



# Electronic Invoicing for Small businesses

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# Abstract

The Norwegian government has released an act suggesting that all invoices sent to the public sector should be sent electronically by the year 2012. In addition more and more large companies demand their suppliers to send invoices electronically. Such demands may exclude less resourceful participants from taking part in trade with a section of the market. Hence, this project is set out to find a solution for sending electronic invoices aimed at the less resourceful small businesses and sole proprietors.

The study has identified user habits with issues involved, and carried out a market analysis including research of existing infrastructure and related systems. The findings of the made studies have been transferred to a solution design, prepared for release within Norway and possibly for use within the Pan-European Public Procurement On Line, PEPPOL consortium. Moreover, certain aspects of the solution design have been implemented in a prototype.

It is believed that the proposed solution will ensure that less resourceful participants can still take part in trade with all of the market. The documented design specification, in combination with the prototype, provides a solid foundation for full-scale implementation.

# Preface

This Master Thesis was submitted in partial fulfillment of the requirements for the degree Master of Science in Computer Science and Engineering. The project work was carried out at the University of Agder, Faculty of Engineering and Science, Grimstad. EDIGard AS initiated the project, and the work has been implemented under the supervision of Associate Professor Andreas Prinz at the University of Agder.

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## Chapter 1

# Introduction

Invoice processing is a central part of the value chain of almost any business. Much of this handling can be automated by use of electronic invoicing, and there is a constant growth of companies that join in on transitioning to electronic invoice processing. Automatic electronic handling may both have a positive financial and performance impact.

### 1.1. Background and Motivation

The main reason for the big interest in electronic processing of invoices lies in the fact that manual invoice handling is costly.

#### **Background**

By transitioning to electronic processing, the handling cost can be significantly reduced. For example, a recent study indicates a potential for saving up to 70 percent for electronic invoices compared to paper-based invoices [1]. In fact, electronic invoicing has been recognized as one of the most important sources of productivity increases in Europe [2]. The utility value of shifting to electronic handling of invoices is remarkable – both for the society as a whole, and in the long run also for individual companies. The savings of such a reform within Norway alone is calculated to be about 1.1 billion NOK in a 10-year perspective when solely calculating the governmental activities. For suppliers the analysis shows a positive utility value of about 178 million NOK within the same 10-year perspective. The reduced communication costs come from the fact that with the introduction of electronic handling, the cost of individual invoice processing is significantly reduced, and the fact that a faster exchange of data without errors can be expected. Hence, the use of electronic processing within invoice interchange is highly beneficial from an economic point of view. Further analysis shows that one, in addition, will accomplish essential non-monetary utility values, both in the governmental administrations and in the industry, i.e. both in the public and the private sectors. With that, adoption of electronic processing is not only beneficial from an economic point of view; it can also improve the buyer-seller relationship [2][3][4].

These benefits from electronic processing have, in light of the financial crisis, lead many governmental administrations in several nations to shift to electronic handling. Also in Norway, the public sector has carried out savings and rationalization action plans, and in particular demands that all invoices sent to the public sector must be sent electronically. White Paper No.36 released by the Ministry of Government Administration (FAD), states that [3];

- By 1.7.2011 all state agencies and health authorities should be able to receive invoices electronically in designated standard format.
- By 1.7.2012 all members of the public sector (including municipal sector) must be able to receive invoices in standard format.
- By 1.7.2012 all invoices sent to the public sector must be sent electronically.

Note that the last point brings that all members of the private sector are decreed to send all invoices, directed to any member of the public sector, electronically in agreed standard format by the year 2012.

### **Motivation**

The motivation of this thesis is found in the White Paper No.36 act, where anyone interested in participating in trade with the public sector in Norway is pressured to adopt a system that enables sending of invoices electronically. In addition, experience shows that big businesses that have not already invested will quickly invest in electronic invoice processing systems, and subsequently require their suppliers to send invoices to them electronically. As a result, demands of electronic invoicing from the public sector and from large buyers sets forward a need for a solution that enables users to send invoices electronically to both the public and private sector.

Small businesses and particularly sole proprietors<sup>1</sup> are especially vulnerable to market shifts by the type White Paper No.36 imposes. Sole proprietors often operate mainly within the local business community and are very dependent on their customers. This part of the market is also strongly influenced by competition with many sole proprietors and small businesses offering the same or an equivalent service. Virtually none of the sole proprietors have the necessary software or hardware to provide electronic invoicing<sup>2</sup>. Consequently, a system design put forward in this project should be aimed at small businesses and sole proprietors.

However, small companies do not generally experience any profit increment from electronic processing, or rather, they do not experience any financial drawbacks from manual handling. Hence, the reason for small companies and sole proprietors to adopt electronic invoicing systems likely comes from client requests, and not from economic benefits. In addition, small businesses and sole proprietors generally do not have the resources for expensive investments. These facts should be taken into account in the solution design allowing for a minimum of adaptation at a minimum of cost.

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<sup>1</sup> A sole proprietorship is an enterprise owned by one physical person, and where there is no legal distinction between the owner and the business.

<sup>2</sup> R. Heimstad (personal communication, September, 2010)

There are several service providers that offer electronic invoicing in the market today. However, most solutions available are aimed towards resourceful participants of the market. Thus, this thesis addresses a pressing issue and aims to provide an urgently needed solution.

## **1.2. Problem Statement**

This project seeks to find an electronic invoice solution aimed at the less resourceful small businesses and sole proprietors.

That is to say, the project goal is to find a way to include the small businesses, by identifying the issues that cause exclusion from the market and transferring this knowledge to a solution design. This implies that the project aims to find a cost effective solution design that meets the needs of a market with deeply ingrained habits and reluctance to take on new technology. Hence, the project seeks to discover why implementation and introduction of such a system is challenging and find if there is a way to possibly overcome those challenges, and with that, the solution should in a larger perspective be conceivable as a framework for managing the problem.

As steps in solving the problem, the project aims to take on the following objectives;

### **Objective 1 – User Habits**

Study user habits and behavioral patterns of the target market.

### **Objective 2 – Market Analysis**

Conduct a market analysis, including integration potential with existing infrastructure.

### **Objective 3 – Requirement Specification**

Identify use cases and requirements for the solution.

### **Objective 4 – Solution Design**

Establish a solution design.

### **Objective 5 – Prototype Implementation**

Implement part of the established requirements and solution design in a prototype, to demonstrate invoice flow and typical usage areas.

## **1.3. Solution Approach**

To reach the project goal and accomplish all of the set objectives, the research will consider four separate parts; user habits, market analysis, requirements specification and solution design. Part of the solution design will then be implemented in a prototype. The relationships of the parts are shown in Figure 1.1.

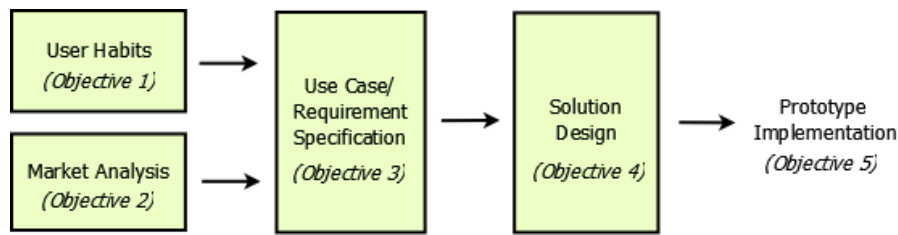


Figure 1.1: Building blocks of the project work.

*Objective 1, user habits*, refers to the fact that the solution must fit into a market with deeply ingrained habits and behavioral patterns. Consequently, effort must be made to understand the situation, and the impacts adoption of electronic invoice processing may have. That is, find out how and why things are the way they are, how and why they came to be that way, and what it means in finding a useful solution.

Any useful solution design has to be integrated with existing infrastructure, systems and standards. Therefore, as defined in *Objective 2, a market analysis* will be conducted aiming to get an understanding of the state of the current market, how and by whom the infrastructure is built and what standards and formats need to be considered.

As stated in *Objective 3, a requirement specification*, including use cases should be specified. The specification will be deduced by applying information attained in the user habit and market analysis studies.

*Objective 4, the solution design*, will be specified according to the identified requirements.

Part of the solution design will then be implemented in a prototype, as stated in *Objective 5*.

### **Research method**

In order to find an appropriate solution, and to build the prototype, different approaches will be taken for the separate objectives.

When studying user habits and conducting a market analysis, an exploratory research design will be used. Existing research, both printed and online sources, will be thoroughly investigated to find conclusions. That is, investigating information and research made by other people will constitute the primary part of the data gathering. In addition, interviews with a number of companies will be conducted to form an analysis and find out to what extent electronic trading is used.

With this research as a basis, gathering of more in-depth information from a small number of informants will be done for further examination. This formative angle will be used to gain a deeper understanding of the problem, and examine the issues in greater detail. That is to say, a few selected informants will be questioned to get a detailed understanding of the entire process.

In other words, both qualitative and quantitative data analysis approaches – by way of exploratory research design – will be used for the purpose of arriving at a more holistic understanding of the task at hand.

In establishing a requirements specification, the study of user habits and market analysis will be taken into account. That is;

- What demands the market puts on the solution design with regard to e.g. functionality.
- What formats need to be handled, what systems need to be integrated, etc.

This specification will then be used to establish a solution design.

The scope of the design specification is to capture a high level design for a solution application. The documentation focus is both the design of a system for use to the public sector (B2G) and the private sector (B2B). The purpose of the documentation is thus to list requirements and present a high level design for the application, as well as to describe the solution design of the system ensuring business, technical and legal requirements.

The prototype implementation will be made using the method of Agile software development and applying Model-Driven Development.

## 1.4. Key Limitations and Assumptions

Some restrictions have been made in order for the project to be feasible. The following lists the key limitations that have been made;

- The supplier-side target market is small businesses and sole proprietors and the goal has been defined to be finding a cost effective solution. Hence, as small companies have a relatively low volume of invoice exchange, their needs can be met through a simplified solution and full automation of the issuer invoice processing lifecycle is left out of scope.
- The prototype developed in this thesis should not be seen as a finished product, ready for introduction to the market. Rather, its purpose is to demonstrate the various aspects of the designed solution.
- Even though integration with existing systems is sought after, actual implementation of connections with other systems will be done only if time allows.
- As focus is on underlying issues, matters such as streamlining or making format handling more efficient are not part of the project.
- The scope of this project is limited to the Norwegian market and, with that, some issues related to internationalization or cross-border trade – such as e.g. VAT compliance – are left out of scope. Note though, that while international market is not the focus here, the market cannot be completely ignored. In today's global society the surrounding nations affect a Norwegian solution design. Hence, though focus will be the Norwegian market, this thesis will to some degree include the European market in the analysis of the solution.

When documenting the solution design, the following items are out of scope;

- Hardware Environments
- 3rd Party software configuration

- Network topology

In addition, the following functions are out of scope for this project;

- Incoming documents (apart from control messages) will not be part of the solution design.
- Creation of invoices to private users, i.e. consumers (B2C).
- Creation of other types of electronic documents, such as tenders, confirmations, reminders, reimbursements or catalogues. Note, however, that though such functions are out of scope for this project, the functionality should be taken into consideration. Hence, parts of this thesis may address or relate to some such functions, as they may be part of an implementation at a later stage.

The following assumptions have been made;

- Invoices to recipients not prepared to handle electronic invoicing are out of scope and will not be considered. That is, it is assumed that the recipients are equipped to receive invoices electronically.
- It is assumed that identified existing infrastructure can be integrated with, and accessed by the solution system.

## **1.5. Target Audience**

This thesis is targeted towards individuals involved in electronic invoice interchange system development, or anyone interested in learning more about electronic invoicing and issues concerning use thereof.

The report requires that the reader is familiar with basic concepts of information and communication technology and computer science. In particular, chapters 4.4 and 6. require some degree of previous knowledge and may be skipped by the more inexperienced reader. Effort has, however, been put on writing the thesis in such way that it should be possible for any interested reader to follow. A brief introduction to the most important concepts and theory is given.

## **1.6. Thesis Outline**

Chapter 2 introduces concepts within electronic data interchange. The chapter provides definitions and brief explanations of electronic data interchange, electronic invoice interchange and electronic procurement.

Chapter 3 presents an overview of user habits. The chapter provides insight both on impacts of adoption on issuers and recipients, and the relationship between them. In addition an analysis on obstacles and barriers that impede comprehensive adoption of electronic invoice interchange is provided.

Chapter 4 provides a market analysis. The market situation within Norway and in Europe is analyzed in brief. Next relevant projects and participants of the market are identified and presented along with existing infrastructure and key concepts. In addition formats and standardization issues are presented. The chapter is concluded

with a brief presentation of open source with key concepts, legal issues, development model and security issues.

Chapter 5 documents use cases, actors and (functional and non-functional) requirements. The documentation is based on the material presented in chapters three and four.

Chapter 6 documents a solution design, providing a high-level description of the application design. Next, functional areas within the application are presented, infrastructure and application overviews introduced and workflow of the application design outlined. Finally, identified issues and concerns are documented. The solution design is based on the documentation provided in chapter five.

Chapter 7 presents realized prototype implementation. The development method is presented in brief, and the – on the solution design based – implementation is introduced.

Chapter 8 discusses the outcome of the work related to project objectives.

Chapter 9 gives a brief summary of the work done, as well as a conclusion and suggestions for further work.

Appendix A lists informants, documents questionnaires, transcribes conducted interviews and credits contributors to this thesis.

Appendix B lists the content requirements of the eHandel.no Invoice format.

Appendix C provides a format comparison between the e2b and NESUBL (eHandel.no) formats.

Appendix D documents the WebRatio data model implementation of the prototype.

Appendix E documents the WebRatio logic model implementations of the prototype.

## Chapter 2

# Concepts of Electronic Data Interchange

There has been a constant growth in the use of information technology to support the exchange of information both within and between organizations. Electronic data interchange (EDI) is a way of conducting inter-organizational transactions electronically.

### 2.1. Electronic Data Interchange

EDI was originally developed as a standard for faster expedition time for freight and goods transported by ship. Pre-submitting forms such as delivery notes, declaration of goods and value, etc. resulted in that they could be processed before the cargo arrived at the transit site. This streamlined the shipping industry through faster processing times and reduced freight time.

With the introduction of information technology and electronic data handling, the forms were increasingly digitalized. Such digital and standardized forms led to further reduction of the processing time. This solution, developed by the shipping industry, was soon adopted by other industries with need for message exchange as part of their demands for streamlining processes. Examples of such messages involve press releases, accounting messages, energy and industry messages.

Today global rationalization and standardizing demands have led to a need for these documents and messages to be able to be interpreted and used by different applications. That is, a file from one application must be possible to use in another application by another user. This saves both time and work. The European Commission (EC) defines EDI as;

*“the electronic transfer, from computer to computer, of commercial and administrative data using an agreed standard to structure an EDI message”<sup>3</sup>.*

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<sup>3</sup> 98/820/EC, ANNEX 1, Article 2.2 [5].



The key components of this definition are; the electronic transfer of data, the use of standards and the exchange of data without (or with minimal) human intervention. The process is enabled by standardization of the message exchange. Organizations involved have to agree on contents, grammar, and organizational actions resulting from the message exchange for this communication to take place without human intervention [6][7]. Such agreement is usually achieved by way of an “interchange agreement”, or “EDI agreement” as called by the EC to avoid confusion with technical interchange agreements. A reference model agreement is provided in the EC recommendation [5].

Today, EDI is without comparison the fastest, most profitable and efficient way to exchange business messages. According to EU, this is a possible rationalization that could save billions annually. In pursuit of increased profitability, EDI is increasingly introduced, voluntarily as well as forced, within both private and public sectors.

## 2.2. Electronic Invoice Interchange

Invoices are the type of messages that have gotten particularly high focus when considering automated data processing. Such interchange within economic transactions is a phenomenon that appears to have been dissected from all imaginable angles; indeed, the 2009 Nobel price in economics was rewarded to work handling economic transactions [8].

This high focus on electronic invoice interchange comes, above all, from a high utility value of electronic interchange, as opposed to manual handling. The high utility value, in combination with an advanced level of technology being increasingly available, is speeding up the migration to electronic handling of invoices. An extensive European market report released in February 2009 shows that the annual growth within electronic handling will increase with about 35 % within the next few years. This implies an increase by 1.200 companies and 11.000 private users every day in Europe [9].

The reason for the reduced cost with electronic invoice interchange can be traced back to the lengthy process manual handling of invoices requires. Manual handling involves several steps in the process, causing the combined expenses to increase. Counting all expenses, estimates show that paper invoices incur costs amounting to 30-50 Euros per invoice [4]. Figure 2.1 shows an overview of the manual process.



Figure 2.1: Manual invoice process.

Use of electronic processing in turn has very few steps, making for a cheaper processing. In addition, most of the handling can be automated. Estimates show that costs can be reduced to 10 Euros when semi-automating the invoice process, and to one Euro by fully automating the process [9]. Figure 2.2 shows an overview of the electronic process.

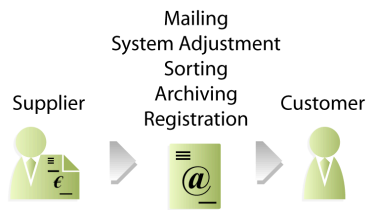


Figure 2.2: Electronic invoicing process.

That way, the cost of individual invoice handling is significantly reduced, and as a result, electronic and automated invoice processing may lead to savings between 1 and 2 % of turnover. Thus, use of EDI within invoice interchange is highly beneficial from an economic point of view and the utility value of switching to electronic handling is remarkable.

However, invoices have been transmitted in electronic format for decades and the early systems were point-to-point systems that required heavy investments in establishing the connection between the two organizations. In this report, these legacy systems are left out of scope and electronic invoices are defined as;

*invoices transmitted using XML-based open standards.*

The focus in this 'electronic invoice' definition is on the automation of invoicing processes, and this in turn requires that the invoice data is sent in a structured format. Therefore, invoices that are transmitted as attachments (PDFs etc) in e-mails are not considered as electronic invoices because they do not allow automatic processing. [4]

### 2.3. Electronic Procurement

Use of EDI, with any type of messages, often breeds adoption of additional integration. In fact, much of the current social change suggests that additional use of EDI in the form of electronic procurement may soon be imposed upon the industry. Projects such as PEPPOL and Europe 2020 Digital Agenda indicate a desire to accelerate the deployment of electronic procurement in Europe, in order to make public services more efficient and more modern.

Though out of scope for this thesis, such projects and initiatives should not be left unnoticed as they influence any design solution put forward by dictating usage and structure of international infrastructure. A closer look at those projects will hence be presented under Chapter 4.3 – Projects and Participants of the Market.

Electronic solutions are and have been of great importance in order to streamline collaboration and logistics for a long time. Such use of EDI has laid the foundation for new business models and changed organizations. The reason for the increase in use can be traced back to the advent of Internet, as electronic procurement over the Internet is much less expensive than traditional EDI usage. Hence the use has increased notably and become more common. Electronic procurement is, in this report, defined as;

*all forms of commercial transactions and business activities over electronic networks in the context of procurement processes. These transactions may be related to ordering, payment and delivery of physical goods and services but may also include the transmission of digitized goods and access to services. [10]*

In this definition focus is primarily put on electronic commerce and business operation, i.e. interaction related to business processes such as tendering, ordering, billing and sourcing. Note that electronic invoice interchange is part of this definition.

## Chapter 3

# Understanding User Habits

In order to identify requirements for a solution design, a closer look at how adoption of electronic invoice interchange impacts the users is needed. In addition, an analysis of why adoption of electronic processing has not been more comprehensive is required. Note that much of the material for this analysis has been attained by way of interviews. For presentation of informants and questionnaires, please refer to Appendix A.

### 3.1. Impacts on receiver and sender ends

An important aspect with electronic invoicing is the impact it will have on the senders, the recipients and on the relationship between them.

#### **Sender**

The sender in this context is considered to be the supplier, and scenarios where the sender also is the customer (i.e. self-billing) or third party (i.e. outsourcing) is considered out of scope.

The impact adoption of electronic invoicing will have on the supplier is mainly economic. As more and more buyers demand electronic delivery of invoices, adoption of EDI brings an advantage to suppliers, and with that, possibly a profit increment. In addition, manual handling and processing is costly and automation reduces the transaction cost. However, adoption of EDI also brings added costs as a result of process reorganizations, training and system investment expenses. This brings that, unless given a cost-effective or free of charge system, the impact may in fact be financially negative. In order to expose the source of the potential savings, a closer look at the costs involved is needed.

Bruno Koch analyzed in his Market Report [9] the full costs based on traditional paper-based processes and compared it with an electronic automated solution. The analysis shows that the big saver is the recipient – especially if the sender is a small company – but also the sender will have a cost reduction.

The calculations made in the market report reflect an industry with 5,000 employees, based on calculated staff cost of €60/hour. Further, the calculations reflect relatively simple invoices with an average size of 1.5 pages. In most organizations, the invoices are more complex and the savings are higher. Figure 3.1 shows an overview of the calculated saving potential for invoice issuers.

	Paper	Electronic, automated
Print, Envelope, Send	3.90€	0
Archiving	2.20€	0.80€
<b>Total Costs</b>	<b>6.10€</b>	<b>0.80€</b>

Figure 3.1: Saving potential for invoice issuers [9].

As can be seen in the figure, the saving potential per invoice is 5.30€. The analysis, however, shows a fully automated electronic solution, and as pointed out in Chapter 1.4 – Key Assumptions and Limitations, full automation of the issuer invoice processing lifecycle is out of scope. Hence, in case a semi-automated solution is presented to the issuer end, a 0.50€ handling cost<sup>4</sup> can be added to the electronic processing costs. That brings the saving potential per invoice to 4.80€ which equals 79 % of the full cost.

The optimization by use of electronic invoicing includes factors such as environmental concerns<sup>5</sup>, real-time delivery with receipt/download confirmation, validation of key data as soon as sent, and secure send via Internet. All this saves time and minimizes errors. Note that closely related to creating and sending invoices is creation and send of credit notes, and a solution prepared for invoices should also support credit notes.

The last step in an invoice lifecycle is archiving, and it stands to reason that automated archiving brings advantages in comparison with traditional options. Search functionality, access from decentralized environments, facilitated and secured auditability possibilities, and saving of storage space to name a few of the advantages. Note that Norwegian law demands certain documents to be stored for a minimum of 10 years, 11 months and 30 days, so the need for maintenance and space may quickly grow large with paper-based invoices in case of a hefty company invoice volume.

Consequently, use of traditional paper-based invoices comes with a number of drawbacks, where high costs is the most obvious drawback. However, when looking at the costs only direct costs, such as invoice printing and stamp costs appear in the organization budget at first glance. Yet, this is only a fraction of all processing costs, in fact, this represents just 9 % of all directly related costs. Another major part is quite often not at all recognized at first glance. Other major cost items, which may be reduced by electronic invoicing, include;

<sup>4</sup> This “handling cost” covers manual entering of invoice data.

<sup>5</sup> Use of electronic invoices contributes an improvement of up to 0.8% of Kyoto protocol requirements [9].

- Sales Back office (Further inquiries in case of dispute).
- Debtor interest.
- IT development and operation.
- Payment fees (reduced or no fees in case of electronically and fully automated processes).
- Customer requests for copies of lost invoices.

In addition, it is calculated that 10-15 % of all invoices require a payment reminder. Many of the reminders are needed due to the fact that recipients have time-consuming workflows and payment release systems for paper invoices. This may be reduced by use of electronic invoicing, as many of the clients process the electronic invoices automatically (below a certain amount and matching with order). Accordingly, use of electronic solutions allows for automatic payment remittance and gives a cash manager better control of all invoices due to faster electronic feedback. This in turn allows for optimized cash management on both ends of the invoice processing. Market analysis shows calculated savings of up to 1.60€ per invoice for the steps payment reminders, remittance and cash management, when using electronic invoices as opposed to paper-based invoices. With these savings included in the above calculated savings the saving potential equals to 6.49€, or 43 % per invoice [9].

However, for such savings to have any visible impact, the sender must have some amount of outgoing invoices per year. Small companies with low volumes of invoice interchange will most likely not experience these savings or related costs as something affecting their budget at all. This in turn bring that they will likely have no interest in adopting or investing in any new system, as that will bring extra work and expenses, and possibly a negative financial impact on their business. The only obvious reason for a small (non high-tech) company or sole proprietor to send electronic invoicing seems to be leverage from their recipients leaving them no option.

### **Recipient**

From an economic point of view the recipient of the invoices, i.e. the buyer, is the big winner. The processing of incoming invoices, credit notes and other business papers incurs surprisingly high costs. The reason for this is found in all the indirect costs that do not necessarily appear as obvious invoice processing costs. Such costs include handling of tasks like;

- Sorting of incoming mail.
- Mail opening and sorting.
- Removal of advertising and non-relevant attachments.
- Entrance stamping and forwarding to Accounts Payable department.
- Manual invoice checking with other departments.
- Copying of invoices.
- Error prone manual entering of invoices (as much as 10 % of entered data is viewed with errors), or scanning of invoices (solves only part of the problem).

- Data conversion of invoices to the accounting format.
- No automated validation of VAT compliance and other key data, which can lead to that discrepancies are detected at a too late stage.
- Manual matching of line items with order data (automated matching brings a faster and better spend analysis, leading to a spend reduction from 1.3 % to 5.5 %) [9].
- Office space used for archiving (certain documents must be stored for a minimum of 10 years, 11 months and 30 days, potentially leading to large needs of storage space).
- Etc.

