	0.43	-1.48*	-2.05**	Yes	0.84	0.88	1.20	-0.11	-1.02	1.00	--
P6[X]	--	0.41	--	--	--	--	1.03	0.00	1.16	--	-0.36	--	--
P7	0.12	0.21	0.21	-0.19	-0.19	--	1.45	0.82	1.03	1.70	1.00	0.66	--
P8	0.73**	0.85***	0.65**	-0.75	0.54	--	1.20	0.92	1.23	1.10	-0.14	1.10	--
P9	0.89***	0.36	0.62**	3.96***	1.50*	Yes	0.99	1.37	1.35	-2.01*	-0.94	-0.05	--
P10	0.84***	0.64**	0.66**	1.23	1.05	--	1.37	0.88	0.92	2.43**	1.50	0.18	--
P11[X]	--	--	-0.32	--	--	--	0.00	1.03	1.35	--	--	0.82	--
P12	0.70**	0.18	0.08	1.37*	1.75*	Yes	1.62	0.92	0.92	2.37**	1.72	0.00	--

* P < 0.10 ** P < 0.05 *** P < 0.01

[X] Participant removed because of showing no variance in Pre, Post, or Then

Table H-3: α and β change detection

	$\overline{x}_{\text{Post}}$	$\overline{x}_{\text{Then}}$	$\overline{x}_{\text{Pre}}$	$t_{(\text{Then})(\text{Post})}$	$t_{(\text{Then})(\text{Pre})}$	**β**	**α**
P1	2.90	3.10	2.70	-0.61	-1.31	Yes	--
P2[G]	3.40	2.50	3.30	1.96*	1.92*	--	--
P3	3.00	3.00	2.60	0.00	-0.77	Yes	--
P4[G]	3.50	3.50	3.30	n/a	-1.50	--	--
P5[G]	2.60	2.90	3.10	-0.67	0.56	--	--
P6[X]	2.80	3.00	2.70	-0.61	-0.82	--	--
P7	3.10	2.70	3.20	0.80	1.34	Yes	--
P8	2.90	3.20	3.20	-1.15	0.00	--	Yes
P9[G]	3.10	3.10	2.60	0.00	-1.34	--	--
P10	3.10	2.90	2.80	0.80	-0.43	--	Yes
P11[X]	3.00	2.80	2.50	0.61	-0.49	--	--
P12[G]	3.20	2.80	2.80	1.08	0.00	--	--

* P < 0.10 ** P < 0.05 *** P < 0.01 – [G] γ change detected

[X] Participant removed because of showing no variance in Pre, Post, or Then

Table H-4: α, β, and γ change results vs participants' properties

	Knowledge of Math Modelling	**Knowledge of System Thinking/Dynamics**	**Gender**	**γ**	**β**	**α**
P1	Yes	Yes	M	--	Yes	--
P2	--	--	M	Yes	--	--
P3	--	--	M	--	Yes	--
P4	--	--	F	Yes	--	--
P5	Yes	--	F	Yes	--	--
P6[X]	--	--	M	--	--	--
P7	--	--	M	--	Yes	--
P8	--	--	M	--	--	Yes
P9	Yes	Yes	M	Yes	--	--
P10	--	--	F	--	--	Yes
P11[X]	--	--	F	--	--	--
P12	--	--	M	Yes	--	--

[X] Participant removed because of showing no variance in Pre, Post, or Then

Table H-5: Symbols used in the paper and their explanations

Symbol	**Explanation**
α	α change, refers to an absolute quantitative change
β	β change, refers to a measurement scale intervals recalibration, i.e. a redefinition in the measurement standards
γ	γ change, refers to a conceptual change, i.e. a redefinition of the measurement construct
$r_{\text{Pre Then}}$	Correlation between a participant's Pre & Then answers
$r_{\text{Post Pre}}$	Correlation between a participant's Post & Pre answers
$r_{\text{Post Then}}$	Correlation between a participant's Post & Then answers
$t_{(r_{\text{Post Then}})(r_{\text{Pre Then}})}$	t-statistic of Williams's test for comparing correlations of two paired/dependant samples, namely $r_{\text{Post Then}}$ & $r_{\text{Pre Then}}$
$t_{(r_{\text{Post Then}})(r_{\text{Pre Post}})}$	t-statistic of Williams's test for comparing correlations of two paired/dependant samples, namely $r_{\text{Post Then}}$ & $r_{\text{Post Pre}}$
s_{Pre}	Standard deviations for participant's Pre answers
s_{Post}	Standard deviations for participant's Post answers
s_{Then}	Standard deviations for participant's Then answers
$t_{(s_{\text{Post}})(s_{\text{Then}})}$	t-statistic of Morgan Pitman test for comparing variances of two paired/dependant samples, namely a participant's Post & Then answers
$t_{(s_{\text{Pre}})(s_{\text{Then}})}$	t-statistic of Morgan Pitman test for comparing variances of two paired/dependant samples, namely a participant's Pre & Then answers

Symbol	Explanation
$t_{(s_{Pre})(s_{Post})}$	t-statistic of Morgan Pitman test for comparing variances of two paired/dependant samples, namely a participant's Pre & Post answers
$\overline{x}_{Pre}$	Mean values of a participant's Pre answers
$\overline{x}_{Post}$	Mean values of a participant's Post answers
$\overline{x}_{Then}$	Mean values of a participant's Then answers
$t_{(Then)(Pre)}$	t-statistic of Student's t-test to compare a participant's Then & Pre answers
$t_{(Then)(Post)}$	t-statistic of Student's t-test to compare a participant's Then & Post answers

Appendix V. Unpublished Papers

Table of Unpublished Papers

I. A. Abdelgawad, ‘Attitudes of Disabled People towards Employment in Norway’, unpublished.

J. A. Abdelgawad, ‘Attitudes of Employers towards Recruiting Disabled People in Norway’, unpublished.

K. A. Abdelgawad, ‘Classifying the Unified Web Evaluation Methodology Tests According to Barrier Sources in Norwegian Municipal Websites’, unpublished.

I Attitudes of Disabled People towards Employment in Norway

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Abstract: *A survey on the attitudes of disabled people towards employment in Norway was conducted in the first half of 2011. The collected information is about the factors enabling disabled people to work, encouraging them to take an available work opportunity, and preventing them from active job application. The main findings from the analysis based on the results compiled by this survey are that accessible workplace facilities is the most common factor enabling disabled people to work, while accessible transportation is the least. Flexible working hours and tasks are the most common factors encouraging disabled people to take an available work opportunity, while personal computer with assistive technology or assistance is the least. Finally, risk of not being able to fulfil job expectations is the most common factor preventing disabled people from active job application, while expecting not to get any job offer is the least.*
Keywords: Disabled people, Disabled people' attitudes, Disabled people employment

I.1 Introduction

Despite repeated statements from governments in Norway, the employment rates for disabled people remains unchanged since 2000, only around 44% of disabled people (aged 16 - 66) are in employment [1], compared to 53% in Denmark (aged 16 - 64) [2] and 62% in Sweden (aged 16 - 64) [3].[187] Enabling more disabled people to take up jobs would be a substantial contribution to the individual capacity building and for the national financial bottom line [5]. In spite of these pervious facts, we have not been able to find any studies exploring factors enabling disabled people to work, encouraging them to take an available work opportunity, or preventing them from active job application.

In this paper we will summarise the attitudes of disabled people towards employment in Norway, as described in the questionnaires filled by disabled people suffering from different disabilities, and having different levels of disability, and geographically dis-

[187] Such employment rates are generally based on different national level surveys, with different designs, timings, surrounding economic conditions, and definitions of being employed [4].

tributed over Norway. The remainder of the paper is organised in three parts; a brief overview of the questionnaire and the sample, the results of the survey, and finally the paper concludes with a discussion on the main findings.

I.2 Questionnaire and Sample Overview

I.2.1 Questionnaire

The questionnaire is intended to identify the attitudes of Norwegian disabled people towards employment. The questionnaire was prepared through successive discussions and literature review. The questionnaire form has 33 questions, 4 question to retrieve identification information restricted to age, gender, county, and education level. Furthermore, the questionnaire contains eight questions to retrieve information about disability type and level, as well as information about benefits received from the government. Finally, 21 questions requiring responses limited to yes or no divided into 3 groups exploring factors enabling disabled people to work, encouraging them to take an available work opportunity, and preventing them from active job application.

I.2.2 Sample Properties

The sample is a convenience sample [6], where respondents are members of organisations which are members of the Norwegian Federation of Organisations of Disabled People (FFO).[188] The respondents filled the questionnaire in the period from 2011-01-24 to 2011-06-28 in order to describe their attitudes towards employment. As presented in Table I-1, Out of 716 respondents, only 302 fully completed the questionnaire. Only fully completed questionnaires were considered in the analysis.

Table I-1: Overall status

	Respondents	**Percentage**
Distributed	119	16.6%
Partially completed	295	41.2%
Completed	302	42.2%
Rejected	0	0.0%
Overall	716	100.0%

Table I-2 presents the geographical distribution of the respondents over the Norwegian counties. 43.8% of the respondents come from *Akershus*, *Oslo*, *Rogaland*, and *Horda-*

[188] http://www.ffo.no

land. Moreover, Figure I-1 shows the respondents distribution over education level. 58.6% of the respondents are University educated. In the sample, the ratio of disabled people is directly proportional with age, except for more than 60 years. After 67 people are transferred to pension and they are not counted in disable people in working age any more. The age histogram of the sample is shown in Figure I-2. Females constitute a majority in the sample with 80%. While in 2010, the disabled females were only 53% of the total disabled Norwegian population [7]. Figure I-4 shows the disability degree histogram of the sample. Obviously, 50% and 100% disability levels are far more common, which is in accordance with the truth that in Norway the use of the 5% grid of partial benefits is not effectively used [8].