Calculating all costs, the savings per invoice are 11.60€. If a 0.70€ processing cost by third party service provider is added to the electronic processing cost, then the savings per invoice are 10.90€ which equals 62 % of the total cost. For any company with a large volume of invoice interchange, this corresponds to a significant savings potential [9].

Note that this thesis does not take part in designing a system that represents the receiving end of the invoice chain. However, much of the motive for this project can be traced back to the high savings the recipient of the invoices experiences.

### **Relationship**

The impacts on the buyer and seller individually have foundation in economic phenomena as discussed above, but use of electronic processing will also impact the relationship between them in a number of ways.

First and foremost, use of electronic invoicing affects the information exchange between the buyer and the seller. Use of electronic invoicing ideally means exchange of structured data between the parties, which facilitates the information flow between the two. Even a semi-automated solution for electronic invoicing facilitates the information flow to a certain degree, or if nothing else from small supplier point of view, prevents the supplier from losing the specific customer demanding electronic invoicing.

Note that with an increased amount of automated information exchange the linkage between two parties may become stronger, as any heightened level of information flow between two parties suggests a heightened level of cooperation. With that, and from the high utility value of electronic processing, buyers demanding their suppliers to send invoices electronically may, within a foreseeable future, demand further automation of processes.

Another effect the structured exchange of data can have on the parties is a resulting necessity for the parties to adapt systems, procedures, and routines to handle the relationship. At one extreme the two companies may operate completely independently, where no routines or systems are affected within the involved companies. At the other extreme, routines and systems must be adapted and adjusted to suit the relationship. Large companies seem to favor large amounts of relationship-specific adaptations from their suppliers, as large amounts of adaptations means large amounts of investments, which in turn leads to a privileged relationship and possibly even to a lock-in of the trading partner. However, a

minimum amount of adjustment for the sending small companies should be sought for in a solution design, as the small company is most likely using the system out of client requests and not out of company profit analysis.

When using electronic interchange, it is not uncommon to sign legal documents, e.g. interchange agreements that specify the obligations and roles of both parties in the relationship. Thus adoption of electronic invoicing may include aspects of commitment and an expectation of future interaction among buyer-supplier pairs that adopt its use. With that, electronic invoicing can be determined to have a positive effect on the relationship between a buyer and a seller. [4][11][12]

### **3.2. Adoption of electronic processing**

The above analysis of impacts on buyer, seller and buyer-seller relationships shows a positive impact on all parties. However, adoption of electronic invoicing comes with several obstacles that make electronic invoice processing a complex task, and that impede a comprehensive adoption. Taking a closer look at those obstacles, some main barriers and factors come across as affecting the willingness, or rather, the reluctance to adopt electronic processing of invoices.

#### **Legal barriers**

There has been a legal uncertainty surrounding use of electronic handling of invoices for a long time. Legislation amendments completed in many nations have, however, addressed this issue and the uncertainty surrounding the requirements is rapidly diminishing. The fact that the public sectors in many countries are themselves using electronic invoicing has without doubt contributed to that any confusion of early ears, caused by contradictory legal interpretations, has almost disappeared [1][3][12].

In Norway the act released by FAD [3], not only reinforces legality but also suggests that the government decrees the industry to adopt use of electronic invoicing. With that, any legal uncertainty can be seen managed and the barrier can be neglected in this context.

#### **Lack of Trust**

Another barrier is lack of trust. People in general seem reluctant to trust electronic, or computer processing solutions for any central part of their value chain. This lack of trust becomes apparent when comparing differences in demands for paper- and electronic invoices. The authenticity of origin of a paper-based invoice is normally verified solely on the basis of the letterhead, whereas use of electronic invoicing mostly require an advanced or qualified electronic signature. Such authentication should offer a significantly higher trustworthiness than paper invoices. However that seems not to be the case [1].

#### **Missing Standardization**

The multitude of available formats and specifications, partly proprietary, obstructs both the interoperability when exchanging electronic invoices and the establishment of an accepted standard. The reason for this can be traced back to the fact that buyers and suppliers may have different preferences over EDI standards due to the conflicts of interest when considering EDI investments. The buyers tend to prefer their proprietary system, as it helps them to be more competitive and to lock in their



suppliers. Large amounts of adaptation can contribute to preserving the suppliers' loyalty and increasing the suppliers switching cost and therefore building a barrier for other buyers to enter. To the contrary, the supplier would likely prefer standardized EDI systems, as the EDI standard makes it cheaper to adopt and easier to use [1][13].

This obstacle is now being addressed in several European nations by legislation amendments. In Norway the government suggests imposing of a standardized use of electronic invoicing and EDI in a White Paper saying that all invoices sent to the public sector must be sent in designated standard format [3]. However, many different formats, or variations of formats, are already in use and the standardization obstacle is far from solved. A presentation of the formats topical for this thesis, and of standardization issues is provided in Chapter 4.5.

### **High Costs**

Adoption of EDI is traditionally costly, which decreases any advantage and profit increment received by a supplier that adopts EDI. Therefore, the suppliers have to make proper strategic decisions before investing, and unless the number of transactions and the frequency of the transactions is high, a costly investment is likely not beneficial. In addition, even if a supplier has a large enough amount of invoice interchange to find adoption beneficial, the supplier might still choose not to invest in a costly system if the relationship with the buyer is not strong enough to provide some sort of trust that the investment will not be in vain [11][13].

For small businesses with small volumes of transactions any costly investment would likely be adverse, leading to the result that they are excluded from participating in trade with buyers that demand electronic invoicing. Such exclusion of suppliers may also have a negative impact on the buyers as their suppliers' base gets reduced.

Any such reasons not to adopt electronic handling can be avoided by offering a cost effective solution.

### **Dependence**

Suppliers that do not have a large number of buyers that they do business with may become dependent on specific buyers. The greater the proportion of sells to a particular buyer, the greater the dependence tends to be. Large organizations with large market shares may exploit being in a position where suppliers are dependent on them to secure the resources they need. Hence, dependence is not a barrier, but rather a persuasion tool for recipients, or buyers to convince their suppliers to adopt electronic handling. Whether or not use of such leverage by a buyer is successful or not depends on how important the specific buyer is to the supplier.

Another angle of the dependence factor is the degree of product customization that a supplier sells to a buyer. The more customized the product requested from a supplier is, the higher is the dependency on the supplier from both buyers and suppliers point of view. The buyer will have a higher switching cost of changing suppliers, but also the supplier is less likely to exit due to the higher sunk cost for producing the customized products. This increases the incentive for establishing partnership relations and to improve communications by use of EDI [11].

A survey made in early 2008 showed that many small customers expressed electronic invoicing systems as a “nice to have” option or something they do not need to concern themselves with. Many larger businesses described in the same survey, however, electronic invoicing as a mandatory requirement for future business relationships. This means that due to increased cost pressures and competition in the coming years, that “nice to have” option may quickly become a mandatory requirement with a short deadline for reaction and implementation, when more and more large organizations demand electronic delivery [9].

### **Technical Capability**

Yet another factor to take into consideration is the level of expert knowledge within a company, and the degree of specialization within the organization. Suppliers with a high level of technical capability are more likely to adopt EDI much earlier than those without. The management view of new technology also affects the likelihood of adoption. A proactive management view of adopting new technology, or with a management view that EDI is a source of sustained competitive advantage increases the willingness to adopt.

This aspect has, however, not only to do with a higher degree of technical capability, but also with the fact that very specialized companies tend to trade with a narrower range of buyers. A less specialized company trades with companies from a wider range of industries and therefore tends to face problems of standards compatibility.

Hence, the amount of integration a company is likely to adopt is influenced by the companies' appreciation of technological innovation, by the learning process already undergone by the personnel, and by the amount of adaptation needed to adopt electronic handling across the buyers pool [11].

In this project the target audience can be assumed to have little or no technical capability.

### **Company Size**

Also the size affects the adoption and integration decisions. A large company usually has greater slack resources than a small company. On the other hand, the level of structural inertia increases with size. It is inherent in their size that small companies can more readily adapt to changes in technology, manufacturing processes, and market forces than larger businesses. Smaller companies, although they often lack financial resources, tend to be more innovative, flexible, responsive, and less bureaucratic and, therefore, have greater incentive to adopt EDI [11].

However, existing routines within small companies without high technical capability seem to be poorly suited for shifting to electronic handling. Small companies often use simple accounting applications when creating their invoices, and with that, much of their invoice lifecycle is manually handled. Common software to use for invoice creation are applications such as Excel or Mamut. Programs such as Mamut come with a possibility to export created documents to XML documents. However, the structure of the XML will be dependent on the style of use within the accounting software. Excel also comes with a possibility to create Comma-Separated Values, CSV files.

## Chapter 4

# Market Analysis

Any implementation of EDI requires a degree of analysis and restructuring of business processes, both from an information generator and receiver point of view. This is also the case when implementing EDI in invoice processing.

The solution design developed in this report should thus take into consideration existing infrastructures and routines in order to avoid interfering with established procedures and definitions as much as possible. To achieve this a closer look at the market is necessary. Firstly, in order to determine potential load on the solution, market potential is investigated in brief. Next, an overview of market participants and their roles is presented, as those participants to large part lay the grounds and define the framework for infrastructures and standards. The existing formats and infrastructure are subsequently investigated. The chapter is closed with a brief look at the open source movement, to determine potential impact on a solution design.

### 4.1. Norwegian Market Overview

In Norway, there are approximately 482,000<sup>6</sup> businesses in total. Of these, only a small minority uses electronic interchange. As of 2009, only 624 Norwegian companies offered electronic invoicing, and 50 million electronic invoices were sent during 2009. The companies prepared for electronic interchange are mainly large organizations.

Of the 482,000 businesses, only 636 are large organizations while the remaining are spread over approximately 192,000 small- and medium sized enterprises (SME) and 289,000 sole proprietors [14]. Figure 4.1 illustrates the distribution.

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<sup>6</sup> [http://www.ssb.no/english/subjects/10/01/bedrifter\\_en/tab-2010-01-29-01-en.html](http://www.ssb.no/english/subjects/10/01/bedrifter_en/tab-2010-01-29-01-en.html)

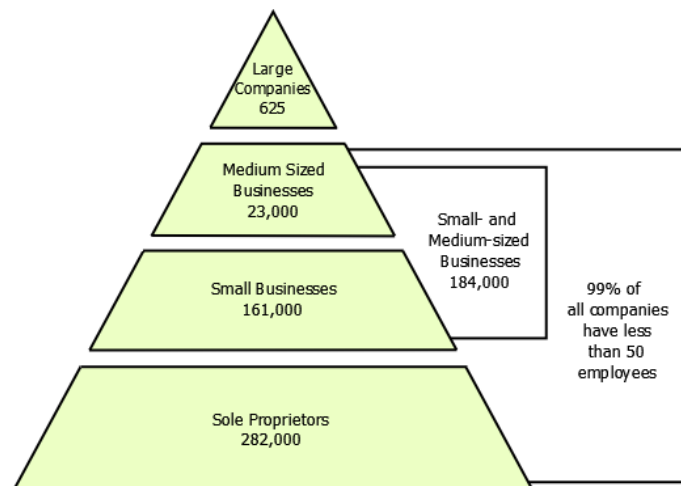


Figure 4.1: Distribution of business sizes in Norway.

The Norwegian Government Agency for Financial Management (SSØ) received 640,000 invoices during 2009 on behalf of 160 state-owned organizations. Those 640,000 invoices were sent from 63,000 different companies. Out of those companies only three were able to send invoices electronically [15]. In fact, numbers from Telenor show that as many as 80-90 % of all Norwegian companies do not have the necessary software to be able to send messages electronically<sup>7</sup>.

This lack of comprehensive adoption of electronic interchange is not limited to the private sector. A look at the municipalities shows an enormous need for development. Fredrikstad is among the municipalities that have advanced the furthest in electronic processing, and they process 4 % of their incoming invoices electronically. They have a total of 100.000 incoming invoices and 240.000 outgoing invoices per year, and calculate savings of between 25-30 million NOK for shifting to electronic processing of invoices<sup>7</sup>.

The proposal presented in White Paper No.36, however, demands 100 % electronic processing by the year 2012 [3]. With that, the White Paper No.36 will be a driving force for the introduction of electronic interaction on all levels in state and municipalities, and this in turn will have an immediate effect on the private sector.

Nonetheless, with the upcoming law amendment, as many as 420,000 businesses may be without ability to participate in trade with the public sector and with buyers that demand electronic invoicing, if they are not offered a solution.

### **Large organizations in the Norwegian market**

In line with the trends presented in this thesis, the largest companies stand strongest and are best prepared to meet the new requirements from the public sector. Most of the large companies already have the necessary software, or have an infrastructure that can easily be adapted to send and receive electronic invoices. Unless these companies do not already demand their suppliers to send invoices electronically, they will much likely do so within a short period of time [9].

<sup>7</sup> R. Heimstad (personal communication, September, 2010)

### **Small companies in the Norwegian market**

The state and municipalities, and likely large organizations, will force Norwegian small companies and sole proprietors to send invoices electronically. Small businesses that do not adapt to these demands will be excluded as potential bidders. According to the above presented figures from Telenor, small companies have only to a limited extent the necessary software and virtually none of the sole proprietors have the necessary software to meet these emerging demands. There is with that a large need for a cost-effective solution to meet the abilities of the small businesses and sole proprietors<sup>8</sup>.

## **4.2. European Market Overview**

The governments within EU see huge modernization potential within electronic procurement. Furthermore, EU sees the opportunity to strengthen European companies by allowing greater use of such technology, and hence, through action plans and legislation amendments EU has opened up for a strong growth in use of electronic procurement and services.

One example of such a step recently taken by the EU to reduce the legal barriers and fuel successful uptake of e-Invoicing in Europe is a new directive that was adopted in 2010 by the Council of the EU<sup>9</sup>. The new directive was based on an independent assessment<sup>10</sup> performed by PricewaterhouseCoopers. One of the most important changes adopted in the new directive is a removal of technological requirements from VAT legislation. This means that a principle of “equal treatment” has been introduced in Europe between paper- and electronic invoicing. That is, the new directive brings that any business controls that are used today to guarantee e.g. VAT compliance of a transaction for paper-based invoicing can also be used for electronic invoicing. The EU member states have until the end of 2012 to transpose the new directive into their national legislation [16]. Note that investigation of VAT compliance has been left out of scope in this project, and the matter will need to be further investigated.

In the year 2009, a total of 30 billion invoices were sent yearly within the Euro zone as a whole. Only 1.4 billion of those invoices were sent electronically. A saving of €50 billion through the use of electronic invoicing alone is expected within EU [9].

The Billentis Market Report shows an expected increase in use of electronic invoicing by 35 % annually. This translates to an increase of 0.5 billion invoices during 2010 alone [9]. Note that the Scandinavian countries are regarded as pioneers in this type of services, and a solution design adopted by Difi is potentially planned to be released as open source and deployed for use within the entire EEA area.

### **Large organizations in the European market**

Large organizations within EU have a huge transaction volume of messages. For example, Deutsche Telekom AG alone sends 60 million B2C invoices per year. This is equivalent to 2.5 times more than the total amount of invoices sent in Norway<sup>8</sup>.

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<sup>8</sup> R. Heimstad (personal communication, September, 2010)

<sup>9</sup> COUNCIL DIRECTIVE 2010/.../EU of amending Directive 2006/112/EC on the common system of value added tax as regards the rules of invoicing

<sup>10</sup> <http://www.pwc.com/be/en/publications/study-on-the-invoicing-directive.jhtml>

Note that such organizations are not considered as target user group for the solution design put forward in this report. However, they may well be part of recipient target group along with large Norwegian organizations and the public sector.

### **Small companies in the European market**

SMEs are defined differently in EU and in Norway. The European SMEs are defined as companies with a revenue of up to €50 million. This EU definition of SMEs leads to that about 99.8 of the European companies are included in that category [9]. The Norwegian definition of an SME is a company with between 20 and 100 employees. In this report the EU definition is applied, though the term is being used loosely.

The number of transactions is expected to rise sharply towards 2013, particularly due to demands from large companies within EU as a result of rationalization processes. Several governments, both within and outside EU, are also pressuring participants of the market to adopt electronic processing [9].

### **4.3. Projects and Participants of the Market**

Both within Norway and in the EU, projects and action plans are carried out as steps towards modernization, improvement of the competitiveness and innovation of the markets. These projects and action plans take part in defining standards and building infrastructures, and hence affect any solution design set forth. Figure 4.2 shows an overview of relevant projects and participants, and their relationships.

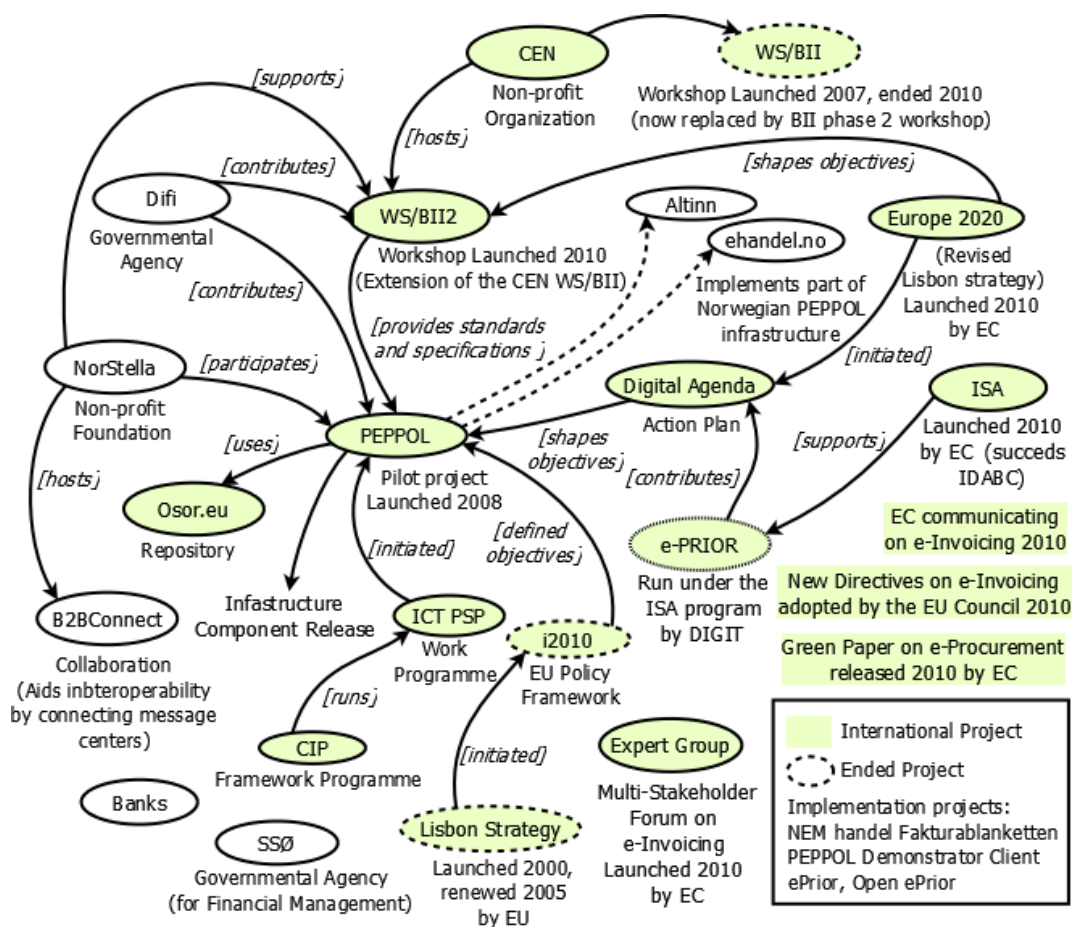


Figure 4.2: Projects and participants of the market, and their relationships.

Each of the participants illustrated in Figure 4.2 are presented in brief below.

### CIP ICT PCP

The Competitiveness and Innovation Framework Programme<sup>11</sup> (CIP) is a EU program that was started 2007 and runs until 2013. The Programme aims to encourage the competitiveness of European enterprises, with SMEs as main target. This framework program is organized around three operational programmes;

- The Entrepreneurship and Innovation Programme (EIP).
- The Information and Communication Technologies (ICT) Policy Support Programme (ICT PSP).
- The Intelligent Energy-Europe Programme (IEEP).

In this context the ICT PSP<sup>12</sup> work programme is of relevance. The objective of the ICT PCP is to stimulate innovation and competitiveness by a wider use of ICT by citizens, governments and businesses, particularly SMEs. Hence, the programme supports activities to accelerate innovation and implementation of ICT based services and systems. One such activity selected by CIP ICT PSP is the e-Procurement pilot project PEPPOL presented below.

<sup>11</sup> [http://ec.europa.eu/cip/index\\_en.htm](http://ec.europa.eu/cip/index_en.htm)

<sup>12</sup> [http://ec.europa.eu/cip/ict-psp/index\\_en.htm](http://ec.europa.eu/cip/ict-psp/index_en.htm)

## **PEPPOL**

The Pan European Public Procurement On Line<sup>13</sup> (PEPPOL) is a 42-month (May 1st 2008 – October 31st 2011) pilot project under the European Commission’s CIP ICT PSP initiative.

The project aims to align business processes for eProcurement across all Government Agencies within Europe. The vision is that any company, and in particular SMEs in the EU, can communicate electronically with any European governmental institution for the entire procurement process. The “entire procurement process” includes the process from notice to pre-award tendering, post-award procurement and finally to payment and archiving solutions (i.e. e-Invoicing, e-Ordering, e-Catalogue, e-Signature, virtual company dossiers and solutions architecture, design and validation).

The scope and structure of the PEPPOL project has been divided into eight work packages (WP). The WPs of interest for this thesis are WP5 that covers electronic invoicing and WP8 that covers architecture. The vision of WP5 is to have a solution that makes it possible for economic operators in any European country to send invoices electronically to any European awarding entity. The vision of WP8 is that exchange of business documents between any private company and any EU governmental institution should be as easy as sending e-mails. Within WP8, a transport infrastructure to support the message exchange is being defined and developed. Note that this infrastructure has also set the framework for the transport of electronic invoices to the public sector within Norway. Please refer Chapter 4.4. – Existing Infrastructure and Key Concepts for further details.

The PEPPOL consortium comprises of the leading public eProcurement agencies in Austria, Denmark, Finland, France, Germany, Italy, Norway and Hungary. These have recently been joined by agencies from Greece, Portugal, the UK and Sweden. It has been suggested that a further extension and enlargement of this PEPPOL project should be supported.

Components released within the PEPPOL projects are primarily released as open source.

### **Osor.eu**

The Open Source Observatory and Repository<sup>14</sup> for European public administrations (OSOR) is a platform for exchanging information, experiences and F/OSS-based code for use in public administrations.

All software components released within the PEPPOL projects are placed in the PEPPOL domain of OSOR.eu<sup>15</sup>.

### **i2010 / Europe 2020**

i2010<sup>16</sup> was a comprehensive strategy for modernizing and deploying all EU policy instruments to encourage the development of the digital economy. The i2010

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<sup>13</sup> <http://www.peppol.eu>

<sup>14</sup> <http://www.osor.eu/>

<sup>15</sup> <https://svn.forge.osor.eu/svn/peppol/>



initiative presented the i2010 eGovernment Action Plan, with the goal to accelerate eGovernment in Europe for the benefit of all. Hence, i2010 was the EU policy framework for the information society. This strategy has now come to an end and has been followed by a new initiative; the Digital Agenda<sup>17</sup>. The objective of the Digital Agenda is to define the key enabling role that the use of ICT will have to play if Europe wants to succeed in its ambitions. The action plan, among other things, aims to encourage SMEs adapt to digital standards.

The i2010 action plans were results from the Lisbon strategy [17]. The original Lisbon strategy was launched in 2000 and renewed in 2005. In March 2010, the European Commission launched a Europe 2020<sup>18</sup> strategy, which is a revised Lisbon Strategy for growth and jobs. The purpose of the strategy is to get Europe out of the crisis and prepare the EU economy for the next decade, and the Digital Agenda is one of seven flagship initiatives of the Europe 2020 Strategy.

These strategies have set the stage and molded the goals of EU today. Note that also the objectives of the PEPPOL cooperation can be deduced from the i2010 strategy.

### **European Commission**

During 2010 the European Commission (EC) has been involved in a number of e-Invoicing initiatives<sup>19</sup>. Such initiatives include communication on e-Invoicing; 'Repeating the benefits of electronic invoicing for Europe'<sup>20</sup>, setting up a European Multi-Stakeholder Forum on e-Invoicing<sup>21</sup> and release of a Green Paper on e-Procurement<sup>22</sup>. Also new directives on e-Invoicing<sup>23</sup> has been adopted by the EU Council during 2010.

### **CEN**

The European Committee for Standardization<sup>24</sup>, or Comité Européen de Normalisation (CEN) is a non-profit organization set up to provide a platform for the development of European Standards and other consensus documents. The CEN cooperation consists of 31 national members (27 European Union countries, 3 EFTA countries and Croatia).

CEN works in a decentralized way where its members operate the technical groups that draw up the standards. The CEN Management Centre (CMC) in Brussels manages and coordinates this system and the European Commission and EFTA act as CEN counselors.

In addition to European Standards (ENs), CEN also offers other types of documents, including CEN Workshop Agreements (CWAs). The CWAs are consensus-based specifications and result from workshops (WS) held by CEN.

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<sup>16</sup> [http://ec.europa.eu/information\\_society/europe/i2010/index\\_en.htm](http://ec.europa.eu/information_society/europe/i2010/index_en.htm)

<sup>17</sup> [http://ec.europa.eu/information\\_society/digital-agenda/index\\_en.htm](http://ec.europa.eu/information_society/digital-agenda/index_en.htm)

<sup>18</sup> [http://ec.europa.eu/eu2020/index\\_en.htm](http://ec.europa.eu/eu2020/index_en.htm)

<sup>19</sup> [http://ec.europa.eu/internal\\_market/payments/einvoicing/index\\_en.htm#ongoing](http://ec.europa.eu/internal_market/payments/einvoicing/index_en.htm#ongoing)

<sup>20</sup> COM(2010)712

<sup>21</sup> C(2010)8467

<sup>22</sup> SEC(2010)1214

<sup>23</sup> COUNCIL DIRECTIVE 2010/.../EU of amending Directive 2006/112/EC on the common system of value added tax as regards the rules of invoicing

<sup>24</sup> <http://www.cen.eu/>

The CEN work has been divided to a number of sectors, and within the sectors a number of workshops. Within the ICT sector, the CEN information Society Standardization System (ISSS) has been created to focus on ICT standards activities. Under the CEN/ISSS sector, a workshop on Business Interoperability Interfaces on public procurement in Europe (WS/BII) was established. This workshop has now been succeeded by a BII phase 2 workshop<sup>25</sup> (WS/BII 2). The WS/BII 2 workshop is represented by participants from 9 different countries, and the main focus of the workshop is to bring out agreed specifications for standardized message exchange within electronic procurement in Europe. Note that the key initiative to implement and put the created standards into use is the pilot project PEPPOL.

### **Difi**

The Agency for Public Management and eGovernment<sup>26</sup> (Difi) is a Norwegian governmental agency with the task to help develop and renew the public sector, strengthen coordination and provide common solutions. The aim is to strengthen the government's work in renewing the Norwegian public sector and improve the organization and efficiency of government administration. Difi was established in 2008, following a merger of the previous public agencies Statskonsult, Norway.no and the Norwegian eProcurement Secretariat. The agency is supervised by the Ministry of Government Administration, FAD.

Difi is the Norwegian partner in the PEPPOL consortium. Also, the EU Commission has via the PEPPOL consortium given Norway the task of leading an e-Procurement project with the goal to streamline procurement across borders within Europe for the public sector. [18]

Difi also contributes in standardization projects, such as CEN/ISSS WS/BII 2. Part of this contribution is done by way of consultancy company EdiSys<sup>27</sup>. EdiSys specializes in Electronic Commerce and EDI, and plays an active part in national and international standardization efforts for EDI. EdiSys has contributed with advice and assistance to Difi, relating to the NESUBL, BII and PEPPOL projects.

### **NorStella**

The Foundation for e-Business and Trade Procedures<sup>28</sup> (NorStella) is a non-profit foundation appointed by the Norwegian Government as the national contact point for all international standardization activities, in the field of electronic business and trade facilitation. NorStella supports the BII 2 workshop and hosts the B2BConnect group, and has also been one of the driving forces (in cooperation with Difi) behind the Norwegian CEN BII standard eHandel.no. The foundation was established in January 2003.

### **B2BConnect**

Service providers, or that is, suppliers for e-Commerce messaging in the Norwegian market have signed a joint roaming agreement named B2BConnect<sup>29</sup>. The collaboration was founded in order to make it easier for issuers and recipients to

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<sup>25</sup> [http://www.cen.eu/cen/Sectors/Sectors/ISSS/Activity/Pages/Ws\\_BII.aspx](http://www.cen.eu/cen/Sectors/Sectors/ISSS/Activity/Pages/Ws_BII.aspx)

<sup>26</sup> <http://www.difi.no/>

<sup>27</sup> <http://www.edisys.no/>

<sup>28</sup> <http://www.norstella.no/>

<sup>29</sup> <http://www.b2bconnect.no/>

mediate e-Commerce messages even if they make use of different message centers. B2BConnect claims to represent over 90 % of the business-to-business (B2B) market for e-Commerce messages. All companies that take part in the collaboration must offer electronic message exchange to the market. Client Computing<sup>30</sup> and EDB Business Partner<sup>31</sup> are two examples of the 12 members in B2BConnect.

## **SSØ**

The Norwegian Government Agency for Financial Management<sup>32</sup> (SSØ) has been given the task to strengthen financial management within the public sector activities and improve resource efficiency within the area. The goal of SSØ is to improve quality and lower the total costs for the public sector within financial management.

SSØ serves approximately 200 organizations under the various ministries (public sector). This makes SSØ an important player when the law presented in White Paper No. 36 enters into effect, as many of the small companies in the market sending invoices to the ministries, will send them to SSØ.

## **Banks**

Norwegian banks are able to offer electronic invoicing by use of Northern European Transaction Services<sup>33</sup> (Nets) technology. Nets, formerly BBS<sup>34</sup> (Norwegian; Bankenes Betalings Sentral), is a provider of electronic ID, payment and information solutions.

Efaktura.no<sup>35</sup> is an example of a portal solution powered by Nets technology. Also the bank DNBNor recently revealed an implementation of the Nets solution for electronic invoice handling [19]. However, the solution includes use of Internet bank, and brings a restriction in relation to format selection. Hence, such solution does not fulfill the demands set forth in White Paper No.36 as it cannot be used to send invoices in the mandatory format eHandel.no. Nevertheless, it should be noted that any solution presented in this thesis could be of interest to integrate with banks at a later stage for further automation of payment and notifications.

## **Ehandel.no**

Ehandel.no<sup>36</sup> is a Norwegian State e-Procurement initiative owned by Difi. The public procurement portal was established to attain user mass to electronic public procurement, and to give the public sector entities and their suppliers easy access to an affordable tool for operational e-Procurement with each other. The ehandel.no was built by Capgemini Procurement services<sup>37</sup>, formelrly IBX, and has today been expanded to act as an access point for the PEPPOL infrastructure. The ehandel.no access point is up and running.

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<sup>30</sup> <http://www.clientcomputing.com/>

<sup>31</sup> <http://www.edb.com/>

<sup>32</sup> <http://www.sfsno.no/>

<sup>33</sup> <http://www.nets.eu/en/Pages/default.aspx>

<sup>34</sup> <http://www.bbs-nordic.com/>

<sup>35</sup> <http://efaktura.no/>

<sup>36</sup> <http://www.ehandel.no/>

<sup>37</sup> <http://www.ibx.no/>

## **Altinn**

Altinn<sup>38</sup> is an official Norwegian web portal, which aims to deliver electronic forms to public authorities and services. Altinn is used mostly by businesses, but also individuals may use the portal to submit e.g. tax returns and other forms electronically. Altinn also provides access to public records and reports from government agencies.

Altinn takes part in building the Norwegian part of the PEPPOL infrastructure by expanding the Altinn functionality to handle access point services, and by building a register containing all Norwegian public agencies, the ELMA Register.

## **Implementation Projects**

### *PEPPOL Demonstrator Client;*

PEPPOL has released a demonstrator client as an open source project oriented to developers. The project includes;

- Demo Client project; i.e. the application itself, in charge of the visual parts.
- Demo Workflow Engine; contributes to the flow of the project.
- Java Plug-in; supports the sending and receiving
- Validation Engine Plug-in; allows the client to perform validation by layers.

The Demonstrator Client project is part of the PEPPOL infrastructure component release. It offers a simple business application capable of creating and receiving orders or invoices to allow developers to adopt and test the PEPPOL infrastructure [20].

### *e-PRIOR / Open e-PRIOR;*

As part of the Interoperable Delivery of European eGovernment services to public Administrations Businesses and Citizens (IDABC)<sup>39</sup> e-Invoicing and e-Ordering program, the Directorate General for Informatics<sup>40</sup> (DIGIT) has developed an e-Procurement platform pilot. The pilot project, electronic Procurement, Invoicing and Ordering (e-PRIOR), offers an infrastructure for electronic invoicing and electronic ordering. The main objective of the project was to set up an infrastructure for e-Procurement at the European Commission and to digitize its own procurement processes.

However, to support the objectives defined in i2010 e-Government action plan – to accelerate e-Procurement in Europe for the benefit of all – an open source version of the platform has been released<sup>41</sup> (Open e-PRIOR). The main objective for the Open e-PRIOR project is to offer a bridging system for electronic invoicing and electronic ordering between all public authorities that wish to pilot e-Procurement and their suppliers. The Open e-PRIOR uses the profiles of CEN/ISSS WS/BII and includes a connector with the PEPPOL infrastructure via an own PEPPOL gateway.

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<sup>38</sup> <https://www.altinn.no>

<sup>39</sup> IDABC has now been succeeded by the program 'Interoperability Solutions for European Public Administrations' (ISA), <http://ec.europa.eu/isa/>

<sup>40</sup> [http://ec.europa.eu/dgs/informatics/index\\_en.htm](http://ec.europa.eu/dgs/informatics/index_en.htm)

<sup>41</sup> <http://www.osor.eu/projects/openeprior>

Though left out of scope in this project, the Open e-PRIOR solution could be of interest to further investigate in order to determine potential for adaptation to the Norwegian market. Such reuse could significantly reduce both implementation time and costs.

*NEM handel Fakturablanketten;*

An open source solution<sup>42</sup> for use within the public sector has been released in Denmark. This Danish system has released OpenUDDI, and a Apache Sandesha/.NET message handler under the MPL license, and a reference client built on .NET WCF and a Java based reference client under the BSD license.

Note that the BSD license is an example of a very liberal license, and the MPL is moderately restrictive. Hence, this solution has been investigated with reuse of the code in mind. In the solution design for the public sector this open source solution showed true potential for reuse of some of the processes in the server design, to reduce development time. A closer look at the code, however, has revealed that the application is not optimal for reuse [21].

#### 4.4. Existing Infrastructure and Key Concepts

As the aim is to find a solution that enables all participants of the market to take part in trade with both the public and private sectors, a look at existing infrastructure is needed.

The architecture of the Norwegian infrastructure for the public sector is based on the PEPPOL transport infrastructure. This is necessary in order to ensure that the same principles apply for communication within Norway as with global trade.

The PEPPOL transport infrastructure is a set of standardized communication protocols, which allow the member states to exchange electronic documents. The PEPPOL technical transport layer is defined by use of the **Business Document Exchange Network** (BusDox) [22]. BusDox is a set of specifications and in the PEPPOL context, it provides transport for procurement documents.

Public agencies and private businesses can use the PEPPOL infrastructure to send and receive electronic documents by connecting to **access points** (AP) [22]. The APs are the base elements of the infrastructure, sharing the same transport protocol and the same document format, and using digital signature algorithms to secure message content. That is to say, an instance of a BusDox infrastructure consists of a number of APs that communicate in a peer-to-peer model across the Internet. The APs use SOAP-based profiles to communicate, and SAML 2.0 assertions are used in that communication.

Hence, the sender of an electronic document uses an AP to connect to the PEPPOL network. The document being sent should include specification of the type of document and the recipient, uniquely identified by a business ID. Figure 4.3 shows the main components involved in the PEPPOL infrastructure [23].

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<sup>42</sup> [https://www.virk.dk/myndigheder/stat/ITST/NemHandel\\_Fakturablanket](https://www.virk.dk/myndigheder/stat/ITST/NemHandel_Fakturablanket)

In order to route the documents received from the sender to the correct recipient, the APs in the network need to discover each other. To do so, the strategy used by the PEPPOL infrastructure is to centralize addressing and metadata information into servers called **service metadata publishers** (SMP) [24]. The SMP servers contain the addresses of the APs related to a given recipient. That is, SMPs are used to store information about the recipients connected to the PEPPOL network, giving details about the document types supported and the business collaboration profiles. Hence, each AP obtains the endpoint address of another AP through the SMP infrastructure [23].

The last main entity in the infrastructure is the **service metadata locator** (SML) [25]. Since every participant in the PEPPOL network can be registered in one and only one SMP, the APs must know which one to connect to, in order to retrieve the metadata about that specific recipient. The SML is the entity that contains, for every business ID, the related SMP. That is to say, the SMPs retrieve data of the location of other SMPs via the SML service, as the SML service provides a client with the capability of discovering the SMP endpoint, associated with a particular participant identifier [23].

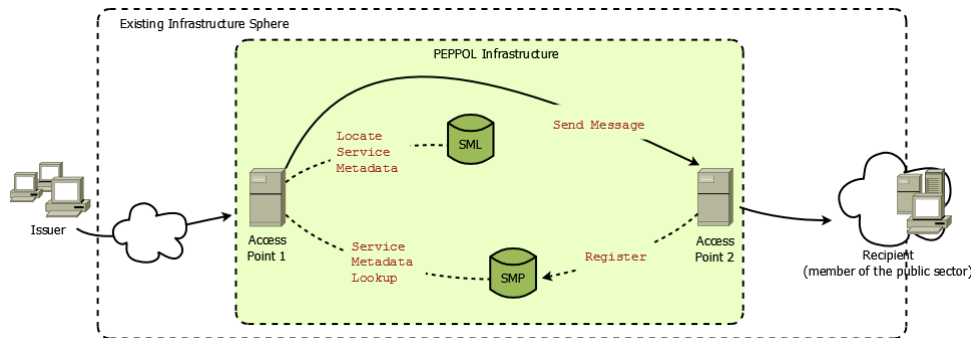


Figure 4.3: PEPPOL Infrastructure overview [23].

The PEPPOL transport infrastructure specification defines two different "profiles", or communication protocols, to let all the involved participants to exchange messages in a standardized manner.

The APs may communicate via optional (BusDox) Transport Profile, but they must always offer a **secure trusted asynchronous reliable transport** (START) [26] endpoint by which any other AP may communicate. The START profile provides a secure reliable approach for messages to be delivered from one AP to another. The START profile is a complete profile that includes all the security and reliability features provided by the infrastructure, and it is used for communication between two APs. It is based on Web Service (WS) technologies, and it uses several WS-standards. In Figure 4.4 an overview of the message exchange between the different components of the infrastructure is shown [23].

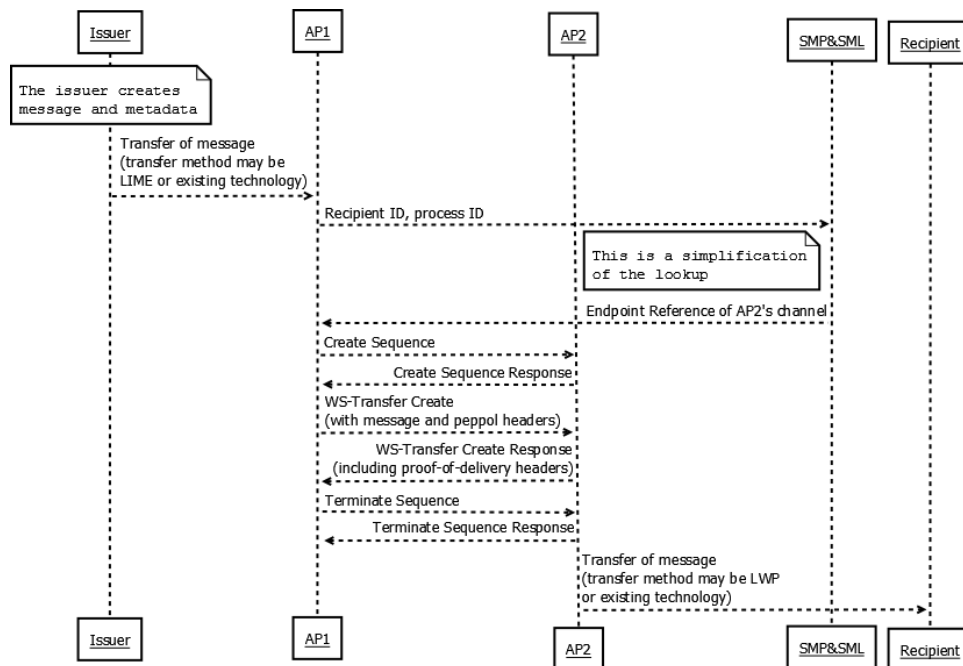


Figure 4.4: Simplified sequence diagram of message exchange using the START profile [23].

As stated above, The START profile does not involve the communication between the actual sender/recipients and the APs. The PEPPOL specification leaves the implementation of this communication part open to final users/businesses, so existing technologies can be used.

Nevertheless, the PEPPOL infrastructure defines a standard protocol to address this issue: the **lightweight message exchange** (LIME) profile [27]. Senders and/or recipients can use this profile to connect to the APs of the PEPPOL infrastructure. It is based upon a subset of the PEPPOL infrastructure specification, and is hosted by the AP. Hence, the LIME profile offers a low cost approach for the users to access the BusDox infrastructure, as the AP supports the profile and manages messages on behalf of the user.

In addition, the PEPPOL transport infrastructure uses a set of identifiers to address resources and to define them uniquely [23][28].

- **Business identifier:** uniquely identifies a sender/recipient on the PEPPOL network.
- **Document identifier:** uniquely identifies a document type in the PEPPOL network.
- **Process identifier:** identifies the process in which the document can participate.
- **Message identifier:** identifies the single message across multiple hops in the network.

SMPs use these identifiers to return the address of the recipient AP to the requesting AP. Hence, APs have to submit the recipient business identifier, the document identifier and the process identifier in their queries to the SMP. As for document and process types and schemas, PEPPOL supports (and encourages) the use of

Universal Business Language version 2.0 (UBL 2.0) standard documents and CEN BII profiles. An overview of a document exchange progress within the PEPPOL infrastructure is illustrated in Figure 4.5.

The above listed information is also carried along in the header of the SOAP messages defined by START and LIME profiles. Note that SAML 2.0 assertions are used in the communication (included in the SOAP header) and the main content for the assertions is;

- Subject (sender) ID.
- Identity and signature of the token issuer.
- Strength of authentication method.
- Time of the authentication.
- Lifetime of the token.
- Audience of the token.
- Subject confirmation.

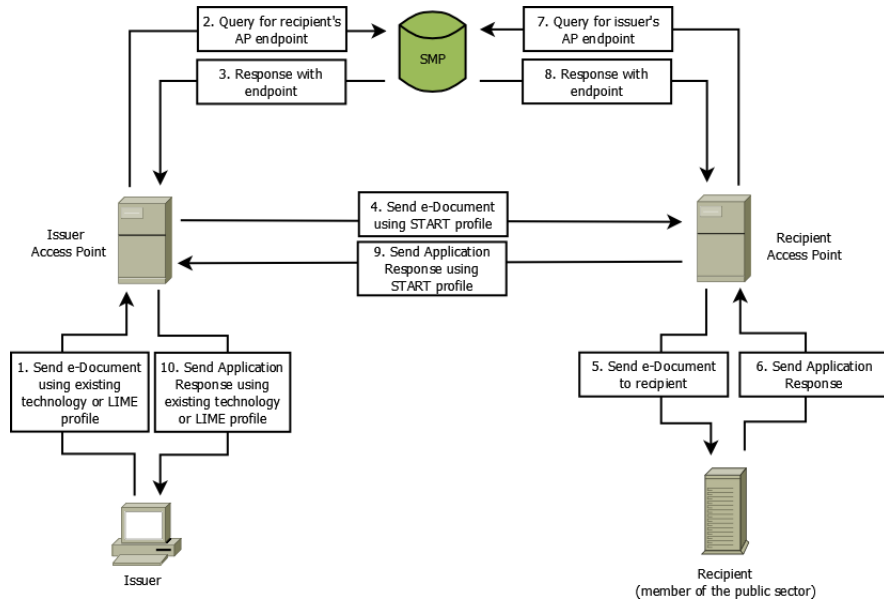


Figure 4.5: Message flow within the PEPPOL infrastructure [23].

The Norwegian section of the infrastructure is currently under construction and will according to proposed plans consist of one SMP and a couple of APs. The SMP, named ELMA Register, will include all approved Norwegian recipients. In the starting phases, the APs will be Altinn and Ehandel.no. One of these APs will also act as a gateway AP for international trade.

Note that as the ELMA Register will include data of all the Norwegian recipients, there is no need to include use of SML for trade within Norway. Also note that “approved recipients” will only be members of the public sector, and consequently a solution using the above infrastructure is not viable for use within the private sector. In addition this means that the ELMA register can only be used for retrieval of recipient data, not issuer data. For retrieval of issuer data, e.g. the Norwegian



companies register – Enhetsregistret – provided by Brønnøysundsregistrene, Altinn should be used.

## 4.5. Standardization and Formats

According to Bruno Koch's market report [9], the market is in a refraction period now where none of the existing providers of electronic solutions are in a leading position. This applies in Norway as well as in the EU, and the world in general. Much of the reason that there are no market leaders is the fact that there are numerous standards in use that are not necessarily compatible with each other.

Software, such as different invoice applications, usually have limited options when it comes to exporting files to a non-proprietary format such as an EDI standard. Hence a multitude of formats and systems are in use in the market.

### Public sector

The public sector is bound by the act presented in White Paper No.36, and with that must follow the regulations put forward in the proposition. However, in order to find the basis of the Norwegian standard implementation, a look at the international market is needed.

As a result of the Lisbon initiative, striving towards making Europe the most knowledge competitive society by 2010, interoperable public electronic procurement and business solutions have been essential. Hence standardization is a key issue that has been addressed by the action plans put forward.

Since 2004, the United Nations Economic Commission for Europe (UNECE) and the UN Centre for Trade Facilitation and Electronic Business (UN/CEFACT) and the Organization for the Advancement of Structured Information Standards (OASIS) have committed to cooperate on Electronic Business using extensible Markup Language, ebXML. ebXML was first started in 1999 and is a modular suite of specifications.

In a joint statement, UN/CEFACT and OASIS stressed that the proposed cooperation agreement should improve understanding and clarify the public perception of how the two entities work together [29]. In June 2006, the UN/CEFACT Plenary (within the context of the UN/CEFACT-OASIS Cooperation Agreement), recognized UBL 2.0 as appropriate for first generation XML documents for eBusiness. It is currently intended to ensure that future versions of UBL are fully compliant with relevant UN/CEFACT eBusiness specifications (including those relating to ebXML, which have become ISO Technical Specifications in the ISO 15000 series).

This OASIS/UBL initiative was born out of a desire to provide XML document standards for the ebXML framework. Later on, UN/CEFACT agreed to build eBusiness standards based on ebXML core component specification. The interoperability interfaces are seen on multiple levels. On a business level, it includes agreement of business processes and semantic document models. On a syntax level it includes usages of XML documents compliant with schemas from eBusiness standards like UN/CEFACT XML and OASIS UBL 2.0. On a technical level, it

implies common requirements for document conformance, usage of digital signatures and document transport infrastructure.

The CEN BII workshop has assisted the two standards to converge under the UN/CEFACT umbrella. More specifically, the CEN/ISSS WS/BII was established in order to<sup>43</sup>;

- Identify and document the required business interoperability interfaces related to pan-European electronic transactions in public procurement expressed as a set of technical specifications, developed by taking due account of current and emerging UN/CEFACT standards in order to ensure global interoperability.
- Coordinate and provide support to pilot projects implementing the technical specifications in order to remove technical barriers preventing interoperability.

Hence, to facilitate implementation of electronic commerce in a standardized way, thereby enabling the development of standardized software solutions as well as efficient connections between trading partners without case by case specification of the data interchange, the CEN/ISSS WS/BII agreed to document the required business interoperability interfaces as profile descriptions. The result is the UBL 2.0 based format CEN BII. The CEN BII specification is meant to facilitate effective public procurement solution, with focus on cross-border interoperability and is an open format.

However, the CEN BII format is developed for use within Europe and does not necessarily comply with Norwegian bookkeeping legislations. Hence, a Norwegian adaptation of the format has been specified. This Norwegian adaptation of the CEN BII format is the eHandel.no format Invoice and Credit Note. The format is based on the CEN BII Core and the syntax of the implementations is based on UBL 2.0. The Norwegian government has decreed that this eHandel.no format is to be used for trade with the Norwegian public sector. Please refer to Appendix B for a full overview of the format contents requirement. As part of the BII toolbox, a conformance testing tool to validate XML samples against CEN BII profiles business rules (including national – Norwegian – business rules as defined in the eHandel.no format) is offered and may be used to verify that the text is a well-formed XML [30]. The eHandel.no formats are maintained by Difi.

### **Private sector**

Though governments and the public sector in many countries are taking active part in speeding up adoption of electronic processing today, the private sector has been the initiator.

The most common way to send messages between companies today is to use service providers. These are either banks or dedicated service providers that are independent of bank networks. The market is characterized by a number of these mediation centers with different technological frameworks and agreements. This creates barriers for the use of electronic invoicing, particularly for the small businesses.

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<sup>43</sup> <http://spec2.cenbii.eu/>

The European Commission calls this the "Four Corners" model. Very often companies have to enter into agreements with each of their suppliers / customers and with their respective service providers, with the effect that the number of deals is increasing exponentially. This constitutes an insurmountable obstacle for comprehensive electronic collaboration, especially for small and medium-sized businesses. The Commission has therefore pointed out a need to establish standardized interconnection agreements between the various mediation centers.