Table I-2: Respondents distribution over counties

County	Percentage	County	Percentage
Østfold	6.0%	**Rogaland**	10.3%
Akershus	12.6%	**Hordaland**	9.6%
Oslo	11.3%	**Sogn og Fjordane**	1.3%
Hedmark	2.6%	**Møre og Romsdal**	5.6%
Oppland	3.0%	**Sør-Trøndelag**	6.0%
Buskerud	3.6%	**Nord-Trøndelag**	3.3%
Vestfold	4.3%	**Nordland**	6.3%
Telemark	3.0%	**Troms**	5.0%
Aust-Agder	2.3%	**Finnmark**	1.3%
Vest-Agder	2.6%		

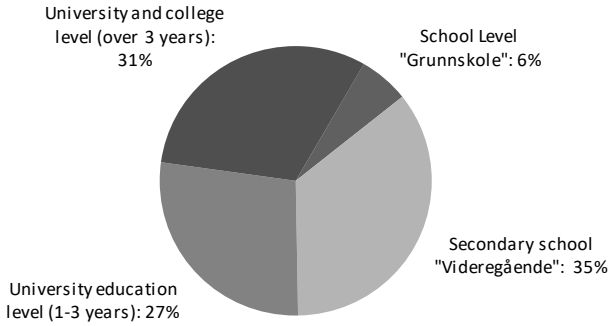

Figure I-1: Respondents distribution over education level

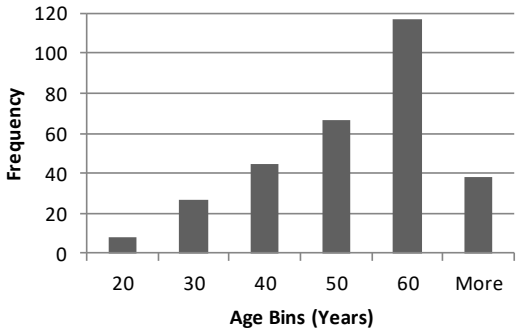

Figure I-2: Respondents age histogram

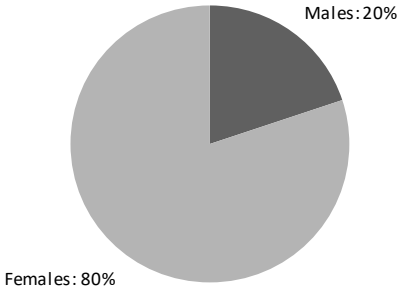

Figure I-3: Respondents gender distribution

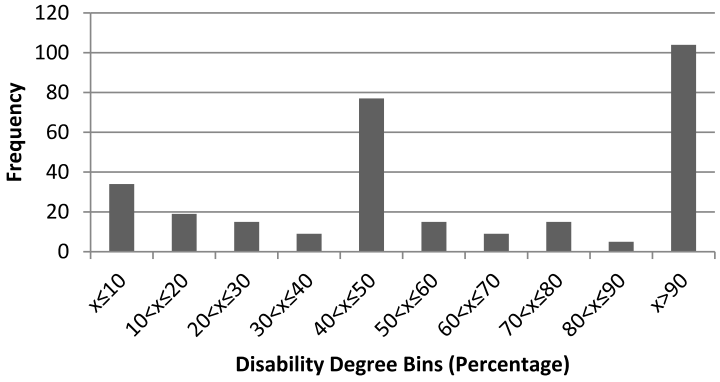

Figure I-4: Disability degree histogram of the respondents

I.3 Survey Results

This section explores the results of the disabled people attitudes towards employment. The following subsections describe the different factors enabling disabled people to

work, encouraging them to take an available work opportunity, and preventing them from active job application.

I.3.1.1 Factors Enabling Disabled People to Work

Figure I-5 shows the percentage of positive answers of the respondents to the group of questions under "**Will one or more of the following factors enable you to work?**". As shown in the figure, accessible workplace facilities is the most common enabling factor to take a job among respondents, while accessible transportation is the least. Worth mentioning that the possibility to keep disability pension when having a part-time job is among the most common factors too, which agrees with computations done in [8], which shows that in general financially it is much better for a disabled person not to work.

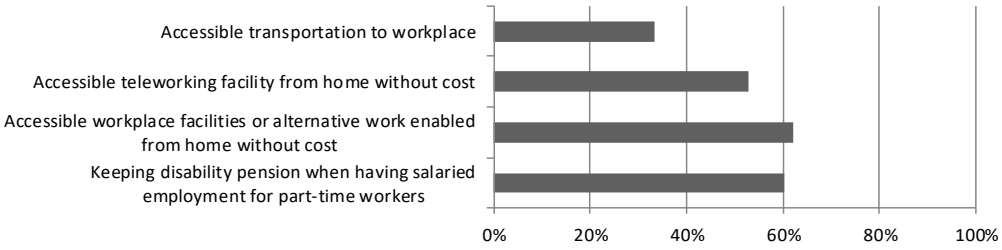

Figure I-5: Will one or more of the following factors enable you to work?

I.3.2 Factors Encouraging Disabled People to Take an Available Work Opportunity

Figure I-6 shows the percentage of positive answers of the respondents to the group of questions under "**Will one or more of the following factors encourage you to take an available work opportunity?**". As shown in the figure, flexible working hours and tasks are the most common encouraging factor to take available work opportunities among respondents. Training is among the least common factors, however this could be explained by that 58.6% of the respondents are University educated while only 6.0% of them didn't pass secondary school level. Unexpectedly, personal computer with assistive technology or assistance is the least common factor.

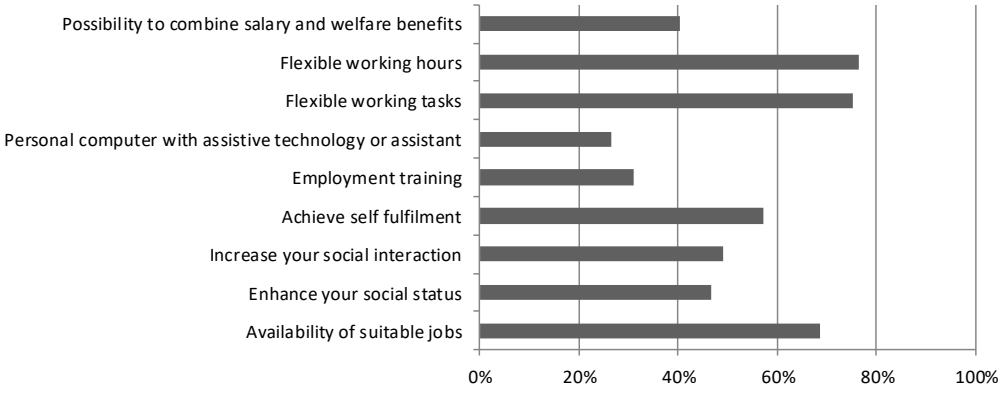

Figure I-6: Will one or more of the following factors encourage you to take an available work opportunity?

I.3.3 Factors Prevent Disabled People from Active Job Application

Figure I-7 shows the percentage of positive answers of the respondents to the group of questions under "**Will one or more of the following factors prevent you from active job application?**". As shown in the figure, risk of not being able to fulfil job expectations is the most common factor that could prevent respondents from taking a job. Unexpectedly, expecting not to get any job offer is the least common factor.

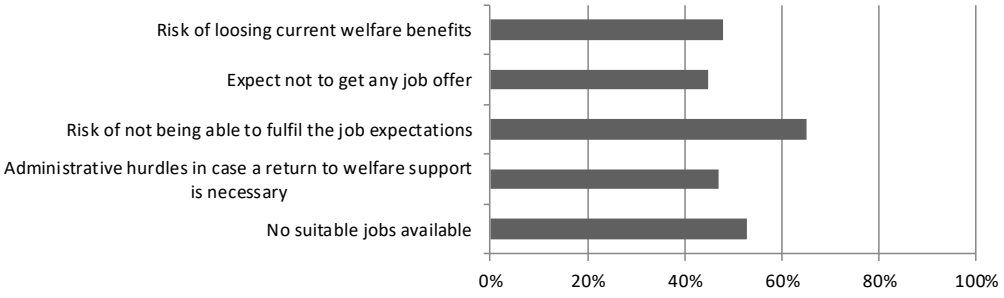

Figure I-7: Will one or more of the following factors prevent you from active job application?

I.4 Conclusions

A survey on the attitudes of disabled people towards employment in Norway was conducted in the first half of 2011. The collected information is related to the factors enabling disabled people to work, encouraging them to take an available work opportunity, and preventing them from active job application. The main findings from the analysis based on the results compiled by this survey are that accessible workplace facilities is the most common factor enabling disabled people to work, while accessible transportation is the least. Flexible working hours and tasks are the most common factors encouraging disabled people to take an available work opportunity, while personal com-

puter with assistive technology or assistance is the least. Finally, risk of not being able to fulfil job expectations is the most common factor preventing disabled people from active job application, while expecting not to get any job offer is the least.

I.5 Acknowledgements

The eGovMon project[189] is co-funded by the Research Council of Norway under the VERDIKT program. Project no.: VERDIKT 183392/S10. The results in the eGovMon project and in this paper are all based on the results from project team collaboration including researchers, practitioners and users.

I.6 References

[1] J. Tøssebro, "Report on the employment of disabled people in European countries - Norway," Academic Network of European Disability experts (ANED), Nov. 2008.

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[189] http://www.egovmon.no

J Attitudes of Employers towards Recruiting Disabled People in Norway

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Abstract: *A survey on the attitudes of employers towards recruiting disabled people in Norway was conducted to first half of 2011. The collected information is related to employers' awareness of facts about disabled employees, factors encouraging employers to, and preventing them from recruiting disabled people. The main findings from the analysis based on the results compiled by this survey are that most of the survey respondents know that disabled and elderly employees can benefit organisations with their valuable experiences, while the fewest know that their organisations can receive financial support from the government when employing disabled people and that the government will provide their organisations with assistive technology when employing disabled people. Disabled and elderly employees can benefit organisations with their valuable experiences is the most common encouraging factor among employers of the sample. While employing disabled people will increase the chances of the respondent's organisation to sell to public sector (Public Procurement) and other organisations (competitors of respondent's organisation) are recruiting disabled people are the lowest encouraging factors among respondents. Expecting overhead in dealing with social benefits because of for example lack of easily accessed information or lack of fast response from public authorities when help related to disabled employees is the highest preventing factor for the sample respondents. While expecting that disabled employees need more flexibility working hours is the least.*

Keywords: Disabled people, employers' attitudes

J.1 Introduction

Despite repeated statements from governments in Norway, the employment rates for disabled people remains unchanged since 2000, only around 44% of disabled people (aged 16 - 66) are in employment [1], compared to 53% in Denmark (aged 16 - 64) [2] and 62% in Sweden (aged 16 - 64) [3].[190] Furthermore, despite that Norway has generous public system that covers financing employers workplace accommodation to suit

[190] Such employment rates are generally based on different national level surveys, with different designs, timings, surrounding economic conditions, and definitions of being employed [4].

disabled employees, as well as providing needed assistive technology to disabled employees, the system is claimed to be underutilised [1], [5]. In spite of these pervious facts, we have not been able to find any studies exploring factors encouraging or preventing employers from recruit disabled people.