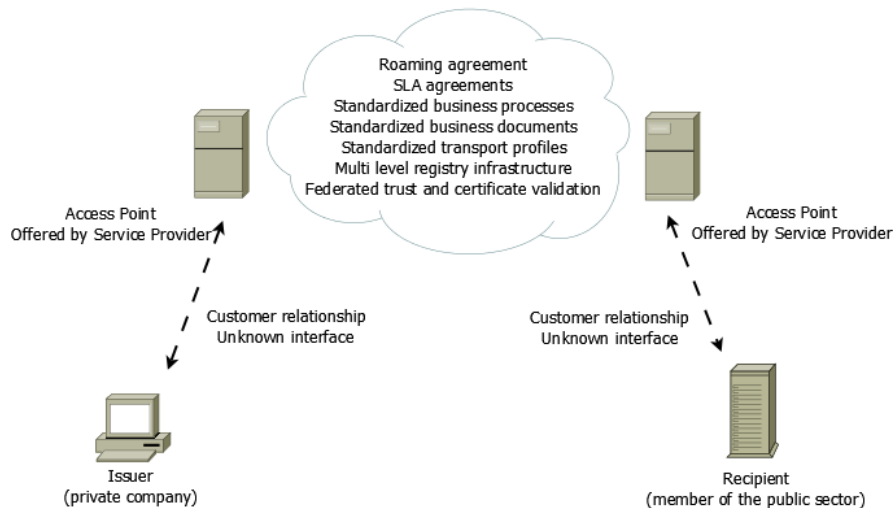


Figure 4.6: The Four Corner Model as defined by PEPPOL [31].

In Norway the industrial forum B2BConnect provides this interconnection agreement requested by the European Commission. The communication centers involved in this collaboration allow users of any one communication center within the cooperation to be able to communicate with any other communication center within the forum. In addition, members of the B2BConnect forum are now considering connection to a related European initiative called The Hub Alliance. This interconnection agreement essentially facilitates cooperation and lowers the threshold for adoption of electronic invoicing in Norway. However, the lack of standardization and common semantic data models still exists.

In the private sector, e2b represents the most commonly used format implementation for invoices. Via private initiative the e2b forum has created a basis electronic invoice format (e2b Basic) particularly useful for small and medium businesses. This format is increasingly widespread. The forum also has a standardized exchange agreement for use between the issuer and recipient.

The e2b has also been the basis for the development of the Nordic initiative NESUBL, which also later became a European initiative. NES stands for Northern European Subset, and is a cooperation among a group of countries and organizations to facilitate the practical use of electronic collaboration in the procurement chain, based on available international standards. The NESUBL format is what today carries the appellation eHandel.no Invoice and Credit Note. Hence, NESUBL is, though now called eHandel.no, the mandatory e-Invoice standard to the public sector. Refer to Appendix C for a comparison between the e2b and NESUBL (eHandel.no) formats.

Given that it in many cases have been the larger companies that have initiated the development of electronic interaction, the software has been forced to also meet their corporate requirements. Such requirements can be hardware and operating system requirements. For example, it is known that the German power producer RWE requires specific hardware and operating system, preventing Windows-based solutions to be used<sup>44</sup>.

In addition, many large companies demand their suppliers to implement their proprietary formats, adapted to meet their own company requirements. This has led to many bi-lateral agreements between parties, slowing down comprehensive adoption of standardized solutions. On top of that, even if a format such as e2b is used, many companies have their own way of using the fields in the format causing variations and forcing individual adjustments.

This has led to a market filled with many systems, standards and formats, both proprietary and variations of thereof. A system design aimed at the private sector must allow for individual adaption for each recipient, and also allow sending via banks or service providers that already have agreements with the particular recipients.

## 4.6. Free/Open Source Software

The use of free software has in recent years experienced significant growth worldwide, both in private and public sectors. The last couple of years, focus in Norway has changed from if free software can be safely used, to how best to exploit the advantages free software can offer the end user.

Free software is technically similar to proprietary software. However, licensing and development models differ, and hence, in addition to brief introductions to concepts and security issues, the licensing and development models are discussed.

### Key Concepts

Much of todays programming tools, slang, and entire surrounding culture can be traced back to the early 1960 at The Massachusetts Institute of Technology, and the birth of ARPAnet. Since those days many people and events have been influential in leading to the open source culture of today. A few of the significant items from this thesis point of view would be;

- The launch of the Free Software movement (1983) with GNU is Not Unix, GNU, and with that the Free Software Foundation FSF<sup>45</sup> (1985) by Richard M. Stallman.
- The publication of “The Cathedral and the Bazaar” (first 1997) by Eric Raymond, and with that the founding of the Open Source Initiative<sup>46</sup> (OSI) (1998) by Eric Raymond and Bruce Perence.
- Linus Torvalds with his Linux project and even more importantly, his very successful open source development model.

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<sup>44</sup> R. Heimstad (personal conversation, August, 2010)

<sup>45</sup> <http://www.fsf.org/>

<sup>46</sup> <http://www.opensource.org/>

The FSF supported a great deal of open-source developments starting in the early 1980s, including tools like Emacs and GCC which are still basic to the Internet open-source world. The FSF movement shows a strong ideology and is seemingly anticommercial. This attitude shows in FSF (Copyleft) licenses. Note that the free refers to free as in free to use, share and add to, not as in free of charge.

Raymond and his friends, decided to use the less confrontational “Open Source” as oppose to ”Free software” to show a deliberately more pragmatic view when founding OSI and defining their less anticommercial Open Source Definition (OSD).

FSF and OSI are today two of the principal advocacy organizations for free and open source software. Deriving from the names of these two organizations, the widely used acronym Free/Open Source Software, F/OSS (or Free/Libre/Open Source Software, FLOSS, as sometimes used to avoid the ambiguity problem of the word free in English, emphasizing free as in freedom).

### **Licensing**

The piece that differs F/OSS from proprietary software is licensing. In order to be classified as a free software license, the recipient must be given the following rights, often called the four freedoms [32];

Freedom 0. The freedom to run the program, for any purpose.

Freedom 1. The freedom to study how the program works, and change it to make it do what you wish.

Freedom 2. The freedom to redistribute copies so you can help your neighbor.

Freedom 3. The freedom to distribute copies of your modified versions to others.

Note that freedoms one and three require the source code to be available. The open source definition includes the same principle freedoms [33].

There are a number of approved F/OSS licenses available today. One of the most widely used and popular ones is the FSF license GNU General Public License, GPL. The GPL is an example of an implementation of the restrictive copyleft concept where work is copyrighted but with a distribution clause that makes sure the code and freedoms are legally inseparable. That is, if the program is distributed, i.e. used for other than in-house purposes, the license comes with a sharing obligation with reciprocal effect. Other examples of restrictive licenses are LGPL and OSL. More moderately restrictive licenses allow completely new files or modules to be excluded from being shared, while changes in existing files and new files that receive existing code still must be shared. Examples of moderately restrictive licenses are MPL and CDDL. Liberal licenses do not constrain the users to share their modifications. Examples of liberal licenses are BSD and MIT [34][35][36].

When choosing license, the goal aimed to be achieved through the use of F/OSS must first be established. When it comes to the public sector, the main interest – apart from being able to practice the four freedoms listed above – is to enjoy the benefits F/OSS can offer, and the dynamics it can be subject to. That is, to be able to take advantage of the mutually beneficial sharing of improvements that takes place when an open source project achieves the necessary spread. Such successful use of F/OSS could bring that the work one governmental agency does, and the costs the work incurs can benefit all public (and private) sector participants both within Norway and abroad. The central criterion when choosing license should, with

that, be to find which license can be able to contribute in creating such favorable conditions.

The product of this thesis solution design may be used, not only in Norway, but also within other EEA nations. This brings to attention a weakness with some of the F/OSS licenses; namely country-specific choices of law rules, i.e. many licenses take into use U.S. law and jurisdiction in the license formulations. The European Commission has recognized this fact, and has conducted a detailed legal study investigating various existing license alternatives [37]. The study concluded that no license correspond to requirements of the European Commission that;

- The license should have equal legal value in many languages.
- The terminology regarding intellectual property rights should be conformant with European law requirements.
- To be valid in all Member States, limitations of liability or warranty should be precise, and not formulated “to the extend allowed by the law” as in many licenses designed with the legal environment of the United States in mind.

Hence, the European Union Public License, EUPL was defined. The first draft of the EUPLv0.1 license went public in 2005, and in 2009 the current EUPLv1.1 was published in all official languages of the EU. OSI approved the EUPLv1.1 as an open source license in March 2009. The main purpose of the license is to be used by public administrations, either European or national, that need a common licensing instrument to mutualise or share software and knowledge. With that, the EUPL may seem a natural choice of license and deserves a closer look.

EUPL is a restrictive license, with a strong copyleft. In fact, the copyleft seems to go even further in EUPL than in GPL, as also certain types of in-house use is considered to be distribution. This condition means that software delivered as an application service provision, ASP, is also subject to reciprocity effect.

An often-upcoming issue when working with F/OSS is compatibility with other licenses. In many cases it may be unclear if the software can be licensed out further under other licenses, rather than the license the software was originally licensed under. The EUPL license has resolved this issue by giving the licensor the freedom to decide in an attachment which other licenses EUPL should be compatible with. This gives flexibility to the license.

Another condition included in the EUPL license is an amendment condition. The condition states that the EU Commission may unilaterally create new versions of the license that is binding on the licensee as soon as the licensee becomes aware that the new version has come out. This means that if a Norwegian governmental agency develops and licenses their software to other Norwegian or foreign governmental agencies, they run the risk that the EU Commission amends the terms between them. This condition may be a bit troubling as it creates an unpredictability and uncertainty that in most contractual relationships is unacceptable. In addition, for an open source project to be successful in the long run, it is dependent on users, and in creating a well functioning community. With such uncertain license terms, licensees may show skepticism toward investing effort, leading to that this can be hard to achieve [38][39].

Another issue to consider is how rights should be managed. It may be of interest to allow the licensees the possibility to add and change the distributed program code without redistributing the changes. Such scenario could be that municipalities or countries should be able to add to, or adapt existing files to fit their needs without requiring them to release their modifications. In such case, a liberal license could be to prefer [39].

No specific license can be recommended or advised against within the scope of this thesis. The above discussion merely aims to point out the urgency of carefully considering the matter. A legal representative should be consulted to assure full overview of legal requirements.

### **Open Source Development model**

In order for an open source software project to be successful a few aspects should be taken care of [40];

- A modular design (a solid kernel facilitating the addition of several modules)
- The use of a version control system.
- A clear documentation explaining the objectives, scope, use cases and interactions according to standards.
- An open mind team spirit, welcoming external participation, while keeping control and setting a direction.
- Good communication and interface with the developers community.

This means that when developing by the open source development model, releases should be made early and often, and the community members that contribute should be well taken care of. Or as Raymond puts it: “Release early. Release often. And listen to your customers” and “If you treat your beta-testers as if they're your most valuable resource, they will respond by becoming your most valuable resource” [41].

Note that by including the beta-testers, the developers community may contribute in a real way to the project. This makes that the development team (now with hundreds, or even thousands of contributors, testing and improving the code) becomes stronger than it ever could be in a closed source project. Hence, the F/OSS culture should be considered serious, simply because the closed-code world cannot win an arms race with open source communities that can put orders of magnitude more skilled time into a problem [41].

### **Security Issues**

If software is well written, the publication of the source code should not facilitate security breaches. To the contrary, the open source publication of the code should by the time reinforce software security by allowing a wider community to screen it for possible bugs.

However, if a software is used for critical applications and if the published source code contains serious security flaws, disclosing the code will generate real risks of possible compromising, at least in a first stage before bug corrections. Therefore, depending on the sensitive character of the application and the nature of accessed data, a risk assessment should be done prior to open source distribution [40].

## Chapter 5

# Specification

From the above analysis, the following primary business requirement can be deduced;

- A platform that will enable users to produce electronic invoices and send to recipients within the public and the private sectors.
- For the public sector recipients; send the invoices in eHandel.no and CEN BII formats. Possibility to easily adopt other CEN BII format variations.
- For the private sector recipients; send the invoices in a format required by a service provider.
- Functionality to manage invoice data.
- Security features, making sure user data is not compromised.

### 5.1. Use Cases

The target market for the supplier-end has been defined as small businesses and sole proprietors, and the goal has been defined to be finding a cost effective solution. In addition full automation of the issuer invoice processing lifecycle has been defined as out of scope.

Small companies and sole proprietors have a relatively low volume of invoice exchange and their needs can be met through a simplified web portal with manual entering of invoice data. The target market has also been identified as most likely to use an electronic invoicing solution out of client requests and not out of company profit analysis. Hence, the solution should require a minimum of implementation and adjustment for the supplier-end. A portal solution fulfills that requirement, and in addition the, within the portal provided, functionality should allow the users to keep their routines and systems and choose to send specific individual invoices via the portal only when necessary. The functionality should also include creation and send of credit notes, as identified in user habit analysis.



Many small businesses and sole proprietors represent businesses with little technical capability within the company. Hence, the solution design should be considered targeted to a user group with little or no technical experience.

The high-level business requirements deduced from made analysis are covered by the use cases illustrated in Figure 5.1.

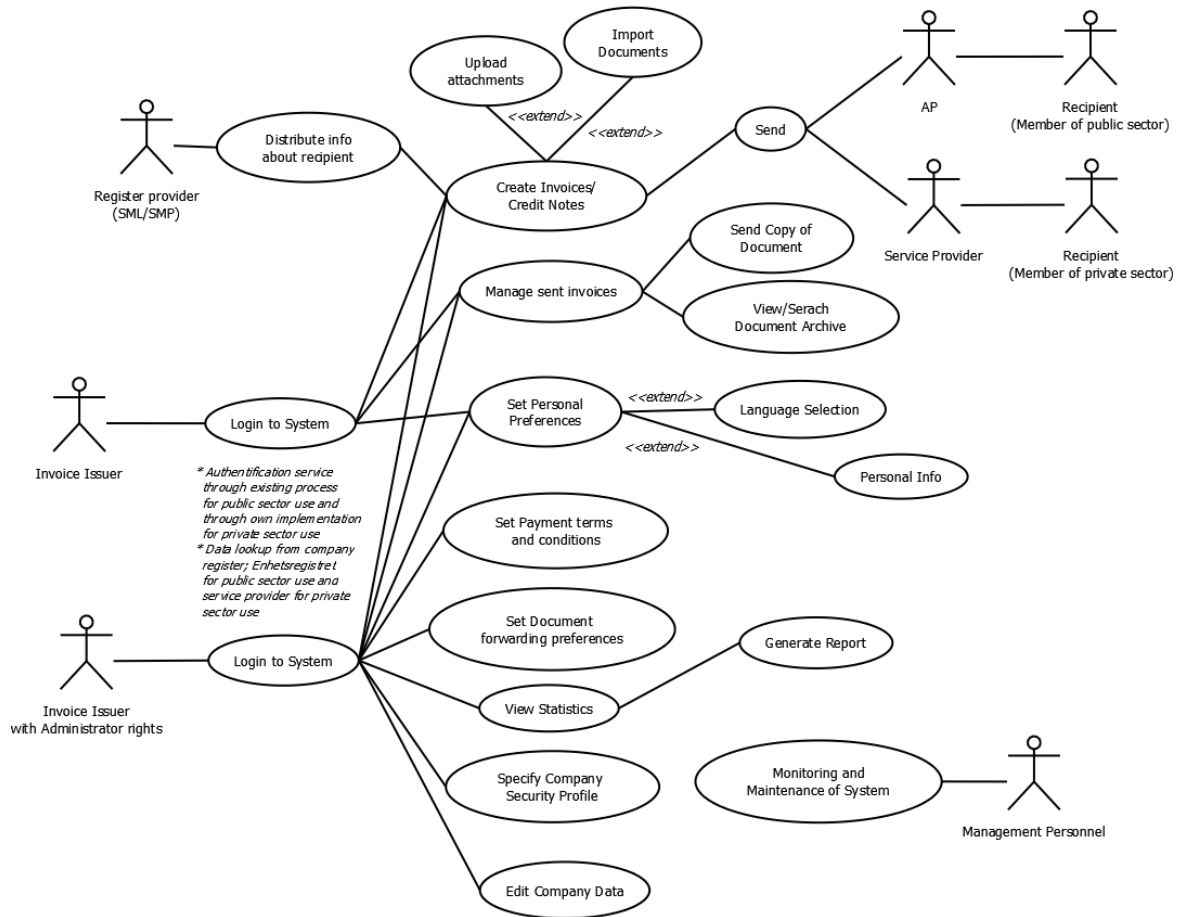


Figure 5.1: Use Case diagram illustrating system functionality.

The use cases illustrated in Figure 5.1. can be specified as;

- User access control with authentication services for login/logout and authorization services for access according to user role and permission set.
- Document handling with creation, upload, validation, send, export and management of documents.
- Statistical data calculation and presentation.
- Preferences management.
- System monitoring with health-check, audit, error and user log.
- System design with consideration taken to existing infrastructure.

The Use Cases defined in this specification relate to functions within the application. Note that this specification addresses all functions/roles that should be planned for the system, even if the functionality itself is not part of this deliverable.

## 5.2. Actors

The following actors for the invoice transaction processing service have been identified;

- Invoice issuer (with/without administrator rights).
- Invoice recipient (member of public sector within EEA, or member of private sector with agreement with back-end system provider).
- Portal manager personnel.
- AP.
- SML.
- SMP.
- ELMA Register (i.e. Norwegian SMP).
- Altinn company register (Brønnøysundregistrene, Enhetsregistret).
- Back-end system (i.e. a system prepared for document handling, conversion and forwarding offered by a service provider).
- Portal application.

## 5.3. Requirements

The following introduces both functional and non-functional requirements of the system.

This specification focuses on invoice creation and handling for customers in both the public and the private sector. As established in Chapter 4. – Market Analysis, those sectors present different challenges, hence the sectors must in some cases be treated separately in the specification. Note that the public/private sector split in this context refers to the supplier of the service, and not necessarily to the customer. The division comes not only from the different identified challenges and restrictions, but also from the reality that a service provided by the public sector should not compete with private service providers.

### Functional requirements

#### *FR001 – Functions*

To fulfill the scope of this thesis including identified related functionality, a supplier should upon authentication be able to create and send,

- a. invoices and
- b. credit notes.

Note that the public sector solution should include B2G invoices and credit notes, and the private sector solution should include B2B and B2G invoices and credit

notes depending on the back-end provider customer agreements. Refer to FR024 – Output, for further details.

#### *FR002 – Additional Functions*

In order for small companies using a portal solution to be able to benefit from full use of EDI, the solution design should open up for functionality that further automates the supplier process. That is, the solution design should be prepared for additional implementation of electronic procurement units at later stages. Hence, though out of scope for this report, functionality such as creation of confirmations, tenders, reminders, reimbursements and catalogues should be possible to add at a later stage. Also further integration with e.g. banks has been recognized as of possible interest, and hence the system design should allow for such further functionality and integration.

#### *FR003 – Preferences*

Some personal preferences and information should be editable. The editable information should include functionality that allows for the users to adjust the portal to their needs;

- a. Language settings
- b. Company data
- c. Payment conditions, terms and information
- d. Document copy forwarding information
- e. Company security profile

Note that to ensure user discretion and fulfill identified demands of security, the availability of the operations should be grouped into roles. Refer to FR013 – Authorization & Authentication, and FR014 – Security, for further details.

#### *FR004 – Support*

To meet the needs of a target group with little technical experience, the system should provide the users an easy route to contact support.

#### *FR005 – Search*

As part of fulfilling the need for management of created documents, a search function should be enabled with possibility to search among sent documents by e.g. invoice number, date range, recipient, KID, reference number or other optional text.

#### *FR006 – Editing*

Sent invoices should not be possible to edit to avoid confusion and errors in document archive. If an error has been made that needs to be corrected, a credit note should be used. (For creation of “edited” duplicate invoices, refer to FR007 – Deletion.)

#### *FR007 – Deletion*

To avoid loss of documents, sent invoices and credit notes should not be possible to delete. However invoices should be possible to mark as “deleted”, upon which a duplicate invoice with the same invoice number can be created, edited and sent. This function should be put into place, as the portal requires error prone manual enter of data. Creation of duplicates allows coping with potential issues arising from

typographical errors made when using both an in-house accounting system and the portal for creating invoices.

*FR008 – Printing*

As part of fulfilling the need for management of documents, invoices, credit notes and any uploaded attachments should be possible to print.

*FR009 – Manual entering of Data*

To provide needed functionality to create proper invoices and credit notes, a supplier should be able to manually submit lines into an invoice via a web form. All mandatory information in the identified standard EDI format should be included in these lines. Note that shipping information about the goods must be possible to include, to manage the case when the supplier is the invoice issuer.

*FR010 – Document Upload*

To allow for needed functionality surrounding creation of invoices, some external elements should be possible to upload;

- a. In order to allow for use of attachments, upload of documents in formats PDF, JPEG and TIFF should be supported. The maximum size of these should be set.
- b. As identified, many small companies use Excel or simple accounting software to create invoices, and to prepare the portal for further automation for the users, upload of Excel (Comma-Separated Values, CSV) files, or files in an approved standard format should be supported. Note that to prevent errors, uploaded data should not overwrite head data from recipient address lookup.
- c. It should not be possible to use links that point to other web pages or sites. Recipients are obliged to keep certain documents for a minimum of 10 years, 11 months and 30 days, as identified in Chapter 3.1. – Impacts on receiver and sender ends, and such links point to pages that the recipient cannot control.

*FR011 – Document Export*

To fulfill the need of a minimum adaption for the users and to allow users to gather their documents in one place, the issuer should be able to send copies of the produced documents. This also adds an extra level of redundancy. The issuer should be allowed to set up own preferences for where copies will be sent (refer to FR003 – Preferences).

- a. Copy to the issuer – the issuer should always receive a PDF or TIFF of the generated document. This copy may be considered a receipt of the sent invoice, and it should be mandatory for the issuer to set up where the copy is sent.
- b. Copy to document hotel – if the issuer uses a document hotel, a copy of the xml format (eHandel.no, CEN BII, e2b, or other selected format) should be sent to the issuers hotel in order to allow the issuers to gather and store all their documents in one place.
- c. Copy to accounting agency – if the issuer uses an accounting agency, a PDF or TIFF should be sent to the agency, in order to allow for the issuers to register their outgoing documents with the accountant.

- d. Additional copy – at any time the user should be able to send an additional copy to an optional email address in PDF or TIFF formats.
- e. Copy data from previous invoice – it should be possible to copy data from an earlier invoice when creating a new invoice with the exception of the invoice number field.

#### *FR012 – Number series*

In order for the portal to allow for the users to keep their routines and systems, and to allow for the portal to be used only occasionally, it should be possible to obtain number series for invoices and credit notes. In addition, if the users wish they should be able to enter their own number. This number should be confirmed unique to avoid duplicate invoice number entries. In case the user enters an own number, this number should be used as main invoice number.

#### *FR013 – Authentication & Authorization*

To mitigate lack of trust, the application should offer high security by careful authentication and authorization service implementation. That is, an authentication service for login and logout functionality, and an authorization service for user role and permission determination should be offered. These services should be at a sufficient security level to ensure reliability and integrity. The Norwegian government offers electronic identification solutions, and hence, the public sector solution should take such a platform into use.

- a. For authentication service in public sector solution, Single Sign-On and Single Logout functionality using eID supported in Altinn or ID porten (e.g. MinID or Bypass) should be implemented.
- b. For an authentication service in a private sector solution, the login function and user authentication should be managed by the application by use of a security framework, e.g. JAAS.
- c. Upon successful authentication, the user should be authorized access to system functionality based on user role and permission set.

#### *FR014 – Security*

To prevent sensitive information from being accessed by unauthorized disclosure and to prevent security breaches, the stored data and user credentials should be handled in a secure manner, and all pages within the solution should be secured with SSL encryption.

#### *FR015 – Error Handling*

An error handling sub-system should be supported to ensure proper handling of errors and generation of error messages.

#### *FR016 – Logging*

To provide high level of system overview and allow accurate error management, the system should provide meticulous logging of all user and system activity. Stored user activity information should include date and time, what actions were attempted, the result of the action and the user id. Note that the stored user activity data should include failed authentication attempts.

#### *FR017 – Statistics*

To allow analysis of system use, the portal should produce easily obtainable statistics for both user and management personnel benefit. The statistics should include information about;

- The number of documents produced per document type
- Turnover for orders and invoices
- Number of registered organizations and users
- Number of active organizations and users
- Number of documents sent per organization
- Errors, resends and system failures

#### *FR018 – Reporting*

To enable easy overview of system use, a monthly report should be generated based on the collected statistical data. Also manual generation of reports should be supported.

#### *FR019– Administration*

To provide one more level of security to hinder system abuse, an administration interface should be offered (to management personnel), with support for locking or disabling individual organizations from the system. The administration interface should also allow for manual generation of statistical reports of overall system use.

#### *FR020 – Health-check*

The system will act as invoicing channel for the small businesses to the public and private sectors. With that the effectiveness, efficiency and uptime demands are high, and in order to ensure that the system is up and operational at all times, the various components of the web and/or intranet should be monitored.

#### *FR021 – Recipient data*

As established in the presented market analysis, the existing infrastructure maintains recipient data registers. Those registers should be used to eliminate errors from manual entry of data and to avoid a need for the portal to manage and maintain such registers. To ensure accuracy, the recipient information should not be possible to overwrite or edit upon placement in the portal web form.

- a. Public Sector – for recipients within Norway the ELMA Register should be used, and internationally the central SML register should be used to select and verify recipient.
- b. Private Sector – the recipient should be selected from pre-defined list of all recipients with agreement with the back-end system provider.

#### *FR022 – Storage*

Automated archiving has been identified as a large benefit from use of an electronic invoicing solution. Such storage also allows information to be available when required and enables implementation of functionality surrounding management of the created documents. To provide a service meeting archiving demands, sent invoices and credit notes should be stored in 10 years 11 month and 30 days. A customer should be able to access the document archive according to her user role.

#### *FR023 – Display*

To allow easy overview and use of the portal, the interface should display a list of the (e.g. 15) sent invoices and credit notes. By clicking on a line, the contents of the document should be displayed.