In this paper we will summarise the attitudes of employers towards recruiting disabled employees in Norway, as described in the questionnaires filled by employers from different economic sectors, and having different numbers of employees and disabled employees, and geographically distributed over Norway. The remainder of the paper is organised in three parts; a brief overview of the questionnaire and the sample, the results of the survey, and finally the paper concludes with a discussion on the main findings.

J.2 Questionnaire and Sample Overview

J.2.1 Questionnaire

The questionnaire is intended to identify the attitudes of Norwegian employers towards recruiting disabled employees. The questionnaire was prepared through successive discussions and literature review. The questionnaire form has 31 questions, 4 question to retrieve identification information restricted to county, economic sector, number of employees, and number of disabled employees if any. Furthermore, the questionnaire contains 4 questions to retrieve information about the employer's awareness of Inclusive Workplace agreement (*IA-avtale og protokoll*) [6], whether the employer has signed the agreement or not, and the reason behind signing, and the results in case of the employer has signed the agreement. Finally, 23 questions requiring responses limited to yes or no divided into 3 groups exploring employers' awareness of facts about disabled employees, factors encouraging employers to, and preventing them from recruiting disabled people.

J.2.2 Sample Properties

The sample is a convenience sample [7], where respondents are companies and organisations having their contacts displayed through finn.no,[191] in addition to companies that have relations with some of the staff members of the ICT department at University of Agder. The respondents filled the questionnaire in the period from 2010-12-16 to 2011-04-01 in order to describe their attitudes towards recruiting disabled people. As

[191] http://www.finn.no

shown in Table J-1, Out of 193 respondents, only 103 fully completed the questionnaire.[192] Only fully completed questionnaires were considered in the analysis.

Table J-1: Overall status

	Respondents	Percentage
Distributed	34	17.6%
Partially completed	55	28.5%
Completed	103	53.4%
Rejected	1	0.5%
Overall	193	100.0%

Table J-2 presents the geographical distribution of the respondents over the Norwegian counties. 69.9% of the respondents come from *Akershus*, *Oslo*, *Rogaland*, and *Hordaland*. In addition to 17.5% that comes from Aust-Agder and Vest-Agder together. Moreover, Table J-3 presents the respondents distribution over economic sectors.

Table J-2: Employers distribution over counties

County	Percentage
Østfold	0.0%
Akershus	12.6%
Oslo	37.9%
Hedmark	0.0%
Oppland	0.0%
Buskerud	1.9%
Vestfold	1.9%
Telemark	0.0%
Aust-Agder	12.6%
Vest-Agder	4.9%

County	Percentage
Rogaland	13.6%
Hordaland	5.8%
Sogn og Fjordane	0.0%
Møre og Romsdal	1.9%
Sør-Trøndelag	1.9%
Nord-Trøndelag	1.0%
Nordland	1.9%
Troms	1.0%
Finnmark	1.0%

Table J-3: Employers distribution over economic sectors

Economic Sector	Percentage
Agriculture, forestry and fishing	1.9%
Mining and quarrying	0.0%
Manufacturing	12.6%
Electricity, water supply, sewerage, waste management	1.9%
Construction	6.8%

[192] One completed questionnaire was rejected, because we were able to detect insincerity from the answers of free text questions.

Economic Sector	Percentage
Wholesale, retail trade; repair of motor vehicles	3.9%
Transportation and storage	2.9%
Accommodation and food service activities	1.9%
Information and communication	12.6%
Financial and insurance activities	3.9%
Real estate and technical activities	1.0%
Administrative, support service activities	14.6%
Public administration and defence	10.7%
Education	4.9%
Human health and social work act.	9.7%
Other service activities, extraterritorial organisation	10.7%

Figure J-1 shows that only 28.0% of the sample respondents have employees who have been diagnosed as disabled. Moreover, the average ratio of disabled employees to all employees in these employers is 3.8%. Figure J-2 shows that although 74.0% of the respondents knew about Inclusive Workplace agreement, only 49.0% of them have signed it.

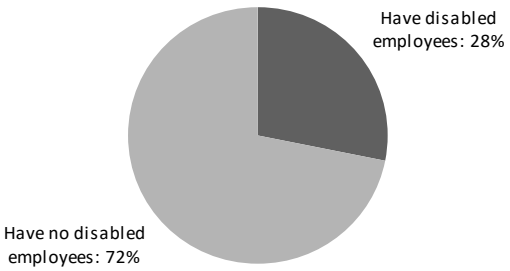

Figure J-1: Do you have employees who are diagnosed as disabled in your organisation?

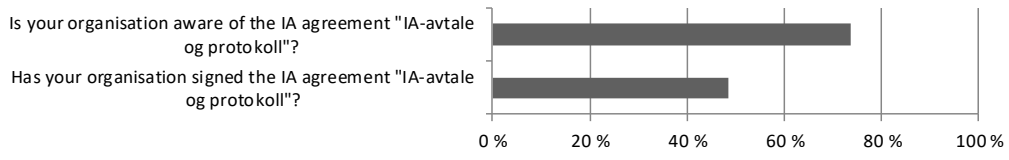

Figure J-2: Inclusive Workplace agreement "IA-avtale og protokoll"

J.3 Survey Results

This section explores the results of the employers' awareness of facts about disabled employees, factors encouraging employers to, and preventing them from recruiting disabled people.

J.3.1 Awareness of Facts about Disabled Employees

Figure J-3 shows the shows the percentage of positive answers of the respondents to the group of questions under "**Is your organisation aware of any of the following?**". As shown in the figure, the fact that disabled and elderly employees can benefit organisations with their valuable experiences is almost known to all respondents, while both facts that organisations can receive financial support from the government when employing disabled people and that the government will provide organisations with assistive technology when employing disabled people are the least.

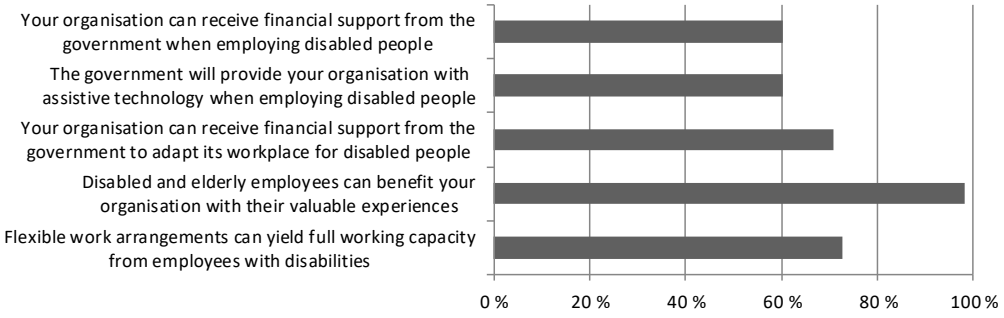

Figure J-3: Is your organisation aware of any of the following?

J.3.2 Factors Encouraging Organisations to Employ Disabled People

Figure J-4 shows the percentage of positive answers of the respondents to the group of questions under "**Will one or more of the following factors encourage your organisation to employ a disabled person?**". As shown in the figure, disabled and elderly employees can benefit organisations with their valuable experiences is the most common encouraging factor among employers of the sample. Group of factors involving supplying assistive technology and financial support by the government come as the second most common among employers of the sample, almost in the same level comes the respondents desire to demonstrate their organisations' social responsibility. While employing disabled people will increase the chances of the respondent's organisation to sell to public sector (Public Procurement) and other organisations (competitors of re-

spondent's organisation) are recruiting disabled people are the lowest encouraging factors among respondents.

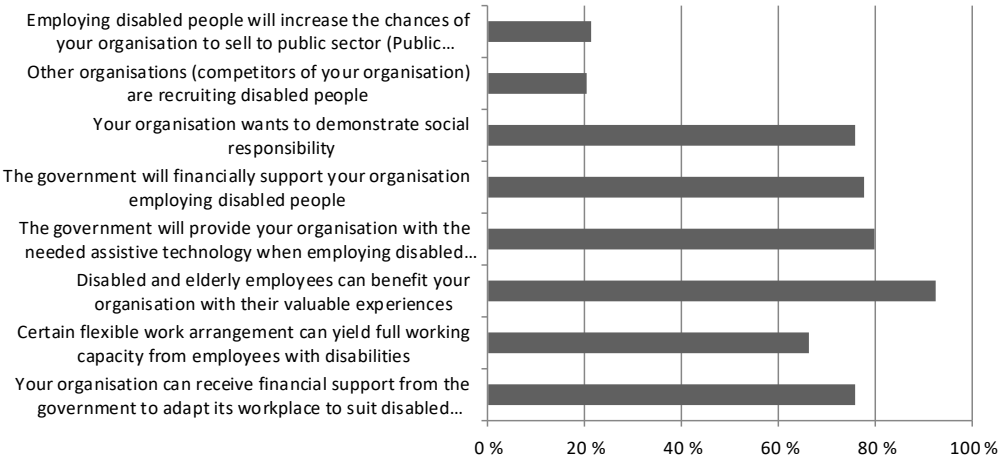

Figure J-4: Will one or more of the following factors encourage your organisation to employ a disabled person?

J.3.3 Factors Preventing Organisations from Employing Disabled People

Figure J-5 shows the percentage of positive answers of the respondents to the group of questions under "**Will one or more of the following factors prevent your organisation from employing a disabled person?**". Expecting overhead in dealing with social benefits because of for example lack of easily accessed information or lack of fast response from public authorities when help related to disabled employees is the highest preventing factor for the sample respondents. While expecting that disabled employees need more flexibility working hours is the least.