#### *FR024 – Output*

To meet the needs identified for standardization and formats in use the implementation should consider public and private sectors separately;

- a. Public Sector – for Norwegian recipients the output should be in eHandel.no format. The portal should also be prepared to send in CEN BII format for international recipients. Note that the formats are being developed and improved, and the format implementation should be done in such a way that changes easily can be incorporated. Note also that other nations have their own adaptations to the CEN BII format, and incorporation of such national adaptations may become of interest.
- b. Private Sector – as no publicly available infrastructure is offered to recipients of the private sector, the solution design aimed at the private recipients should be integrated with a back-end system that allows for individual adaptation to each recipient. Hence, the output should be adapted to service provider system specification. The service provider in turn, should be prepared to handle the CEN BII profiles, national adaptations of them and other formats in use among the clients.

#### *FR025 – User Data*

The user data should be retrieved from existing registers

- a. Public Sector – Altinn provides a companies register in Enhetsregistret, and a data lookup should be done from there.
- b. Private Sector – in case the back-end system customer register holds needed data, this should be used.

### **Non-functional requirements**

#### *NFR001 – Agreement*

Study of user habits revealed that legal barriers and uncertainties have, to a large part, been managed in Norway. However, in order to avoid confusion or potential upcoming conflicts, a legal agreement should be signed by the user before allowing access to the system functionality. Such agreement certificate provides protection based on the legal system to both user and system owner, should something go wrong.

#### *NFR002 – Solid design*

The system is to be released for use within a market and infrastructure still very much under construction. Hence, the system design should provide flexibility to facilitate international variations and later additions to the system. This brings that the system should be designed with international use in mind, and it should provide flexibility to change the way data is acquired, processed and delivered. And also, considering the public sector design, it should be easy for other nations to adapt the system to their own infrastructure and their own legislation and versions of formats.

#### *NFR003 – System release*

- a. Public Sector – as identified in the made market analysis, the design solution put forward in this thesis should be viable for use within the infrastructure defined by PEPPOL. Components released within the PEPPOL projects are released as open source, and as should the solution design put forward in this thesis for use within the public sector be prepared for open source release. Such release allows for deployment of core parts for international use. Note that also any third-party software used by the system should be covered by open source software license.
- b. Private Sector – the manner of system release should be left to the service provider to decide.

#### *NFR004 – Documentation*

Considering the changeable nature of the market, in addition to recommendation of open source release of public sector design, full and good documentation is necessary.

#### *NFR005 – Platform and Database independent*

As a system implementator is not determined, and the system should be possible to deploy for international use, the system should be possible to install on any platform and configure to use any database type.

#### *NFR006 – Document delivery*

The delivery of documents should conform to existing transport infrastructure. That is, the system should be connected to a system provider or AP.

#### *NFR007 – Fields*

To ensure that the EDI system works properly and laws and regulations are complied with, the standard formats must be used correctly. Hence, the invoice fields displayed in the interface should be the data fields from the format used. I.e. from eHandel.no, CEN BII (and possibly national adaptations to this format), e2b or other format in use. All mandatory fields should be marked. For full overview of content requirements in eHandel.no format, please refer Appendix B.

Note that in order to fulfill VAT regulations more than the presence of correct fields is needed. Consequently – though out of scope in this project – such regulations must be further investigated in order to ensure proper compliance.

#### *NFR008 – Internationalization and Localization support*

To fulfill the identified need of internationalization and localization support, the users should be allowed to select language (selected language settings should be stored in user profile, refer FR003 – Preferences). In stage one, the portal should handle Norwegian and English, including both prompts and help texts. Note that the language support should be implemented in such a way that the application easily can be configured to use any additional language.

#### *NFR009 – User Interface*

Considering that the system is aimed at small companies to be used from their existing hardware, the interface must be suitable for usage on a variety of screen resolutions.



*NFR010 – Browser Support*

The system should allow for use from existing user software, and with that, support for the commonly used web browsers should be included.

*NFR011 – Disc Space*

To avoid excessive storage and upload of documents the disc space for each user should be restricted (e.g. 5 GB).

*NFR012 – Cost*

As established, small businesses will most likely use the portal to send electronic invoices out of client requests, and not out of own gain. Hence, a solution design put forward should offer an easy to use system that does not have any implementation costs and very moderate or no running costs. The web portal should be free of charge or very cost effective to use.

*NFR013 – User friendliness*

The solution should be easy to use and of a low threshold for the suppliers (SMEs).

## Chapter 6

# Solution Design

From the above analysis and specification, the following primary technical objectives can be deduced;

- Module-based design to ensure flexibility to add additional functionality at later stages, and to modify the system to changing market demands.
- Build a system capable of scaling and fault tolerance.
- Build a service oriented architecture.
- Make use of existing infrastructure.
- Allow for open source deployment of core modules.

### 6.1. Proposed High Level Design

The system design must fulfill all presented requirements. The requirements include additional functionality (FR002) in later deliverables and release as open source (NFR003a). The system design may also be used for international delivery where countries must be able to adapt the application to local needs and legislation (NFR002). Hence, a modular design approach is proposed. The design should provide a solid kernel facilitating the addition of several modules. With that, the proposed design presents a layered structure, using model-driven architecture, MDA. Note that well-defined interfaces and functions give modularity to the architecture, and allows for aggregation to build composite services, and hence, the system design needs to be well defined. Figure 6.1 shows an overview of the proposed architecture design.

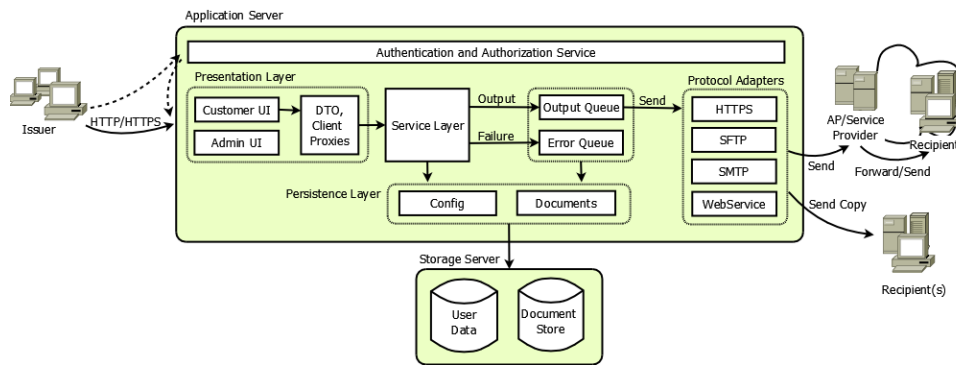


Figure 6.1: High level Architecture Overview.

The architecture design includes the following layers and services;

- A persistence layer, to provide the flexibility of database interoperability, relational to object mapping, dynamic SQL creation and encapsulation, and built in performance logging and monitoring. To ensure correct results for concurrent operations, the application should use optimistic locking for database updates. The service layer should handle optimistic locking exceptions.
- A service layer to ensure communication and data processing between presentation and persistence layers. System business logic should be encapsulated inside the service layer. All services should be synchronous services. However invocation of a synchronous service may produce another asynchronous command or series of commands that will be processed in a background process.
- A presentation layer to support user interfaces. The presentation layer should contain user interface objects, client data transfer objects and client service proxies.
- Output and error queues to hold messages ready for delivery until corresponding sending module become available.
- Storage server to hold database, files, file archives, JCR and any other types of data that need to be stored. Significant disk redundancy should be implemented on this server in order to ensure data safety. Additionally regular back-ups should be performed.

## 6.2. Functional Areas

The presented high-level design corresponds to the following functional areas in the application.

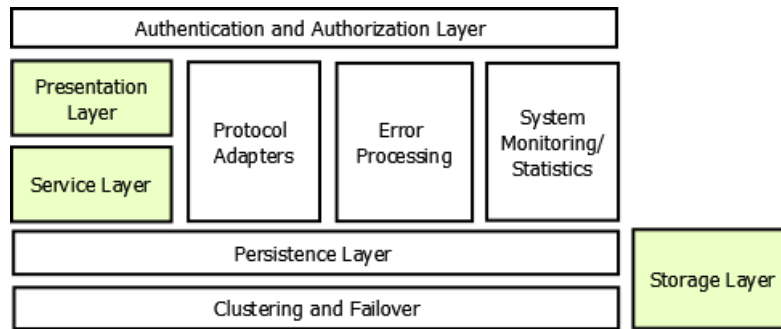


Figure 6.2: Functional Areas.

Table 6.1: Description of Functional Areas.

Functional Area	Description
Authentication and Authorization Layer	Authorization and authentication. User roles (administrator and regular user), permissions to view different data, logic to prevent security violation attempts; account locking or disable
Presentation Layer	UI services (Customer UI/Admin UI), Client Proxies, DTO
Service Layer	Services to support request actions. All services are synchronous services. However invocation of synchronous service may produce another asynchronous command or series of commands.
Storage Layer	Database. Document storage, Configuration & Rules.
System monitoring/Statistics	Services to support system monitoring. Statistics service provided of number of documents produced per document type and turnover for orders and invoices.
Protocol adapters	Modules and APIs for communication support with all required message delivery protocols
Error processing	Service to support error message processing and storage
Persistence Layer	A layer that uses e.g. Hibernate to provide database object mappings and persistence. As well as a layer of independence from database technical implementation as defined in NFR005.
Clustering and failover	Use of load balancer to share workload and to provide failover and recovery

### 6.3. Public Sector Infrastructure Overview

In order for the system to be useful, and as defined in NFR006, the application must integrate with existing infrastructure.

As presented in Chapter 4, the international infrastructure that has been designed follows the many-to-many computing paradigm. The architecture is based on the PEPPOL four-corner model architecture where the point is that users with different service providers still should be able to communicate.

In the case of issuers using the portal application to send invoices or credit notes, the existing infrastructure is, however, used in a one-to-many fashion both within and outside of Norway.

## International Infrastructure

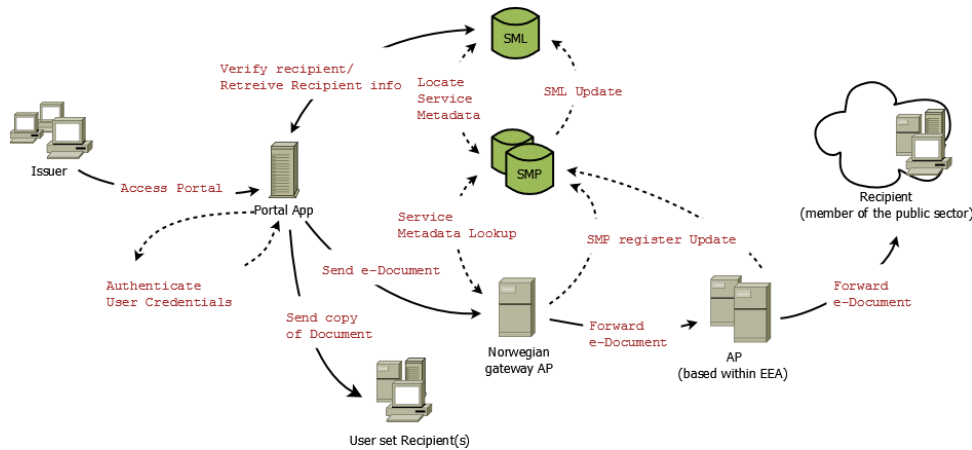


Figure 6.3: Portal integration with International Infrastructure.

- Users that want to receive documents over the PEPPOL infrastructure must be linked to an AP and be registered in an SMP.
- The portal does a register lookup in the SML central register to verify recipient accuracy and retrieve metadata (FR021a).
- The portal creates message and metadata (sender/recipient id, process id etc) The transfer may be done by use of LIME profile or existing technology.
- Documents with international recipients should be sent to gateway AP. The gateway AP will then forward the document to correct AP.
- Norwegian users of the portal will send documents in CEN BII format for international recipients. Other countries may implement their national formats based on CEN BII (FR024a).
- The authentication of user credentials should be done using existing electronic id service, e.g. MinID or Buypass provided by Altinn or ID-porten. Solution should be flexible in terms of possibility to integrate with other SSO application servers for international use (FR013a).

Note that the implementation only needs to locate service metadata (by SML) to verify the recipient existence by use of business identifier. The service metadata lookup (by SMP) is handled by the AP.

Document flow out of Norway will follow the described flow. Note that document flow in to Norway is out of scope here as the portal does not include the function of receiving documents.

## Norwegian Infrastructure

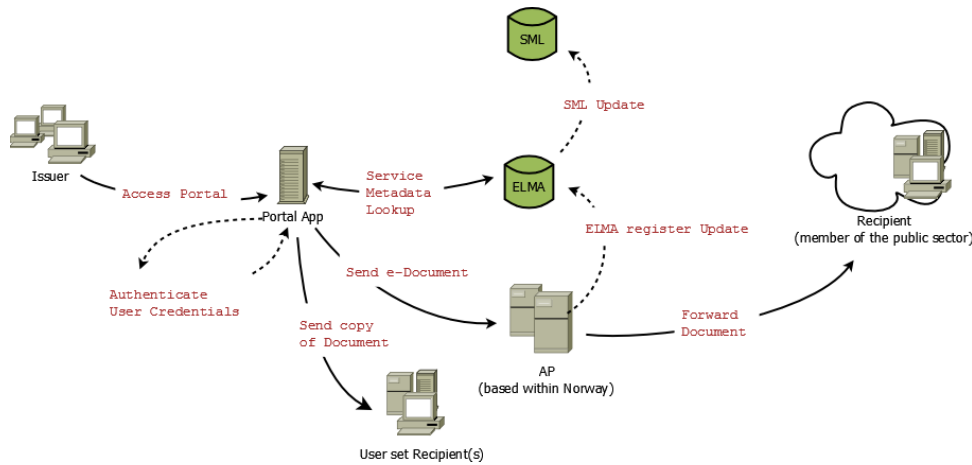


Figure 6.4: Portal integration with Norwegian Infrastructure.

- Recipients within Norway should be registered in the ELMA Register
- The portal should do a lookup in the ELMA Register and send the document to correct AP (FR021a).
- The portal should send the documents to an AP by use of LIME profile or by any other protocol supported by the AP.
- Norwegian users of the portal should send documents in eHandel.no format to Norwegian recipients (FR024a).
- The authentication of user credentials should be done using existing electronic id service, e.g. MinID or Buypass provided by Altinn or ID-porten (FR013a).

The Norwegian solution is based on the PEPPOL architecture. The same principles that are used in international document exchange are introduced in Norway and should be used by the portal. Note that the SML is excluded when sending documents to Norwegian recipients.

## 6.4. Private Sector Infrastructure Overview

The private sector infrastructure is not centralized or public. Or better yet, there really is no “infrastructure” per se. The solution design should use HTTP, HTTPS and Web Services to communicate and for system access. The portal should be integrated with a back-end system that is prepared for document handling, conversion and forwarding, offered by a system provider.

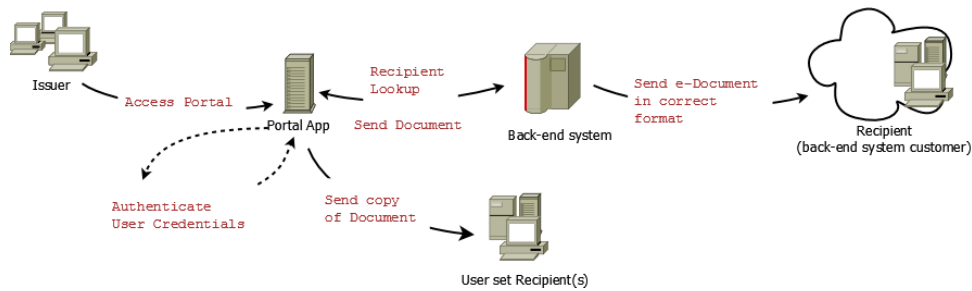


Figure 6.5: Portal integration for Private sector use.

- The authentication of user credentials should be done by way of application implementation (FR013b).
- The portal should do a lookup in the back-end system register, and the document should be sent to correct customer address via the back-end service provider (FR021b).
- Users of the portal should send documents in format required by the recipient. However, the back-end system should be prepared to provide mapping and transformation of formats, and with that, the portal output is determined by the back-end system provider (FR024b).

Note that the recipient may be member of the public sector, in which case the document is sent to the recipient AP by the service provider.

## 6.5. Application Overview

In order to fulfill the requirements the application must handle a number of cases. Those cases are defined and clarified here.

### Dependencies

The above presented infrastructure overview shows a strong dependency of external systems both within the private and public sector solution designs. The dependencies represent the key risks of the application.

Public Sector;

The demands identified for the portal shows a need for six integrations with external systems (B2G);

- *ELMA Register*. New register with electronic addresses for the different companies. The ELMA Register represents the Norwegian SMP implementation and will be made as part of Altinn. The register is responsible for maintaining an accurate and up to date register of all receivers (public sector within Norway). The register maintains and supplies info of correct receiving AP. No documentation is available, which puts this dependency at high risk. Hence this dependency should be put into critical path by the development team and monitored periodically. An analysis should be performed as soon as documentation become available in order to document system intercommunication options and find out new requirements or demands from the portal application.

- *MinID* (or Buypass), which is responsible for ensuring accurate and secure authorization and login to access application. Documentation is available<sup>47</sup>.
- *Enhetsregistret*, which contains basic data about the units that have registration requirements in NAV Aa-Register, Sales Tax Register, Register of Enterprises, Statistics Norway's business registry, the Tax Register for taxpayers, Foundation Register or the Bankruptcy Register. This register is used to retrieve supplier company information. Documentation is available<sup>48</sup>.
- *AP* is responsible for forwarding documents to correct destination. System specification for both the Altinn<sup>49</sup> AP and for the ehandel.no<sup>50</sup> AP is available<sup>51</sup>.
- *SMP*. Decentralized registers, which are distributed all over the EEA area. The SMPs are responsible for maintaining accurate registers for all recipients and their correct AP. Documentation is a part of PEPPOL Infrastructure<sup>40</sup>.
- *SML*. Centralized register, which is responsible for maintaining a register containing information of which SMPs that have detailed information of the particular receiver. The register includes all registered companies and SMPs located over the EEA area. Documentation is a part of PEPPOL Infrastructure<sup>40</sup>.

Private Sector;

For use within the private sector (B2B);

- The portal should be connected to a back-end system prepared for format conversion and mapping. Recipient data should be retrieved from the service provider client register.

In order to mitigate the risks these dependencies bring, all systems intercommunication options and approaches need to be analyzed, documented and approved in an early project stage. In addition the external systems need to be analyzed in terms of new demands from the portal application. The external systems must be ensured to have all services required by the portal (if any) developed according to plan. Also the systems must be made sure to have enough resources to handle increased amount of requests after the portal goes live. Such analysis is out of scope of this project and is left to appointed development crew.

### **Login/Logout**

The login and logout functions should be designed separately for the public and private sectors as defined in FR013a and b.

However, both solution designs should include that a corresponding record is added into log notifying user login / logout actions as defined in FR016. In addition both solution should include time limits for local sessions to ensure that FR014 – Security, is not breached. The following limits are proposed;

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<sup>47</sup> <http://digimaker.difi.no/samarbeid.aspx?m=53690>

<sup>48</sup> <http://www.brreg.no/registrene/enhet/>

<sup>49</sup> <https://www.altinn.no/no/>

<sup>50</sup> <http://www.ehandel.no/>

<sup>51</sup> <http://peppol.forge.osor.eu/links.php>



- Maximum length of inactivity before timeout: 30 minutes
- Maximum length of the session before the timeout: 120 minutes

Public Sector;

The public sector solution should implement Single Sign-On (SSO) and Single Logout (SLO) functionality using MinID (or Buypass or other eID supported by Altinn or ID-porten). MinID follows SAML version 2.0 standard. SAMLv2 includes methods for both SSO and SLO. MinID support both Web Browser SSO and SLO profiles. Corresponding user token should be created and populated with user permissions upon user system access. (FR013c)

On login user is transferred to MinID login screen, where the user is able to enter user name and password. Successful authentication gives user a possibility to access the portal system. Note that authenticated user should be able to access any other service in the MinID Circle of Trust without re-login. MinID is using SAML HTTP Redirect and SAML Artifacts bindings for Single Sign-On, including request from the service owner to MinID for user authentication and subsequent response from MinID after completing the authentication of the user.

SLO means logging out from all services automatically when user logs out from a single service owner. This is an essential feature and must be implemented. User logout (as well as SSO) is propagated to the MinID Circle of Trust. SAML HTTP Redirect and SAML SOAP bindings are used for the SLO profile.

Note that all bindings must be secured with SSL (for both SSO and SLO profiles). The same applies to all other pages within the secure solution. All endpoints with service owners and identity provider must also have certificate installed on the server side.

Private Sector;

Use of e.g. JAAS security framework for authentication and authorization. Each user should be assigned to a group of principals which can be either permissions or roles. To ensure full overview, each user should be able to login into the system only once. Next consecutive login with the same id should invalidate previous connected user session.

Each user should have possibility to change his/her personal information and login password.

System Parameters set should include; User password length, Password strength, Allowed failed login count, Account lock, Failed attempt reset minutes, User password expire days.

### **Agreement Certificate**

In order for a user to be allowed access to the system, an agreement should be signed between the customer and the Portal supplier in accordance with NFR001.

The agreement should be signed upon first login after the user data has been fetched (either from Altinn, or back-end system). In the agreement the user should confirm that he or she is authorized to act on behalf of the company. The certificate

(contract) should be saved in the database first time the user logs in and accepts the terms of use.

Refuse to approve an agreement should force user disconnect from the system (SLO). Successful agreement approve should let user to process further into the system. According to user security profile, reflected in security token, user should be allowed or disallowed to perform system actions (FR013c).

### **Retrieval of User Data**

Upon first user login, the system needs to create a user profile in the user register, which will be used for all consecutive logins. To achieve this the system needs to query user data from Altinn (Enhetsregistret) or back-end system register. That is, if the user login is a first time login, the company user role fetched from appropriate register should be checked. Company administrator should be given possibilities to set standards preferences / profile for the company – payment conditions, payment information, e-mail forwarding, etc. As well as setup company security profile, giving company employees corresponding permissions to access a system and act on behalf of a company. Such functionality fulfills FR003a-e, FR013 and FR025. For more details please refer security section below.

Note that a user will belong to a company and hence, there should be two actor registers in the portal solution – company register and user register.

A successful (MinID or custom) login returns a persons identification number, which should be used for user data query. An Altinn (and Enhetsregistret) query returns the following information (as should a back-end system query);

- User name
- Address
- Phone number
- Organization (or organizations) number
- Role in organization

This data should be inserted into user register and user security token should be created, setting user roles and permissions in the system. For all consecutive logins user security token should be created immediately after successful login.

### **Security**

To meet requirements FR003a-e, FR013c and FR014 a few security measures should be incorporated in the design.

Use cases within the application should be granted on three distinct levels; read only, full access and no access. The access levels should be granted by function and by user permissions / roles. That is, the users should be given read/write/create/edit/delete permissions according to role and function.

Three user roles should be defined in the system;

- Administrator
- Super User

- User

In general administrators should be able to access all company data in the system, execute any operation, create /accept a new users and grant permissions. More specifically this brings that users with administrator privileges should be allowed to create or edit company profile. Company profile should include;

- Company business address and other company specific data.
- Payment conditions, terms and information.
- E-mail addresses for document copy forwarding.
- Company security profile.

The profile should be created and stored in company register on first administrator login. Company administrator should also have an ability to upload a logo for company to be used during document export to PDF and TIFF. By default all users registered in Altinn or back-end system register with company administrator roles should have unlimited access to company data in the portal. Users with all other roles should have no access, unless explicitly granted by administrator.

Super Users should be able to create, delete and view documents in the system and request a copy of document sent to their e-mail address, but not create a new user, grant permissions or access system log and statistics.

Users should be able to view documents previously sent and request a copy of document sent to their e-mail address. They should not be able to create or delete documents, create users, grant permissions, or access log and statistics.

Default permission set for all roles are depicted in permission set Table 6.2.

Table 6.2: User Permission set table.

Role/ Permission	View Logg/ Statistics	Create Users/ Grant Per missions	Create/ Upload Docume nts	E-mail Docu ments	Delete Docu ments	View Docu ments
Administrator	Yes	Yes	Yes	Yes	Yes	Yes
Super User	No	No	Yes	Yes	Yes	Yes
User	No	No	No	Yes	No	Yes

Users that belong to more than one company must have possibility to choose from which company they want to perform an operation. A separate security profile must be applied on each company in this case. Note that also user preferences, like application language selection (FR003a) must be stored for each user (e.g. in cookie).

### Encryption

To add a second layer of security in compliance with FR014, all sensitive user data including passwords, personal and payment information should be encrypted before saving into datastore. This provides one more level of data protection from unauthorized access.

There should be a module in the system, as part of persistence layer, that performs data encryption before serialization and decryption after de-serialization.

## Document Handling

In order to fulfill FR009, FR010a, b and FR011, document handling should support upload, export and manual entering of data. The fields presented in the web form must fulfill NFR007, the output must comply with FR024, and in accordance with NFR006 document delivery must conform to existing infrastructure.

### *Creation of new document / Invoice Fields;*

There should be two possibilities to enter a new document in the system – either manually enter all required fields in web form, or upload already existing document. Please see below for document upload description. A corresponding document storage (FR022) should be maintained in a system (database or JCR). For public sector solution, invoice and credit note data schema should reflect CEN BII format field set, and be extended with fields specific for eHandel.no format. The schema should also have a possibility to extend with additional fields specific for other country format implementation. The private sector solution data schema should by default reflect standard e2b format, and be adapted according to back-end system owner specification.