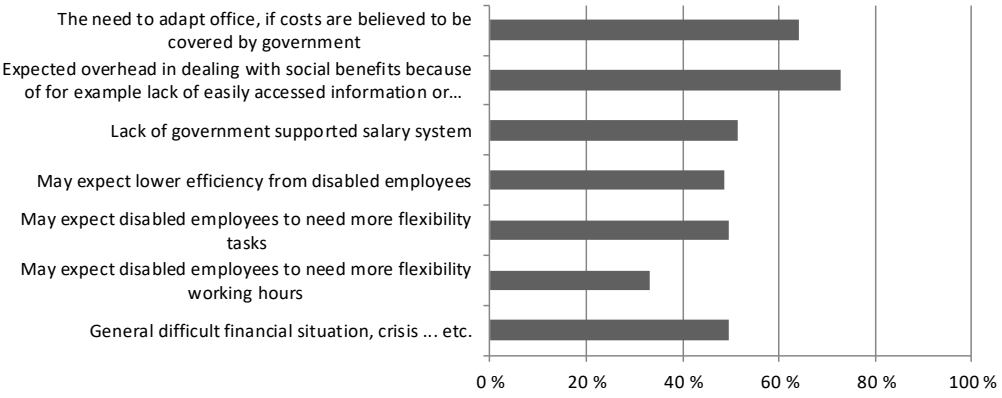

Figure J-5: Will one or more of the following factors prevent your organisation from employing a disabled person?

J.4 Conclusions

A survey on the attitudes of employers towards recruiting disabled people in Norway was conducted to first half of 2011. The collected information is related to employers' awareness of facts about disabled employees, factors encouraging employers to, and preventing them from recruiting disabled people. The main findings from the analysis based on the results compiled by this survey are that most of the survey respondents know that disabled and elderly employees can benefit organisations with their valuable experiences, while the fewest know that their organisations can receive financial support from the government when employing disabled people and that the government will provide their organisations with assistive technology when employing disabled people. Disabled and elderly employees can benefit organisations with their valuable experiences is the most common encouraging factor among employers of the sample. While employing disabled people will increase the chances of the respondent's organisation to sell to public sector (Public Procurement) and other organisations (competitors of respondent's organisation) are recruiting disabled people are the lowest encouraging factors among respondents. Expecting overhead in dealing with social benefits because of for example lack of easily accessed information or lack of fast response from public authorities when help related to disabled employees is the highest preventing factor for the sample respondents. While expecting that disabled employees need more flexibility working hours is the least.

J.5 Acknowledgements

The eGovMon project[193] is co-funded by the Research Council of Norway under the VERDIKT program. Project no.: VERDIKT 183392/S10. The results in the eGovMon project and in this paper are all based on the results from project team collaboration including researchers, practitioners and users.

J.6 References

[1] J. Tøssebro, "Report on the employment of disabled people in European countries - Norway," Academic Network of European Disability experts (ANED), Nov. 2008.

[193] http://www.egovmon.no

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[7] A. Bryman, *Social Research Methods*, 3rd ed. Oxford: Oxford University Press, 2008.

K Classifying the Unified Web Evaluation Methodology Tests According to Barrier Sources in Norwegian Municipal Websites

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Abstract: *To classify the reasons behind UWEM failed test/barriers in Norwegian municipal websites, we have inspected the websites of municipalities of Trondheim, Grimstad, Larvik, Holmestrand, Re, Hole, and Haugesund as examples. Reasons behind barriers could be the article prepared by the web-editors working in the municipality, or the templates prepared by the vendors selling the Content Management System (CMS) to the municipality. Moreover, the barriers due to template could be attributed to the template itself or the CMS limitations. Only in the case of Trondheim, Grimstad, and Larvik, we could differentiate between barrier due to template and due to CMS, because of the availability of a document evaluating the compliance of the CMS they are using with WCAG 1.0 and ATAG 1.0.*
Keywords: Accessibility, UWEM, Barriers

K.1 Intorduction

The objective of this paper is to classify the reasons behind UWEM failed test/barriers in Norwegian municipal websites. In this paper the websites of *Trondheim* (using *EPiServer™* CMS), *Grimstad* (*EPiServer™*), *Larvik* (*EPiServer™*), *Holmestrand* (*ACOS™*), *Re* (*ACOS™*), *Hole* (*Custom Publish™*), and *Haugesund* (*CorePublish™*) were inspected as examples of Norwegian municipal websites.

Reasons behind barriers could be the article prepared by the web-editors working in the municipality, or the templates prepared by the vendors selling the Content Management System (CMS) to the municipality. Moreover, the barriers due to template could be because of the template itself or the CMS limitations. Only in the case of EPiServer CMS, it was possible to differentiate between barrier due to template and due to CMS, because of the existence of a document evaluating EPiServer CMS compliance with WCAG 1.0 and ATAG 1.0 [1].

K.2 Method

The UWEM failed tests per webpages dated March 21st, 2011 were extracted from the eGovMon database. For each website, 3 to 5 webpages containing the same barrier was

visually inspected with the help of eGovMon page checker.[194] Based on this inspection a barrier was classified to be related to articles or templates.
For example, the inexistence of "alternative text of image" appeared in many pages in Grimstad website. It was noticed that when it is more frequent per page the barrier is caused by:

- http://www.grimstad.kommune.no/Templates/SSP.eDemokrati/images/acrobat.gif
- http://www.grimstad.kommune.no/Templates/SSP.eDemokrati/images/word.gif

Which are icons that appear beside URLs to documents stored on the server; such a barrier was classified to be related to template.
Other cases still exist, for example one page contains a picture of some politician without alternative text, apparently article related barrier. However, the former barrier related to template is more common.

K.3 Results

The following table presents the results of the inspection of the tested websites. The table also presents the number of webpages that failed the test at least once (Freq.).[195]
During the testing, it was not possible to reach Hole website pages tested by the eGovMon in March 21st, 2011.