Additionally, to fulfill FR002, field set schemas for tenders, confirmations, reminders and reimbursements should be analyzed and included in an early project implementation phase in order to avoid storage restructure in later phases.

All fields defined as mandatory in CEN BII format (or eHandel.no or e2b) should be defined as not nullable in datastore. All mandatory fields should be validated prior to sending and save. In case of discrepancies, an appropriate error message should be presented to user, informing which field is missing or malformed. Refer to Appendix B for list of mandatory fields in eHandel.no format. Furthermore, to fulfill FR012, duplicate number series should be supported. One of the number series should be generated, and the other should allow for manual entering of invoice number, and with that, the system should check that the entered number is unique. Any manually entered number should be treated as main number by the system.

After mandatory fields validation document should be transformed into XML file, according to format description. An XML file should undergo XSLT validation using utility provided by CEN Conformance Testing Tool for Norway BII Invoice Transaction profile<sup>52</sup>. Additionally created XML document should to be validated against XSD schema definition file.

The validation logic should be built up by a layered structure for the public sector solution to prepare for deployment to other nations. The layers can be divided to e.g. technical structure, profile specific requirements, national requirements, industry specific supplements, and bilateral. This way maintenance is facilitated, and when implementing instances of the system, the parts of the code that must be replaced for national adaption can easily be identified.

After data validation it should be persisted within datastore. Failure to persist document after pre-defined amount of persistence re-tries should stop normal

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<sup>52</sup> <http://www.cen.eu/cwa/bii/specs/Tools/TestConformance.html>

document handling lifecycle. An automatic error notification should in such case be generated, and sent to system administrator (FR015).

*Export;*

All documents should be stored in order to provide a possibility to export created invoice or credit note into PDF or TIFF file for automatic forwarding to customer selected e-mail recipients.

In more detail, an XSLT (Extensible Stylesheet Language Transformations) template must be created that will be used for documents XSL transformation from XML to PDF and TIFF. In an early project phase, use of one template may be enough, as invoice and credit note documents utilize the same field set and should have the same standard view. The templates must have a possibility to insert company logo into pre-defined space, if logo has been registered for the company. The template must be compliant with Norwegian laws and regulations.

It is not required to store documents exported into a file, as documents source data is already stored and re-export can be performed any time, if user request it (for manual document re-send via e-mail). A document naming convention could be e.g.;

*PortalAppName\_<sender company name>\_<document type>\_<document number>.<extension>*

There should be a possibility for authorized users to send a copy of any document via e-mail. Workflow is as follow;

- a. User login into application
- b. Find required document on document view
- c. Press send button
- d. On a new pop-up window enter e-mail address and confirm document send. An e-mail with selected document as attachment should be send to entered address.

In addition, in accordance with FR008, the system should support printing of sent documents and attachments.

*Upload;*

System must have a possibility to parse and load document data from user uploaded Excel CSV (comma-separated values) and/or XML files. For those purposes corresponding template files or data export rules must be created/defined. That is, there must be a pre-defined Excel template created for clients that want to import their invoice/credit note data from external file. This template should list all invoice/credit note fields, marking which of them are mandatory.

When client imports an Excel file into the system all invoice/credit note information should be placed into corresponding web form giving possibility to fill in or edit data before validation. After that this process should follow standard document handling lifecycle.

Upload should be limited to one document per file (i.e. it should not be possible to upload 2 invoices in one file).

Additionally user should have a possibility to create a credit note from any invoice sent previously. In this case credit note web form should be automatically filled in with invoice data, allowing data modification before validation. After that process should follow standard credit note processing lifecycle.

Please note, that it should not be possible to upload documents recipient data, as this information must be fetched from corresponding registry (FR021). There is no need to store uploaded document file inside the system, as all necessary data should be parsed and stored as document data, when document is processed.

After successful document create user must have a possibility to upload document attachments. Attachment upload represents the last step in document lifecycle before actual sending. Total size of all attachments to one document should not exceed a certain limit. All document attachments should be stored in system storage for the same amount of time, as linked document unless Norwegian legislation demands otherwise (such as in the case of phone bill specifications that must be deleted after three months). Note that it should not be possible to use links that point to other web pages or sites to represent attachments, as such linked attachments cannot be stored (FR010c). Note also that total disk space for a user should be limited (to e.g. 5 GB) as defined in NFR011.

There should be a content repository (such as e.g. JCR<sup>53</sup>) maintained in the system, used for attachment document storage. A content repository is a content management system used for documents and their associated metadata storage. It utilizes document access control, versioning, searching and backup functionality. All document attachments should be delivered along with the linked document.

An automatic virus check for uploaded attachments should be included.

#### *Document Delivery;*

Every outgoing document should be delivered to corresponding AP or to a back-end system. After that the AP or the back-end system takes care of finding the right path and technique to deliver the document to the actual recipient. In case of delivery via a back-end system to a private sector recipient, also the correct recipient format is determined and created by the back-end system.

For Norwegian public sector infrastructure, Altinn is one of the proposed AP solutions. Altinn offers different interfaces for most functional integration points;

- Integration via Web Service - Service Contract (WSDL) describes the format for data used.
- Integration via XML files (batch) - Altinn has defined standard formats for all XML integration.
- For file-based integration with Altinn an SFTP protocol can be used. There are two approaches how to deliver a file to Altinn:
  - Altinn can retrieve data from the remote party system.
  - The external party can deliver data in pre-defined area - SFTP server connection must be established by an external party.

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<sup>53</sup> Content Repository API for Java

Additionally, upon successful delivery to Altinn, each document should be checked for other user defined delivery requirements. For example, user can select to deliver a copy of each document to his accounting company, shipping department, invoice hotel, etc (as defined in FR011a-e). This delivery should be conducted via e-mail message with document as attachment. User should have a possibility to select a file type for document export for attachment – PDF or TIFF. It would also be recommended to give the users a possibility to assign mail subject and body text.

Note that documents should not be possible to edit nor delete after delivery as defined in FR006 and FR007. Documents should, however, be possible to be marked as deleted in order to send a “duplicate” invoice (an invoice with same invoice number).

### **Recipient data lookup**

FR021 a and b describes recipient retrieval requirements for public and private sectors.

In new invoice and credit note screen user should have a possibility to find document recipient data using recipient business identifier (name and/or company organization number, or country specific defined id). It should not be allowed to enter document recipient data manually.

For the private sector solution, the user should select a recipient from a predefined list consisting of by the back-end system approved recipients (customers).

For the public sector solution the user will first need to select recipient location – Norway or International. For Norwegian recipients the ELMA Register should be used. For this lookup there are two options, depending on ELMAR capability;

- User enters company name and/or organization number (business identifier). System does lookup/query in ELMAR and shows companies that match this criteria. If ELMAR allows it, it would be preferred to use wildcards in company name for search. Organization number validation according to Brønnøysundregistrene register rules<sup>54</sup> should be preformed before ELMAR query, if organization number is a subject of query, in order to ensure that number is correct.
- It may also be possible to give user a possibility to select a recipient from full company list fetched from ELMAR (if ELMAR supports it), but such approach will introduce significant network overhead due to large amount of data that needs to be fetched from ELMAR for each invoice. It is possible to cache such list, but then it becomes an issue of cache synchronization with ELMAR.

For international recipients system should use business identifier provided by recipient for SML central register query. Found company data should be pre-set in document web form.

In all cases (Norwegian/international, private/public sector) the user should not be able to continue with the document until the corresponding recipient is found and selected.

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<sup>54</sup> <http://www.brreg.no/english/coordination/number.html>

### **Internationalization and localization**

NFR008 defines an internationalization and localization requirement. To fulfill this criterion, the system should by default be available in both Norwegian and English language. It should also be possible to easily add any other language in the system. For this purpose all system screen items, messages, notifications, user log, template, etc. text should be marked with unique identifiers. A separate storage space (database or proprietary files) should be reserved where it should be possible to extend corresponding markup identifiers text translations with any other language text. Hence, it is mandatory, that none of the text messages is hard coded within the application.

### **System monitoring**

To fulfill requirements FR015, FR016, FR017, FR018 and FR020, describing logging, statistical data handling, report generation, error handling and health checking, the following should be included in the system design.

#### *Logging;*

As a minimum, the service owner should log the following information about authentication attempts;

- Date and time
- What action was attempted
- The result of the action
- The user id and IP address
- Session Index

Additionally all system create, delete and upload actions should be logged with following information;

- Date and time
- What action was attempted
- The result of the action
- The user id

Log file storage time should be the same as required for invoice data storage.

System should also have comprehensive system log available for system administrator that may have to identify hardware and software problems.

#### *Health-check;*

System health-check is a utility process aimed to monitor the various components of the web and/or intranet and to ensure that they remain up and operational at all times. The check should be run by standard system scheduler like cron or NT Scheduler at short intervals (e.g. once every hour). The health check tests should include the following;

- Check that database and/or other storage is operational by connecting to it and reading pre-defined values.
- Check that web services are running (if any).



- Verify that email services are operational.
- Verify that performance is within acceptable range for specified urls.
- Verify that the application framework is operational by connecting to it.
- Verify that the servlet runtime system is operational by running a status servlet.

The following actions should be performed in case in any of the verification checks fail:

- Log a message to the server log.
- Send an email and/or SMS notification to the system administrator.
- Display a prominent message on the console (in case all other system administrator notifications fail).

*Error notification;*

As a minimum, automatic e-mail notification to system administrator in case of unrecoverable system errors should be supported. Such errors could include database crash, FTP or Mail server shutdown and so on. All such errors should be grouped into the same exception class. Each exception of this class should trigger a new e-mail message to pre-defined administrator address with exception text. Additionally, an SMS notification support might also be needed in the system in order to speed up urgent problems alarm delivery.

In future project phases application might need a facility also for user notification. Such notification facility could come into use e.g. if the portal application should be upgraded with possibility to accept documents for user or company. In such case users might need a sub-system that informs about incoming documents and other events.

*Invoice receipt processing;*

In case an invoice receipt from invoice recipient is expected back, the portal must implement an invoice recipient communication sub-system. Else this functionality needs to be implemented by way of AP or back-end system. Hence, the receipt processing implementation is subject to discussion with AP provider and back-end system provider.

Currently in Altinn receipts are used in following cases:

- Messaging / Data received by Altinn for processing.
- When messages / data is validated and passed on to processing.

Invoice receipts should be matched with corresponding invoice by invoice number and displayed as linked objects in the UI.

*Statistical data calculation and presentation;*

The system should give possibility to display delivered document statistical data. It should be possible to select either all document types, or view statistic by delivered document type (invoice statistic or credit note statistic). It should be possible to filter data by counter party (buyer), and to group the statistics by company if user belongs to more than one company.

Statistical graphs should draw representation by;

- Number of documents versus time scale.
- Total amount invoiced versus time scale.

It should be possible to gather and view statistics based on following time frame selection;

- Today
- Last Week
- Last Month
- Last Year
- Custom time frame with Date From and Date Till calendar selectors

Along with graphical statistic data representation it should be possible to view the data as a table with possibility to export displayed data into Excel document.

The system should also be prepared to generate monthly reports, and to manual generation of the collected data to system manager personnel. Such statistic data should include information about;

- The number of documents produced per document type
- Turnover for orders and invoices
- Number of registered organizations and users
- Number of active organizations and users
- Number of documents sent per organization
- Errors, resends and system failures

### **Administrator Console**

To fulfill FR019, a system administrator console should be implemented.

The console should provide possibility for special on-demand functions, such as locking or disabling individual organizations from the portal, system monitoring, health check or manual generation of statistics reports.

The system monitoring functionality in the console should include possibility to monitor number of requests to different components and services (showing successful and unsuccessful counts), average operation time in milliseconds and last health check results.

### **Data Search**

Data search functionality should be supported to comply with FR005.

Default view on document display screen should show last 15 documents sent out of system for selected company (FR023). Pagination option should list number of pages, assuming 15 items per page, and allow to list previous / next pages and go to selected page. Additionally it would be preferred to extend user preferences with

possibility to select how much items he/she wants to see on a page (change from default 15 items).

There should be two search possibilities implemented in the system; Quick search/filter or Free text search.

*Quick search/filter;*

On document view there should be a possibility to search or filter documents list using the following parameters;

- Invoice number.
- Invoice recipient company name.
- Invoice recipient organization number.
- Invoice issue date (from date – till date).
- Invoice due date (from date – till date).
- Invoice receiver KID number.
- Document type (invoice/credit note as defined in this project phase).

Search / filter should support wildcard search.

*Free text search;*

The free text search option will be used in case user wants to find some documents(s) by particular word or phrase. For this purpose the following fields should to be indexed inside the system;

- Invoice number
- Invoice recipient company name
- Invoice recipient organization number
- Invoice recipient KID number

Free text search can be executed within indexed fields set only. User should have a possibility to enter a word or phrase, containing wildcard sign as search criteria. Any documents that have indexed field matching entered criteria should be displayed in the UI.

Documents that are older than some certain amount of time should be archived either on hard disk, or exported to a tape device.

**User interface functionality**

High level activity diagram describing the creation of new documents in the web form (Fulfilling FR001, FR021, FR010a-b, FR015)

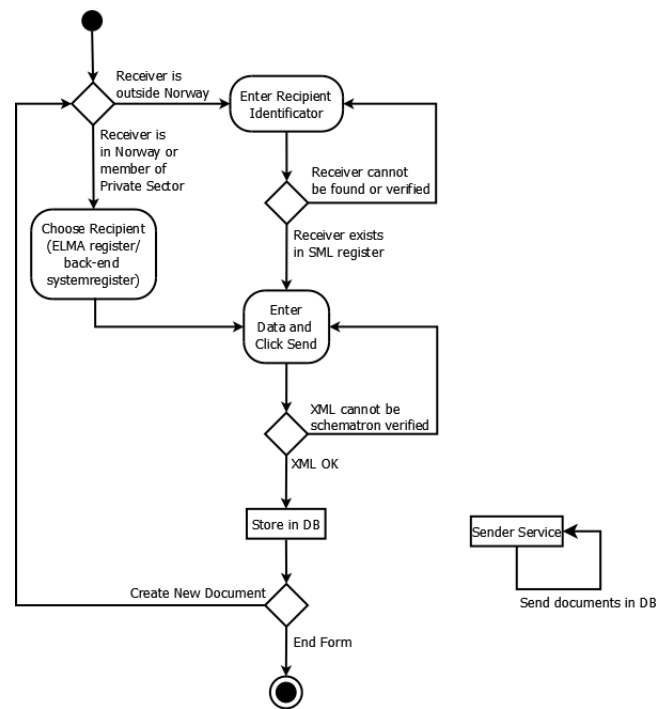


Figure 6.6: User interface, Activity Diagram

Proposed workflow is as follow;

- a. In UI user should be able to execute search for recipient data
- b. After successful recipient lookup user should be offered either to enter document data manually, or upload it from file
- c. Standard file upload dialog window should be displayed, if user chooses to upload file.
- d. Selected file should be uploaded to the server side and parsed. Appropriate error message should be displayed, if document is in incorrect format, or malformed.
- e. Information should be parsed and inserted into web form.
- f. User should then be given possibility to edit data and start standard document processing lifecycle.

Note that the document processing lifecycle includes a possibility to upload attachments before sending of document.

As defined in FR004, effortless access to support functionality should be put in place in the user interface. The interface should display contact information and provide a contact form. In order to fulfill NFR013, the system should be very easy to use for the SMEs, and of a low threshold. Note that this may conflict with FR013 and hence, effort should be made to make the process of authorization and authentication effortless. In addition, the interface should be made as intuitive as possible to use.

To comply with NFR009 and NFR010 the UI should be adapted to user soft- and hardware with support for standard screen resolutions and for commonly used

browsers. The supported screen resolutions should be ranging from 1024x768 to 1920x1200, and support for following web browsers should be included;

- Internet Explorer, version 7 or later.
- Firefox, version 3 or later.
- Opera, version 9 or later.
- Safari, version 3 or later.
- Chrome, version 5 or later.

## 6.6. Application Workflow

The workflow of the application functionality is illustrated in Figure 6.7. Note that the application should be well documented as defined in NFR004, and that the system should be released for use free of charge or at very low cost in accordance with NFR012.

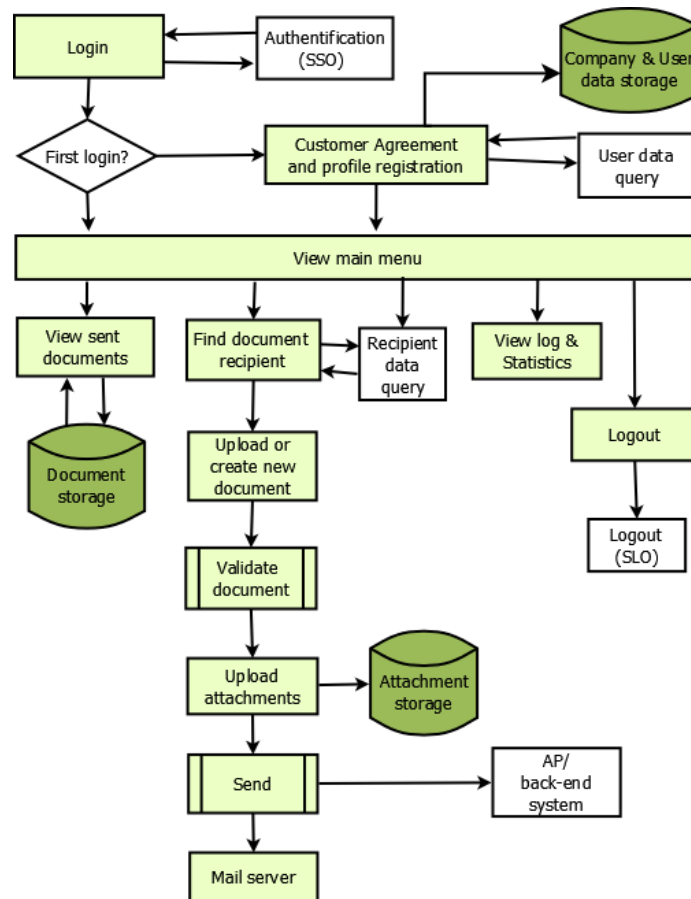


Figure 6.7: Workflow Overview [42].

The proposed workflow includes;

1. Authentication and authorization of user via Single Signon and Single Logout by e.g. MinID SSO application server, or by application

authentication server. (FR013)

2. Upon first login system should (NFR001, FR003);
  - a. Query register for user data (using user identity number returned by authentication service).
  - b. Create and save a user profile within the system.
  - c. User must accept agreement on terms of use.
  - d. Company administrator should upon first login be prompted to setup company profile and define company users access rights. Company data and security profile should be stored by the system.
3. User preferences, like default application language selection and pagination settings should be stored for each user (in e.g. cookie) (FR003). System should support different interface languages (NFR008).
4. Upon login to the system all users should have possibility to search for previously sent documents and request a copy of document and associated attachments sent via e-mail. (FR011, FR022) Sent documents should be displayed with e.g. document type, date, status and recipient, and a detailed view of the sent document should be provided when the user clicks a single line.
5. Users with permissions should be allowed to create new documents manually or upload documents from file (FR010b). Before the user can start creating or uploading a new document, a recipient data lookup should be executed (FR021). Document creation, validation and saving should follow standard document processing lifecycle (FR021, FR022, FR024). When a document has been created and validated it should be possible to attach files to be sent along with the document (FR010a).
6. When user presses Send button, the document and all associated attachment should be sent to correct AP, or to back-end system (NFR006). In addition the document along with the attachments should be exported to user selected format and sent via e-mail to user defined e-mail addresses (FR011). Note that the possibility to export created documents into PDF or TIFF formats brings about an underlying process. In addition the system should have the ability to accept, parse, process and match delivery reports received from AP or back-end system (FR015).
7. The system should collect and present statistical data about document processing as well as user action. The collected data log should be available for company administrator (FR016, FR017). Error log and monitoring/system management console should be created for system administrator (FR019). Additionally system should be implemented with health-check process running periodically in order to notify system administrator in case of hardware or software problems (FR020).

Proposed workflow of the sender service should include;

1. There should be a message queue created that is a placeholder for messages indicating documents ready for delivery.
2. Document send or resend from UI should cause a new message created and sent to output queue.

3. Sending module should read messages from the queue, get corresponding document and execute sending. Document should then get status SENDING.
4. Document status should get updated upon sending execute;
  - a. The status should be set to SENT, if sending process is a successful.
  - b. The status should be set to FAILED, if there occurs a problem (exception) during sending.
5. Corresponding notification message should be generated and sent to user, in case document fails to be sent to any of the designated channels (to original destination, invoice hotel, accounting company, or back to user).
6. Additional routines might need to be implemented, if delivery receipts registration is required in the system. In this case document should be able to get RECEIPT\_WAITING status upon successful delivery, if delivery channel is marked as capable of delivery receipt send-back. Upon receipt receive there should be a logic that matches receipt with original document, as well as receipt message parser in order to get a status of receipt. Document status should then be changed from RECEIPT\_WAITING to SENT, if receipt status indicates that data is received correctly. Otherwise status should be changed to FAILED.

## 6.7. Issues and Concerns

There exist some known issues and concerns of the presented design, which need to be addressed and clarified.

### Authorization Functionality

In accordance with FR013a, the presented design solution for public sector application suggests use of existing login function offered via either ID-porten or Altinn (e.g. MinID, Buypass ID). A closer look at the MinID authentication solution shows use of SAMLv2.0 token in the authentication process, where the attributes included in the assertions include values;

- User social security number (SSN)
- Language and country code
- Security level.

The use of SSN as user identification may form a problem. The Norwegian Data Inspectorate shows great skepticism towards use of SSN for authentication purposes. The only apparent exception from this skepticism seems to be requests for credit reports, where the SSN is needed, but even then the Data Inspectorate direction requests the number not to be stored. This skepticism for use of SSN comes forth in a case recently handled by the Data Inspectorate, involving employee certificates [43]. The issue in the case is similar, and an apparently skeptical attitude is shown by the Data Inspectorate, as point 5.4.1 indicates (freely translated); “There is no legitimate reason to use the SSN for employee certificates, and SSN is also not necessary to use to achieve identification”.

Hence, implementing a system where SSN is (even temporarily) stored should be done with great caution, as it most likely will meet some degree of resistance from the Data Inspectorate.

In addition it is not unusual for individual persons to hold roles spread across multiple companies or organizations, or to outsource accounting services. In such cases the SSN and organization number/organization role will not coincide.

There are a number of options to deal with this problem.

- Use self-composed username and password, as in private sector solution design (The Research Council of Norway SkatteFUNN solution does so and the method can with that be deemed sufficiently reliable). This can usually be done with org.nr as pre/postfix so that the user is not stolen by the "first come first served". Note that use of only company Org.nr as standard lowers the security as the Org.nr is publicly available on Enhetsregistret
- Use login via sms-pin for cellular phone number with a timeframe (more complicated)
- Add functionality of use of Org.nr in MinID – or other available electronic id service.

Note that in accordance with FR013b, the private sector solution design proposes a custom authentication authorization system, and with that this issue only concerns the public sector solution.

### **Storage of documents**

According to FR014 sent invoices and credit notes must be stored in 10 years 11 month and 30 days, and according to NFR011 disc space for a user should be restricted to e.g. 5 GB. Such storage can quickly become complicated. Since the design solution proposes storage to be done after consumption, the extent of the complexity is reduced. However there are to date 232,000 sole proprietors and SMBs in Norway. In a worst-case scenario this will result in 5GB x 232,000, which equals 1,160 TB of storage space (where only to date existing users are calculated).

The solution design for the private sector includes integration with a service provider. The obvious recommendation is to include possibility for portal users to access back-end system storage of sent invoices, and by that the storage problem may be solved for the private sector solution.

For the public sector solution there is no back-end system that stores the sent invoices. However, as the portal only acts as intermediary, there is no obligation for the portal to save the documents. The archiving responsibility lies with the supplier, not the portal owner. With the tight timeframe for the solution implementation, an alternative solution should be at least considered for early project phases.

A proposal for a potentially elegant solution is to eliminate storage completely. The workflow may then be as follow;

1. Sender register and set up receiving mail (mandatory)
2. When generating an invoice, a pdf is concurrently generated as part of the process cycle.



3. The pdf is sent to and received by the supplier (invoice issuer)
4. The supplier stores the invoice in accordance with company procedures
5. The portal have no legal responsibility for the document

#### Alternative redundancy

- Supplier is offered function to generate pdf runtime and get a pdf of the document in a pop-up “print” function.
- Supplier is offered possibility to send duplicate pdf to secondary email address.
- The e.g. 15 last sent invoices can be kept in storage in order to avoid problems in case of connection interruption during pdf generation/send. And in order to avoid issues when supplier is in need of resending an invoice.

The portal will with that avoid costly infrastructure while maintaining functionality. Note that all user activity should still be logged, along with number of sent invoices and invoice numbers.

#### **Upload of Excel files**

In accordance with FR010, the prototype implementation includes function of Excel document upload. However, upload of such semicolon separated Excel invoices is tricky and a much better solution would be upload of SML files. Upload of Excel would mean transformation of the uploaded document to XML, which is complicated and error prone.

In addition, according to current guidelines (at least for public sector use), the functionality should more correctly be designed for Open Document Format, ODF (.ods) to avoid proprietary software. Support for Excel file upload but not ODF may be seen as preferential treatment of Microsoft Office software.

Though based on user habits, and deemed important enough to include in the requirements and solution design, the function may in actuality in the end seem like a nice-to-have function, as oppose to a need-to-have one.

#### **International Use**

Concerning use within international markets, this thesis has not included study of international country-specific legal requirements. Hence, any potential problems arising from sender-recipient law discrepancies have not been identified. However, it should be noted that in organization presentation it is very important that the organization is presented with VAT. Without this being done the receiver in accordance with the law will not be able to use the correct sender VAT in their VAT accounting. NO prefix should also be listed by organization presentation.

#### **Retrieval of user Data**

User data for the private sector solution can be expected to be stored and maintained either by the portal itself, or by the back-end server system. In either case, the systems can be expected to be interconnected tightly enough for this not to pose a problem. However, for query of user data from Altinn, more information is needed. The identified issue here is; if user data changes in Altinn register

(Enhetsregistret), this will not be reflected in the portal application. A solution to avoid this would be to query data on each login, but such solution can be anticipated to give large network and system overhead with minor practical value. Hence some web service should be in place for user data retrieval purpose, and documentation of how to query data from Altinn needs to be further investigated.

### **User roles and permissions /Security**

The user permissions defined in this thesis does not take into consideration added functionality in the form of other document types apart from invoices and credit notes. It might be needed to set separate permissions for different document types in the later project phases. For example, there might be need to award permission to a user to view tenders, confirmations, reminders, reimbursements and catalogs and deny ability to view company invoices and credit notes.

### **Recipient data lookup**

A potential issue arising from the recipient data lookup, where the user is left with no possibility to change recipient data is that the user might be left with no possibility to enter recipient shipping and billing information for invoice recipient. Only business address fetched from the registry is available.

### **Invoice receipt processing**

As established in application overview, invoice receipt processing is subject of discussion with AP or back-end system provider. A look at Altinn has been made, but the subject is not covered in documentation apart from cases when receipts are used, and further investigation is needed to establish if a communication sub-system must be implemented in the application.

### **Tight timeframe**

For the public solution there is a strict time limit with concern taken to pending law amendment. Development lifecycle should be split into separate releases/phases to cope with the tight timeframe. Each phase should have a number of use cases assigned based on use case priorities and business values. Each release/phase should be split into development sprints in order to control overall project cycle, identify new project risks and find mitigation.

## **6.8. Project Approach**

As identified in Chapter 6.7. – Issues and Concerns, the public sector solution has a tight timeframe and should be split into separate releases or phases. Such division is consistent with Agile SCRUM methodology. The Scrum methodology suits well also with the private sector solution development demands. The approach consists of; product backlog, release planning, sprint planning, Sprints (technical, synchronization and showcases), retrospectives and daily stand-ups.

In addition, as the public sector solution has been proposed to be released as F/OSS, use of the advantages from open source release should be taken to full use. The approach is to create and maintain a community of potential co-developers and testers, and release the source code to the community as early and often as possible. That is, the program doesn't really have to work particularly well. It can be crude,

buggy, incomplete, and poorly documented, but the developer community needs to have something runnable and testable to play with, so a prerequisite is that the program must not fail to run. Note that in a F/OSS development environment part of the core development team task becomes coordination of work, recognizing good ideas from users and finding a way to incorporate them into the code, while maintaining control and project direction.

The process should include maintenance of the community with beta lists, issue and bug tracking, subversion control system. The process should also be split to development-, test-, user acceptance testing-, and production environments.

Note that the open source model of development to parts can be practiced also during pre-project phases by the public sector. When getting more people looking at one problem, all problems become shallow and any potential shortcomings, issues or concerns within the solution design can quickly be resolved. Hence, use of competitive dialogue when publishing announcement for public procurement could be considered.

## Chapter 7

# Prototype Implementation

Part of the prototype implementation was made as a part of Specialization Project course IKT509, run at University of Agder by the same project group. For full description of the work done please refer to project reports, as presented in *Web based portal interface for electronic invoice interchange in the Norwegian SMB market*, and *Project implementation in WebRatio*, both documents released for University of Agder, Grimstad, 2010 [44][45].

A short summary of the development method and user interface implementation done during the specialization project, and a more comprehensive description of further development work done during this project period is provided here.

### 7.1. Development Method

The development method used to implement the user interface was Model-Driven Development, MDD, with WebRatio as development environment.

MDD is an approach to develop applications by focusing on conceptual modeling. That is, MDD makes use of the fact that modeling is a vital part of any development process. It supplies a way to think issues through before coding by letting you think at a higher abstraction level. The whole idea is to convert the created models to source code instead of starting all over again with coding. Figure 7.1 illustrates the components and stages involved during MDD by use of WebRatio.

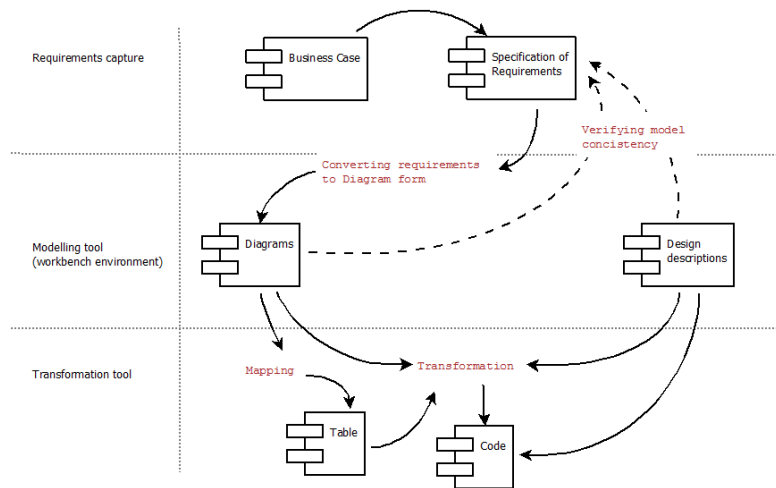


Figure 7.1: Implementation process when using Model Driven Development with WebRatio

When developing the interface using WebRatio, the requirements are translated into an application model, from which the web application is generated. An application model developed in WebRatio consists of three basic levels; data, logic and presentation.

The *data model* is defined as an Entity Relationship diagram. The data model is then used to generate and maintain the structure of the physical database of the web application.

The *logic model* is defined through the WebML visual language. This language defines all logic/functional requirements of the web application. Within WebRatio, the logic model is created by designing a logic diagram using a standard set of Units provided by WebRatio, or by creating custom units to implement specific features. The logic model is then used to generate all Java classes and configuration files needed to run the web application from a functional point of view, such as for data reading and writing, transactions, procedures and calculations.

The *presentation model* is defined by a set of templates that defines the layout at different levels in the model. From the presentation model, dynamic JSP pages are generated with the desired layout and rendering language.

For full description of implementation by using WebRatio, please refer to mentioned specialization project documentation [44][45]. In addition, Appendices E and F present current implementations of data and logic models.

## 7.2. Implementation

During implementation the following components were used in the development environment.

- WebRatio (not open source but during this project a free academic license was used)
- Apache Struts, transformation tool (included with WebRatio)

- Apache Derby database (open source and WebRatio includes a special support to this database)
- Apache Tomcat web server (open source)

Within WebRatio two projects were created; a Web Project and a Style Project.

The Web Project was implemented by use of an Entity Relationship diagram and WebML visual language. When creating pages in a Web Project the pages get a standard design provided by default table-based layout given by WebRatio. In order to modify this layout a Style Project must be created, where the design can be modified using templates and CSS.

In order to view the result, whether a Style Project is used or not, code must be generated. This process – supported by Apache Struts – interprets the entire model and generates a Tomcat web application.

During prototype interface implementation, focus was put on main functionality enabling to demonstrate invoice flow and typical usage areas. Hence, the prototype should not be seen as a finished product ready for release to the market, nor should it be seen as a complete implementation of the presented solution design.

The implementation has been based on the solution design. However, a simplified version of part of the design has been implemented. Design descriptions of the different parts can be found in Chapter 6.5. – Application Overview.

The prototype supports a simple authentication and authorization system. Figure 7.2 shows the prototype login screen.

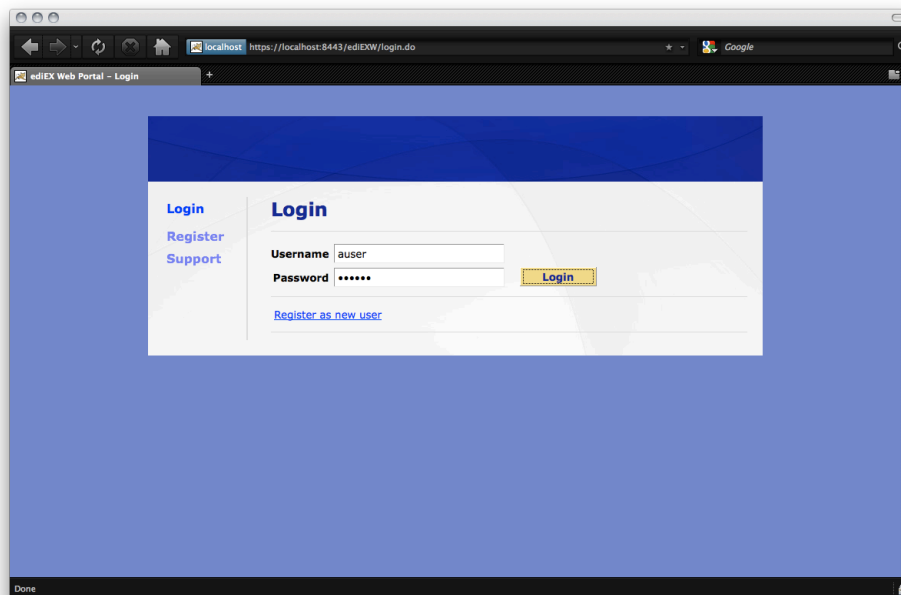


Figure 7.2: User view of prototype login screen.

The authentication solution supports login and logout from the system for already registered users. The users have also been allotted user roles, and permissions according to those roles. In this simplified implementation the users have been

awarded permissions on two different levels; User and Super User. The functionality of the system is available to the users according to group and role. In addition to above presented two user groups, the system has been implemented with support for an Administrator permission group. Login with an administrator account gives access to an administrator interface where users and customers (recipients) can be added, removed and edited. The system implementation also includes support functionality, and to administrate the support implementation, a fourth user group has been implemented (only for prototype implementation purposes), namely Support User. Login with a support user account gives full access to all other user accounts (note that this is not recommended in full-scale implementation).

The available functionality surrounding document handling in the prototype includes creation of basic invoices by manual entering of data or by uploading an Excel document (Excel 97 – 2004 compatibility). Figure 7.3 shows manual enter of data, and Figure 7.4 illustrates file upload dialog window for the Excel file.

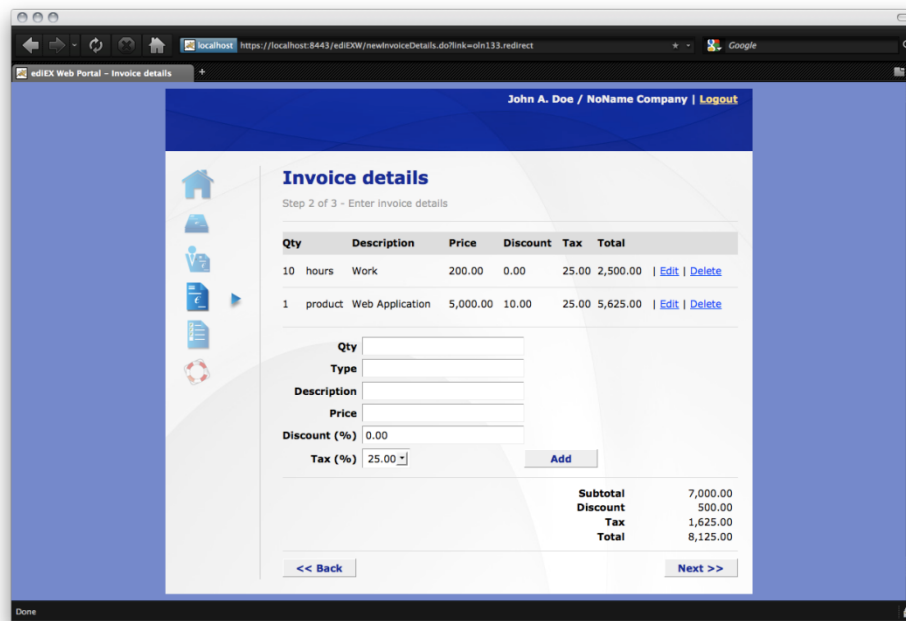


Figure 7.3: Manual enter of invoice details.

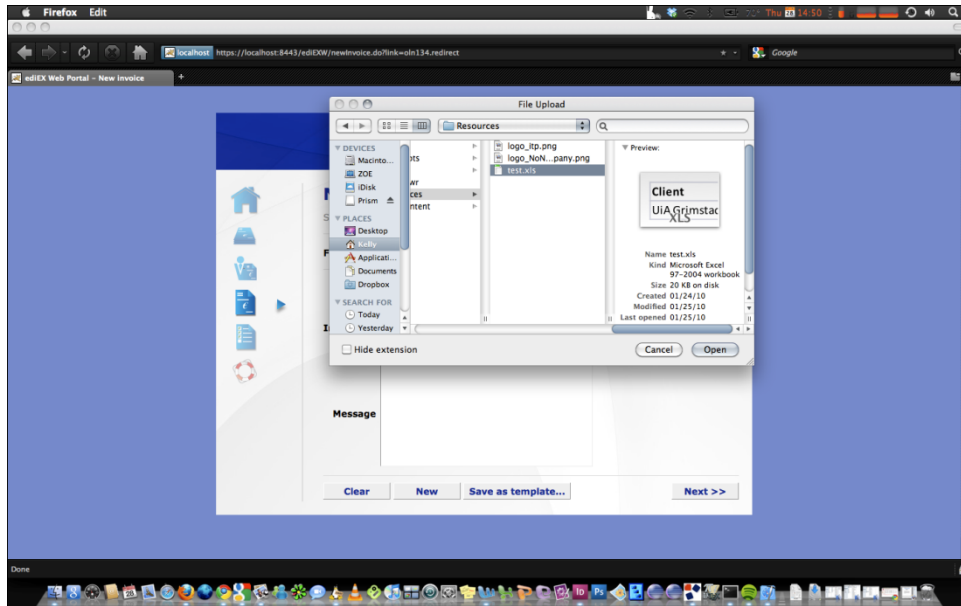


Figure 7.4: File upload dialog window.

Though the implemented simplified invoice does not include all fields included in the identified EDI document format, the fields have been adapted to existing standard format e2b. The pre-defined Excel template lists all the same – e2b subset – invoice fields. As defined in the solution design, the sent invoices are neither editable nor deletable. The sent invoices are, however, stored in a sent invoices archive as defined. The archive displays sent invoices as single lines, and by clicking a line the user is shown invoice details of the specific invoice.

Additional functionality supported in the prototype, includes editing of preferences, such as company data and upload of company logo. Also support for saving of invoice drafts, and templates have been implemented.

Consistent with the design specification, encryption by SSL has been activated on all pages, and with that, the system is not accessible unless the user connects via a secure connection (https). For recipient data lookup a simulated recipient data register was created.

The interface has been adapted to support screen resolutions ranging from 1024x768 to 1920x1200. This has been accomplished by making sure that the used design does not require users to scroll in all kinds of directions in order to see the entire page. Support for the most common web browsers has also been assured during implementation (IEv6, FFv3, Operav9, Safariv3 upwards in versioning). Below, an example is showed where a part in CSS is tweaked to function properly also in Internet Explorer.

```

a:hover {
    color: red;
    filter:alpha(Opacity=100); /* IE */
    opacity: 1;
}

```



As identified, the system should be connected to surrounding infrastructure, and document delivery should be done by way of existing infrastructure. This is the case both for private and public sector solutions. However, in order for the application to function for public sector use, the system needs to be connected to a number of external systems, whereas for the system to be useful within the private sector only one dependency exists. Hence, the prototype application has been connected to a back-end system prepared for format conversion, consistent with presented system design for private sector use.

The EDIGard ediEX system developed by ITP AS was connected to the application. EdiEX is a software suit for electronic interchange, and the application supports all business standard formats, including the, in the portal implemented, e2b format. This server back-end provides a platform that acts as intermediary between invoice issuer and invoice recipient.

The EdiEX system allows client applications to communicate with the system via client services and protocol adapters. The prototype portal represents one such client application and can, with that, send requests to the server using the provided Web Service interface.

WebRatio supports standard SOAP protocol, and the available operations data sent out is described by Web Services Description Language (WSDL)

In WebRatio, a Web Service-call is handled by a “Request Response Unit”. The unit can be used in slightly different ways;

- Feed it with data and the unit makes sure the SOAP structure is created correctly, or
- Feed it with a complete SOAP document that it sends to the Web Service.

In the implementation the latter was used due to the fact that an extra parameter in the SOAP header was needed (as instructed by the Web Service provider). Thus, an XSL that transforms XML data to a SOAP document adapted for the Web Service was created. A complete SOAP document was then created from an XML-dump of the database for the invoice to be sent, by use of the XSL transformation file. Figure 7.6 shows the operation module for sending of invoices to the back-end system.

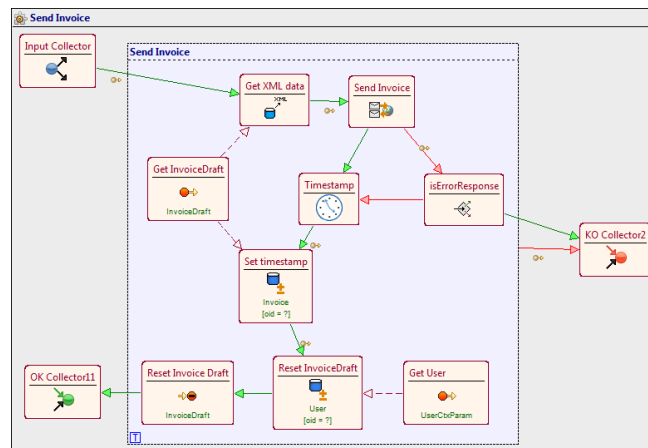


Figure 7.5: Operation module for sending of invoices to back-end system.

The Send Invoice operation module extracts the data for the current invoice draft into an XML document and uses a *Request Response Unit* in WebRatio to send the invoice to a web service in the backend system. If the backend web service accepts the invoice, the invoice is marked as sent in the database by setting the sent timestamp. The invoice “sending status” is removed. Note that this is a simplified version of the specified application design, as successful send in reality only results in the invoice changing from “draft” to “sent” invoice and with that moved from drafts to sent invoices in the user interface.

The XML document that is created by the *XML Out Unit* is a dump of all the database elements containing data for the current invoice draft. This includes *Invoice*, *InvoiceItem* and *Company* (both buyer and supplier). An example output XML is shown in Appendix E.

The web portal is expected to send a proper XML document to the backend web service in accordance with the supplied WSDL [46]. To achieve this, the *Request Response Unit* is configured to apply an XSL transformation file on the xml output described above, before calling the web service. The XSL used for the transformation can be found at *WebContent/transformation/xmlout\_to\_e2b.xsl* in the WebRatio project.

The XML message generated by the XSL transformation from the XML invoice data is a complete SOAP message containing an (subset of) e2b Invoice Interchange message according to the e2b invoice format specification [47]. An example SOAP message sent to the backend web service is shown in Appendix E.

In the current implementation of the back-end web service, there is no response message sent back to the client unless there is an error. This makes it a bit tricky to correctly handle the result of the web service call in the WebRatio model. It is suggested that the backend web service is changed so it always returns a status message.

The process of sending an invoice to the back-end system in WebRatio looks as follows;

```
Get XML data (XML Out Unit) + xmlout_to_e2b.xsl -> Send  
Invoice (Request Response Unit)
```

For full description of WebRatio implementation of the functionality, including implementation example highlighting how the application modeling procedure works, please refer pointed out documentation [44][45]. For full documentation of the current version of WebRatio prototype implementation Data Model and Logic Models, please refer to Appendix D and E respectively.

## Chapter 8

# Discussion

In Chapter 1.2. – Problem Statement, a set of problem areas was defined, and a total of five objectives specified. The results of the work done related to the objectives are here discussed.

### **Study of User Habits and Market Analysis**

Objectives one and two, stated that user habits and behavioral patterns of the target market should be studied, and that a market analysis, including integration potential with existing infrastructure, should be conducted.

Note that the proposed solution design has been based on the identified requirements and the requirements, in turn, have been based on the made study. With that, the quality of the design boils down to the validity and reliability of the made study, and hence affects the validity of the entire thesis.

The study was made by way of exploratory research design, mostly of a qualitative type, but also quantitative research was conducted in order to arrive at a more holistic view of the problem at hand.

The qualitative research was made by way of literature surveys, and by studies of key informants. The literature study included printed and online sources, and the literature was investigated in a comparative manner. The informants were selected from the information gained in market research indicating key players in the market holding key information and great insight within the field of study. In order to increase the reliability of the study several persons were interviewed about the same subject making cross check of information possible. The informants include several personnel closely involved in development of both surrounding infrastructure as well as existing solutions. Also governmental representatives involved in the arrangement of a (partly in this thesis specified) portal solution, and legal personnel were questioned. These informants held both a high level of knowledge and great insight from different angles and points of view, and hence, the validity of the study can be determined satisfactorily. The validity can also be seen increased by that the

made study may be used as base to increase the scope to include use of electronic invoicing in other nations with different economic development, and also globally.

The quantitative research was made to give an indication as to e.g. what degree electronic invoicing is used within Norway. A number of companies and municipalities were interviewed, and also existing statistical surveys were investigated. Hence both primary and secondary data sources were used. The population from where the primary data collection was made does not represent all of the target market. Hence, the primary data collection cannot be concluded to alone give a reliable representativeness. However, the purpose was to give an indication to if the situation implied by extensive surveys made by secondary data sources stand to reason. The secondary data sources include both Norwegian and international statistical bureaus, mainly statistics collected by the Statistics Norway (SSB) and Billentis. Hence, though the external validity of the quantitative study and the generalized representativeness of the primary data gathering can be questioned, the quantitative study can be concluded relevant and reliable within the study. I.e. the internal validity can be determined satisfactory. Note that both the reliability and the validity of the study are largely affected by time. That is, the quantitative study made stands the test of reliability from an internal point of view, but the time frame of the study is short and transitory.

The study and analysis can on the whole – much due to great experience and knowledge among involved informants – be seen as comprehensive enough for the purpose at arriving at a solution design. Hence, objectives one and two can be seen satisfied.

## **Requirement Specification**

Objective three states a goal to identify use cases and requirements for the solution. The requirement specification was a direct result of the study made fulfilling objectives one and two.

The user habit study revealed that the target user group is largely being forced to use electronic invoicing, and displays a great reluctance to adopt new technology. This was taken into account when specifying mainly the functional requirements by ensuring e.g. simplicity and usability, but also to a degree when specifying the non-functional requirements by ensuring e.g. low cost.

The market analysis included study of market potential to identify potential load on the system. The market analysis also identified actors, existing infrastructure, formats and standardization. A system unable to cope with the load, or to fit into existing infrastructure and to conform to formats, routines and standards in use would be useless. The information gathered was used when specifying both functional and non-functional requirements. The market analysis revealed a need to partly separate the public and private sector solution.

The study of existing participants, action plans and their roles revealed an open source solution – Open e-PRIOR – released by the commission. This implementation was not fully investigated, but showed potential for reuse and is recommended to be further investigated. The study also revealed an existing open source solution in Denmark. This implementation was investigated to determine

possibility to reuse part of the code to strip down the development time of the new system. The code was found unfit for reuse in this context, but the system implementation still gave some insight and pointers as to functionality and solution design. This was taken into account both in use case and requirement specification and solution design.

The requirement specification has hence identified the functionality and non-functionality needed for the project to be successful, and the project success criteria is with that covered by the identified requirements. However, without question some functionality, in some way relevant for the solution, can be assumed neglected, missed or left out. For this reason requirements ensuring flexibility for added functionality and growth and evolution over time in directions now out of sight was included (see FR002 and NFR002).

In Chapter 5 both identified use cases and requirements have been presented and objective three has been fulfilled.

## **Proposed Solution Design**

Objective four states a solution design should be established. The solution design should fulfill all identified requirements.

The solution design has been based on the identified requirements and the requirements showed a target market still under construction with much of the needs yet to be identified. Such target market can produce a dynamic environment, almost to the point of a living organism, with needs of new services or applications frequently. Such infrastructure puts a strain on the solution design to be flexible without compromising security, performance and availability. Such environment is far too complex for a traditional top down approach, and a solution design aiming for a single module approach with a minimal amount of internal interfaces would quickly become insufficient and fail to fulfill NFR002.

The design was, with that, chosen to take on a layered structure to allow for flexibility and scalability. The advantages of a Model Driven Architecture approach allowing flexible changes and driving artifact creation has also been included in the design approach. All interfaces have been designed in a loosely coupled fashion for independence and to allow for modifications and addition without need to restructure other parts of the system design. The designed architecture is service oriented in the sense that the architecture separates the service interface from its implementation. Such design adds flexibility as it separates the what from the how. This design approach fulfills requirements FR014, FR020 and NFR002.

The defined application design includes functionality specified in FR001, FR003-025, and with consideration taken to the, in FR002 specified, additional functionality. In addition specification describing implementation of NFR001-013 has been included. The design leaves freedom to the development team to choose both hardware and software, fulfilling NFR005.