[194] http://accessibility.egovmon.no/en/pagecheck

[195] The maximum number of the tested webpages is 600 according to the eGovMon methodology [2].

K.4 Overall view

Test	Trondheim		Grimstad		Larvik		Holmestrand		Re		Haugesund	
	Reason	**Freq.**	**Reason**	**Freq.**	**Reason**	**Freq.**	**Reason**	**Freq.**	**Reason**	**Freq.**	**Reason**	**Freq.**
1_1_HTML_01	no occ.[i]	1	Template	186	Template	7	no occ.	0	Template	1	no occ.	0
1_1_HTML_06	no occ.[ii]	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0
3_2_HTML_01	Template	2	no occ.	0	no occ.	0	Template	563	Template	1	Template	31
3_2_HTML_02	Template	328	Template	354	Template	600	Template	600	Template	600	Template	501
3_5_HTML_03	no reason identified [iii]	11	no reason identified	333	no occ.	0	no occ.	0	Template	12	Template	75
3_6_HTML_03	Article	2	no occ.	0	Article	6	Article	12	Article	2	no occ.	0
6_4_HTML_01	Template	600	no occ.	0	Template	1	no occ.	0	no occ.	0	no occ.	0
7_2_HTML_01	no occ.[ii]	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0
7_3_HTML_01	no occ.[iv]	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0
7_4_HTML_01	no occ.[ii]	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0
7_5_HTML_01	no occ.[ii]	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0
9_1_HTML_01	no occ.[iv]	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0	no occ.	0
11_1_HTML_01	Template	2	no occ.	0	no occ.	0	Template	563	Template	1	Template	31
11_2_HTML_01	Template	9	Template	3	Template	114	Template	19	Template	563	Template	76
11_2_HTML_02	Template	131	Template	589	Template	580	Template	600	Template	600	Template	569
12_1_HTML_01	Template	9	no occ.	0	no occ.	0	no occ.	0	Template	20	Template	569
12_3_HTML_01	no occ.[iv]	0	no occ.	0	Template	6	no occ.	0	no occ.	0	no occ.	0
12_3_HTML_04	no occ.[iv]	0	no occ.	0	Template	0	no occ.	0	no occ.	0	no occ.	0
12_4_HTML_01	Template	21	no occ.	0	no occ.	0	no occ.	0	no occ.	0	Template	569
12_4_HTML_02	no reason identified	1	Template	589	Template	580	Template	383	Template	595	Template	2

Test	Trondheim		Grimstad		Larvik		Holmestrand		Re		Haugesund	
	Reason	**Freq.**	**Reason**	**Freq.**	**Reason**	**Freq.**	**Reason**	**Freq.**	**Reason**	**Freq.**	**Reason**	**Freq.**
13_1_HTML_01	Article	125	Template	64	Article	165	Template	179	Template	579	Templates	149
3_2_CSS_01	Template	600	Template	589	Template	22	Template	600	Template	600	Template	569

[i] According to eGovMon database there was only one occurrence, however, this occurrence was not found during this inspection.

[ii] Older inspection on Trondheim website showed that barriers were due to Template.

[iii] Older inspection on Trondheim website showed that barriers were due to Article.

[iv] Older inspection on Trondheim website showed that barriers were due to Template (CMS).

K.5 Conclusion

The inspection results were not very satisfactory in deciding the barriers sources. Clearly because of the limited number of inspected pages, and in some cases the mix between barriers sources in the same website. Another limitation that should be considered is due to the human error in classifying the barriers. However, some results could be extracted in the following table.

Test	Most probable source
1_1_HTML_01	Cannot decided
1_1_HTML_06	Template (personal point of view)
3_2_HTML_01	Template[196]
3_2_HTML_02	Template[197]
3_5_HTML_03	Template (personal point of view)
3_6_HTML_03	Article[2]
6_4_HTML_01	Template[2]
7_2_HTML_01	Cannot decided
7_3_HTML_01	Cannot decided
7_4_HTML_01	Template (personal point of view)
7_5_HTML_01	Template (personal point of view)
9_1_HTML_01	Template (personal point of view)
11_1_HTML_01	Template
11_2_HTML_01	Template
11_2_HTML_02	Template
12_1_HTML_01	Template
12_3_HTML_01	Cannot decided
12_3_HTML_04	Cannot decided
12_4_HTML_01	Template
12_4_HTML_02	Template
13_1_HTML_01	Cannot decided
3_2_CSS_01	Template[2]

Additionally, whenever all the tested pages fail the test, it could be inferred that the barrier is due to template/CMS.

[196] Agreeing with http://svn.egovmon.no/svn/eGovMon/trunk/eGovMonDB/storedprocedures.sql

[197] Agreeing partly with http://svn.egovmon.no/svn/eGovMon/trunk/eGovMonDB/storedprocedures.sql

K.6 References

[1] EPiServer, "EPiServer CMS 5 Compliance to WCAG and ATAG," EPiServer AB, Oct. 2007.

[2] A. Nietzio, M.G. Olsen, and L. Berntzen, *Comparison of accessibility evaluations carried out by eGovMon and norge.no*, eGovMon, 2008 http://archive.tingtun.no/eGovMon/d2.1.1_final_v1.0.pdf.