A few key risks, issues and concerns with the solution design have been identified and documented within the design specification. The risks have been documented with suggestions to mitigate the risks, and issues and concerns have been listed with

suggestions to manage the problems. Such documentation reduces errors and adds to the validity of the design.

All identified requirements have been addressed in the solution design, and objective four can be determined fulfilled.

## Prototype Implementation

The last objective stated that a prototype should be implemented.

An implementation was made by method of Agile software development, and applying MDD with use of WebRatio.

The MDD/WebRatio combo proved a powerful tool when creating flow and functionality of the interface and well suited for designing data models and logic models. When it came to implementing presentation models, however, it turned out a rather complex task that required a lot of coding and tweaking to make the desired result. That is, when the standard table based layout is not sufficient, coding is required. Or if the standard units (content and operation units) provided by WebRatio fall short, custom units must be coded using java. The process is illustrated in Figure 8.1.

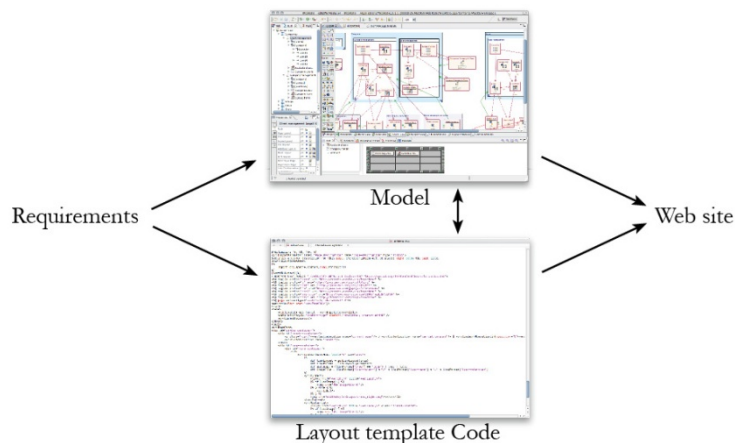


Figure 8.1: Diagram showing Model-Driven Development process by use of WebRatio.

For a more comprehensive analysis of the development method please refer related documentation from IKT509 Specialization Project [44].

Part of the user interface was developed during specialization project run prior to this project. Hence, part of the implementation was in reality made prior to specification of the solution design. However, during the specialization project, focus was put on basic functionality surrounding creation and handling of invoices, and implementation of that functionality. That is, basic user functions were specified and implemented during the specialization project. Such basic user functionality was not changed by the studies made or by the specification of the complete solution design.

Changes and amendments made to the earlier prototype implementation include a few adjustments and additions to user functionality and to user role and permission set specifications. Selected fields were also added to database (and web form) to conform to e2b format specification. The largest addition was, however, implementation of a connection to a back-end system. When implementing this connection it was noted that, in the current implementation of the back-end web service, there is no response message sent back to the client unless there is an error. This made it tricky to correctly handle the result of the web service call in the WebRatio model. It is suggested that the back-end web service is changed so it always returns a status message. When testing the connection, invoices could be successfully generated and sent to and received to the back-end system without any error message being sent back, and hence the connection can be concluded as successful.

Note that, as defined in objective 5, the prototype implementation purpose was to demonstrate invoice flow and typical usage areas. Hence, the graphical design of the interface has not been the focus. The used design does not agree with the Norwegian public sector demands of graphic design, where the graphic profile of Difi is to be used.

A small survey was made to measure the user experience and determine if the interface was perceived as user friendly or not. Seven participants with various computer experiences completed the questionnaire, and all in all, the user survey showed a positive user experience. Figure 8.2 displays the average result of the survey.

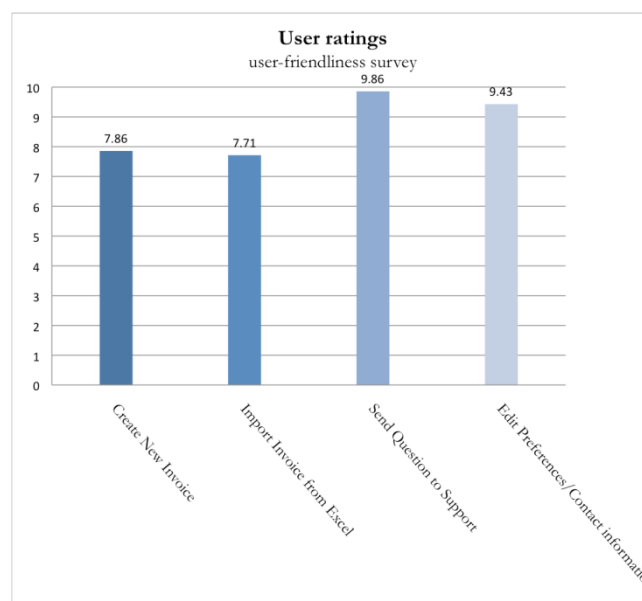


Figure 8.2: User ratings from user-friendliness survey.

For questionnaire used in the survey, please refer Appendix A.

The implementation represents a fraction of the identified solution design, but as defined under key limitations, the implementation should be seen as proof of concept and not as a finished solution. Hence, objective five can be seen satisfied.

## Chapter 9

# Conclusion

The in Chapter 1 presented Norwegian parliament report, White Paper No.36, reveals that Norwegian state owned businesses goes for mandatory electronic invoices. To avoid small businesses and sole proprietors, vulnerable for market shifts, to be harmfully affected from the demands the act brings, a solution aimed at them is needed. Hence, the ultimate goal of this thesis was to combat any arising problem by finding an urgently needed solution design aimed at small businesses and sole proprietors.

The first two objectives in finding such solution design were to conduct studies of user habits and a market analysis. The goal of the made studies was to form an information framework in finding use cases and requirements for the solution design. The use case and requirement specification formed the, in objective three, defined goal. The fourth objective described specification of a solution design based on the specified requirements. This objective represents the main contribution of the thesis, and the specification is documented in Chapter 6.

The last objective involved implementing part of the defined solution design in a prototype implementation. The implementation made has been presented in brief in Chapter 7, and in more detail in appendices E and F.

The documented design specification, in combination with the prototype implementation can be concluded to provide a solid foundation for a full-scale implementation of both a system for use for both public and private sector recipients. This fulfills the problem statement. Note that the solution allows for global use both within the public and the private sector. That is, the design allows for the recipient-end to be a cross-border recipient. In addition, the solution design has been specified with consideration taken to easy adaptation for public sector implementation outside of Norway. The implication is that this adds to the thesis contribution to knowledge.



## Further Work

The thesis has taken on an extensive study of both user habits and market, but the area is far from covered. Though the system design has been prepared for both cross-border use and use within other nations, such application would require further studies. Hence, an extension of the study to include a legal and VAT compliance analysis and a study of what kinds of modifications would be required on a global scale could be subject of further work.

With a global market of substantial size a future study could be limited to a comparative analysis between a number of nations, where developing, developed and transitioning economies are represented. Such analysis should include challenges in cross-border interoperability from an information technology perspective and build on the, in this thesis, presented solution and analysis. Such study can be used as base to draw conclusions;

- How much more complex do things get when considering a global market.
- Find differences and issues.
- Define a general model for small businesses.
- Define what aspects and elements each of the countries need to consider in order for the model to apply for the specific country.
- Point out differences between developing/developed/transitioning economies.

Note that such study can be made with focus on technical-, semantic-, organizational- and legal interoperability. Such study can present a general model that potentially could be considered a first step towards finding a global model, and identified country specific additions could provide a real contribution to knowledge.

## Glossary

Word	Description
AP	Access Point
ARPAnet	Advanced Research Projects Agency Network
ASP	Application Service Provision
BII	Business Interoperability Interfaces for public procurement in Europe
BII 2	Business Interoperability Interfaces for public procurement in Europe phase 2
BSD	Berkley Software Distribution
BusDox	Business Document Exchange Network
Buypass	Solution for electronic identification
B2B	Business to Business
B2C	Business to Customer
B2G	Business to Government
CEN	European Committee for Standardization (Comité Européen de Normalisation)
CIP	Competitiveness and Innovation Framework Programme
CSS	Cascading Style Sheet
CSV	Comma-Separated Values
CWA	CEN Workshop Agreement
Difi	Agency for Public Management and eGovernment
EC	European Commission
EDI	Electronic Data Interchange
EdiEX	Electronic data interchange application
EDIFACT	Electronic Data Interchange For Administration, Commerce and Transport

EdiSYS	Consultancy company specializing in Electronic Commerce and EDI
EEA	European Economic Area
EFTA	European Free Trade Association
eHandel.no	Norwegian translation of CEN BII formats electronic invoice and credit note (UBLv2.0-based)
ELMAR	Electronic Recipient Registry (Norwegian; Elektronisk Mottaker Register)
EN	European Standard
EUPL	European Union Public License
e2b	XML-based electronic invoice format
FAD	Ministry of Government Administration
FSF	Free Software Foundation
F/OSS	Free/Open Source Software
GNU	GNU's Not Unix
GPL	General Public License
ICT PCP	The Information and Communication Technologies Policy Support Programme
ISSS	Information Society Standardization System
KID	A number used to identify a customer and invoice regardless of who pays the invoices (Norwegian; Kunde-ID)
LGPL	Lesser General Public License
LIME	Lightweight Message Exchange
Mamut	Vendor of integrated business solutions
MDD	Model Driven Development
MinID	Electronic ID offered by Difi
MIT	Massachusetts Institute of Technology
M2M	Machine to Machine
NESUBL	North European Subset of Universal Business Language
JAAS	Java Authentication and Authorization Service
JSR	Java Specification Requests
OASIS	Organization for the Advancement of Structured Information Standards
ODF	Open Document Format for Office Applications
OSD	Open Source Definition
OSI	Open Source Initiative
OSOR	Open Source Observatory and Repository
OSS	Open Source Software
PDF	Portable Document Format
PEPPOL	Pan-European Public Procurement On Line

SAML	Security Assertion Markup Language
SMB	Small and Medium sized Business
SML	Service Metadata Locator
SMP	Service Metadata Publishers
SOAP	Simple Object Access Protocol
SSL	Secure Sockets Layer
SSØ	Norwegian Government Agency for Financial Management
START	Secure Trusted Asynchronous Reliable Transport
TIFF	Tagged Image File Format
UBL	Universal Business Language
UI	User Interface
UML	Unified Modeling Language
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business
VAT	Value-Added Tax
WS	Workshop
WSDL	Web Services Description Language
XML	Extensible Markup Language
XSL	Extensible Stylesheet Language
XSLT	Extensible Stylesheet Language Transformations

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# Appendices

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## **Appendix A**

### **Interviews and Questionnaires**

## Interviews

As part of gathering information and fulfilling objectives one and two, a number of interviews were conducted.

The interviews were divided in two main groups; key informants interviewed with a qualitative approach, and non-key informants interviewed to gain insight in establish to what degree electronic invoicing is used in Norway.

The first group of interviews included the following informants;

- Sales Agent Ole Jacob Bruserød, Client Computing.
- General Manager Jostein Frømyr, EdiSys.
- General Manager Rune Heimstad, EDIGard.
- Per Martin Jøraholmen, SSØ.
- General Manager Olav Astad Kristiansen, Difi.
- Virpi Nyssönen, Lifts All AB.
- Byggmester Terje Roland, Byggmester T. Roland.
- Ulf Skipsfjord, Brønnøysundsregistrene.

The interviews were made both by way of organized interviews and by way of informal conversations. The interview protocols from the organized interviews as transcribed below. Note that the target market is Norway unless otherwise stated. Note also that all the interviews were conducted in Norwegian and the transcripts represent loosely translated versions of the interviews.

### **Interview with General Manager Jostein Frømyr from EdiSys, conducted 6 of April 2010.**

*What EDI standard formats are today most commonly in use?*

The e2b format is most commonly used today (and will likely satisfy the needs and be suitable for use for a long time still). Within trade of goods the EDIFACT Invoice is most commonly used. Also supplier-specific proprietary formats are largely in use, and service providers use their own xml formats.

*Is there a difference of choice between small and large companies when it comes to format?*

There is no real difference between small and large companies within the formats. However, small and medium sized companies have, to a degree, different requirements.

*Within one format, are there differences in use that cause differences in the outbound format?*

The e2b format comes in several versions depending on when it was implemented. Also what industry the user is part of affects the outbound format as industries have their own industry specific additions.

*Is frequent errors an issue, and is the cause of the problem often the format or a transaction error?*

The sources of errors are usually implementation flaws, not format issues. Within implementation errors, mappings of the internal data seem the most frequent source of error.

*How big is the reach of the eHandel.no format?*

The format can reach all of the market [Frømyr emphasizes that this a personal estimate, not based on facts].

*Which information is necessary to transfer in order for a transaction to take place?*

The bookkeeping law states the requirements, and the requirements for the contents vary nationally. Two European forums – PEPPOL and CEN BII – are aiming to solve issues relating to national differences in order to improve interoperability.

*Why is there a problem in finding a common format/standard to use?*

Much of the discussions and decisions are made on a national level instead of on an international level. In addition the market has not agreed on what is the best solution. That is, the problem comes on two levels; one is a problem of coming to an agreement, and another is a resistance to change. Hence, first we must agree on what solution to use i.e. what is the best way of doing things, and then we must get things into use – get people to use it.

In addition, there are different interests in play; the IT industry - system providers and application providers – resist finding a common solution, as the complexity of the situation provides an argument to charge people for solving the problem.

*Why has eHandel.no format been chosen for the public sector? What are the advantages/disadvantages?*

Disadvantages; The format is an issuer-oriented format, and to my personal opinion it may be too issuer-oriented. In addition it does not have a clearly enough defined common core.

Advantages; Low processing cost, possibility to make handling more efficient, possibility to tie an invoice to an order, and possibility to use the same channel to companies and to consumers. (Note that the netbank handles the majority of the consumer market today.)

## **Interview with Senior Advisor Olav Astad Kristiansen from Difi, conducted 26 of April, 2010.**

*What formats are today used as standard for invoices?*

There is no standard invoice comprehensively in use today. Ehandel.no will be standard for the public sector. The Ehandel.no-format is a Norwegian translation and adaptation of the CEN BII CWA 16073:2010. The first version of the Ehandel.no format defines formats for invoices and credit notes. The complete Norwegian profiles can be downloaded from [anskaffelser.no](http://anskaffelser.no)<sup>55</sup>.

The format is based on UBL 2.0, and the Norwegian Ehandel.no format – though based on the CEN BII profiles – stems from the NESUBL project.

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<sup>55</sup> <http://www.anskaffelser.no/nyheter/2010/04/implementeringsveileder-for-elektronisk-faktura-og-kredittnota-klar-for-horing>

*What are the shortcomings and strengths of the existing formats?*

The e2b weakness is the reference fields; there is no restricted way of using the format. In addition, the e2b format handles only invoices, while UBL can handle the entire chain of supply; e.g. acknowledgement, credit note.

The strength of Ehandel.no is that there are no industry-specific supplements. It is calculated that 80% of the usage can be covered by the core version of the format.

The CEN BII base is implemented in 14 different EU countries, which increases interoperability. E.g. the Norwegian version of CEN BII profiles is the Ehandel.no format, in Denmark they have OIOUBL, in Sweden they have Swefakt, etc. – all based on CEN BII.

*Is frequent errors an issue, and is the cause of the problem often the format or a transaction error?*

Errors often stem from the fact that the formats are used differently or erroneously. That is, when e.g. the e2b format is used the sender can use the fields as he/she wishes, potentially resulting in that the recipient cannot interpret the format correctly.

*Why is there a problem in coming to an agreement, and finding a common format/standard to use?*

One of the challenges users face is that they must choose two partners. One from the financial network and one from “the rest”; that is, one bank and one partner from the b2b connect collaboration. In addition, not all are customers to the above collaborations. Today out of 20 000 companies, about 6000 use service providers and the rest go via banks.

Difi is attempting to create a national register for all companies. A register including all public entities is being created already, as part of an (PEPPOL) infrastructure, and all participants of the market will be given access to use the infrastructure.

The address register will act as a junction/hub where all participants can look up correct address.

The intention is to have other business documents in the same format, and integrate. The access points will be national, and PEPPOL is building a demo.

*How long will we be able to use this format?*

We will be ready for 2012, growth and evolvment comes naturally with experience.

*What is the predecessor of the current EDI formats? That is, are we still in such early stages that the predecessor is a paper-based invoice or have we passed that – with electronic predecessors to the current formats.*

I would say that we have removed ourselves completely from paper by now.

*Is there a difference of choice between large and smaller companies.*

Many of the requirements are similar regardless of size. However there are differences between e.g. industries and nations.

Nation specific differences are the reason to why a Norwegian version of the CEN BII format was developed. Norwegian bookkeeping legislation dictates what needs to be included in an invoice. E.g. an invoice sent in Norway must include such fields as supplier organization number, due amount, invoice number, invoice date, delivery location, name of the recipient, organization number of the recipient, VAT percentage, reference of the buyer.

There are no demands of a PDF attachment of the invoice for visual purposes; such demands would be client requests, not based on any legislation requirements.

The goal is to make it as easy and cheap to send invoices as it is to send e-mails today. See [www.ehandel.no](http://www.ehandel.no) and [www.peppol.eu](http://www.peppol.eu) for further reference.

**Interview with Per Martin Jøraholmen from SSØ conducted 27 of April, 2010.**

*How common is use of electronic invoicing at SSØ?*

Out of our approx. 700,000 incoming invoices yearly, only 8% are received electronically. None of the companies that send electronically are small businesses. 1-2% of outgoing invoices are sent electronically.

We have a total of approx. 63,000 suppliers, where some of them are franchise companies. That is, approx. 15,000 of the suppliers are unique, and about 100 of those are large.

*What formats are today used as standard for invoices?*

For the public sector, CEN BII – a UBL 2.0 based format is used as basis. The BII comes with five profiles, and Norway has taken the invoice and credit note profiles and created Norwegian versions that comply with Norwegian legislation (e.g. KID and organization number has been added as mandatory fields). One important point is that a foreign invoice that is based on the BII profiles should also be interpretable in Norway, which increases interoperability between countries.

The profiles do not include industry-specific additions, and the profiles are restrictive in how they can be used, this also adds to interoperability.

*Why is there a problem in coming to an agreement, and finding a common format/standard to use?*

The recipient is the biggest winner economically. The issuer must pay, and there is no business case between service providers.

A new access point is being created now facilitating transmission of electronic invoices to the public sector.

*What are the shortcomings and strengths of the existing formats?*

Today e2b is largely in use, with custom solutions and implementations. The format is too open, which is a large drawback.

The biggest advantage with the Ehandel.no standard invoice is that it is restricted in how it can be used, and the recipients are unable to come with their own demands.

Note that it is not allowed to print electronic invoices. Also, style sheets are used for visual view of the invoices – not PDFs.

*How big is the reach of the eHandel.no format?*

There is no limitation to the reach of the format.

*Is frequent errors an issue, and is the cause of the problem often the format or a transaction error?*

Errors are not normally due to errors in the format. I'd say the most common source of error comes from service providers being clever in their implementation of the mappings and conversion from one format to another.

*What is the predecessor of the current EDI formats? That is, are we still in such early stages that the predecessor is a paper-based invoice or have we passed that – with electronic predecessors to the current formats.*

To my opinion the paper-based way of viewing invoices when implementing EDI formats is a thing of the past.

Note that informal conversations with Mr. Frømyr and Mr. Kristiansen has been conducted at later stages in addition to above transcribed formal interviews.

The following companies were contacted for the second type of interviews;

- Aker Solutions ASA
- Block Watne AS
- Bonnier Publications
- Brilleland
- Bygger'n
- Byggmakker Norge AS
- Brønnøysundregistrene
- Color Line AS
- De Norske Bokklubbene AS
- DEKK partner AS
- Elkjøp Norge AS
- Esso Norge AS
- Expert AS
- Helly Hansen
- IF
- ISS Facility Services AS
- Jotun AS
- Kruse Smith AS
- Mascot Høie AS
- MAXBO
- MøllerGruppen
- MøreNot AS
- Norgesfør AS
- NorgesGruppen AS
- Norgro AS
- Norsildmel
- Norsk Hydro ASA
- Norske Shell AS
- Orkla ASA
- Plantasjen
- Skanska Norge AS
- SSØ
- Statoil ASA
- Storebrand ASA
- Texcon AS
- Veidekke ASA
- Yara Norge

The questions asked were;

How many invoices do you send/receive pr year?

How many of the outgoing/incoming invoices are sent/received electronically?

How many suppliers/customers do you have?

Are any of the suppliers/customers that send/receive invoices electronically SMEs?

Do you see any savings in the use of electronic invoices?

Will you be expanding the use of electronic invoicing the following years?

Part of the contacted companies declined sharing information, and among the companies that did share their information many requested that their answers would be kept anonymous. For this reason only a short summary is published here.

2.6% of outgoing invoices were reported being electronically sent (PDFs excluded)  
12.1% of incoming invoices were reported being electronically received (PDFs excluded).

Only one of the companies reported that they have any small companies sending invoices electronically to them. No SMEs were reported as recipients of invoices electronically.

Many of the companies reported that they were in the process of expanding their use of electronic invoicing, particularly on the incoming invoices. Few of the companies even calculated that they would increase the use up to 50-60% within only a few months.

Many companies, however, also reported that they experienced that adoption of EDI with implementation, testing and education is a complicated and lengthy process. Many also found that getting their suppliers to adopt electronic invoicing was a demanding process, and for these reasons they had not committed or put focus on adopting electronic invoicing.

The amount of experienced savings varied much between the respondents. Some reported not experiencing much savings at all due to complicated EDI systems, whereas others reported that they calculate savings up to 70 NOK/invoice (outgoing) – though they mentioned that the real savings were most likely lower than the calculated savings. On average, savings up to 70% for outgoing invoices, and 60% for incoming invoices were reported. However, many respondents pointed out that the experienced savings were larger for incoming invoices as the handling costs per invoice for incoming invoices is larger. With that, many of the respondents reported that they have no focus on expanding use of electronic invoicing for outgoing invoices.

A surprisingly large amount of the respondents were unaware of what an electronic invoice is altogether.

### **Contributions**

Associate Professor *Andreas Prinz*, has helped with advice, suggestions and recommendations throughout the project period.

Development Manager *Pavels Nikitins* at ITP AS has contributed to the technical specification presented in Chapter 6. His contribution consisted in giving advice on the choices made, and contributing in writing of the final versions of Web Document Portal Request For Proposal, released for Difi, 2010. The RFP includes the same solution, as presented in Chapter 6.

Systems Developer *Petrus Bergman* at CSN has contributed with help, support and advice during the implementation of the prototype.

A few selected persons have proofread the report and given valuable feedback, adding to the information flow and to the reliability of the report;

Director *Pieter Breyné*, PricewaterhouseCoopers.

General Manager *Jostein Fromyr*, EdiSys

General Manager *Rune Heimstad*, EDIGard.



Also a number of fellow students contributed by proofreading the report; MSc students in ICT with Security profile, *Vegard Haugland*, *Marius Kjolleberg* and *Svein-Erik Larsen*. All three also work as Security Analysts at Telenor Security Operation Centre.

MSc student in ICT with Mobile Communication profile, *Thomas Dverseth*.

Ph.D research fellow in Mechatronics, *Tore Bakka*. The title of Tore's Ph.D project is 'Multi objective optimization and multivariable control of offshore wind turbine system'.

### User friendliness survey questionnaire

The questionnaire used during the survey displayed here<sup>56</sup>.

Table A.1: Questionnaire used during user friendliness survey.

Question	Answer
Where you able to successfully log in?	Yes/No
Did you manage to create and send invoices?	Yes/No
If yes, how would you rate the process from one to ten? 1-2-3-4-5-6-7-8-9-10	
Did you manage to successfully import invoices from Excel?	Yes/No
If yes, how would you rate the process from one to ten? 1-2-3-4-5-6-7-8-9-10	
Did you manage to successfully send a question to support?	Yes/No
If yes, how would you rate the process from one to ten? 1-2-3-4-5-6-7-8-9-10	
Did you manage to update your own preferences and account details?	Yes/No
If yes, how would you rate the process from one to ten? 1-2-3-4-5-6-7-8-9-10	
Did you find the portal intuitive?	Yes/No

<sup>56</sup> The questionnaire design has been inspired by survey made in IKT410 project; Wireless Hotspots Creation, Analysis, Exposure and Defence By Vegard Haugland, Marius Kjolleberg and Svein-Erik Larsen.

Comments?

**Thank you to all that have contributed to my work!**

## **Appendix B**

### **eHandel.no content requirements**

Content requirements for eHandel.no Invoice<sup>57</sup>

Table B.1: Content requirements for eHandel.no Invoice.

Content Requirement	According to UBL 2.0 Schema	According to CEN BII Core	According to Norwegian Book keeping legislation	According to Norwegian public requirements
UBL Version identifier		Mandatory		
Customization Identifier		Mandatory		
Profile Identifier		Mandatory		
Invoice Identifier	Mandatory	Mandatory	Mandatory	
Issue Date	Mandatory	Mandatory	Mandatory	
Currency Code	Mandatory	Mandatory		
Order reference (header level)				Recommended
Document reference				Recommended
Supplier party	Mandatory	Mandatory	Mandatory	
Supplier name		Mandatory	Mandatory	
Supplier address		Mandatory	Mandatory	
Supplier organization number (as listed in official company register)			Mandatory	
Supplier reference				Recommended
Buyer party	Mandatory	Mandatory	Mandatory	
Customer identifier (number)				Recommended
Buyer name		Mandatory	Mandatory	
Buyer address			Mandatory	
Buyer organization number (as listed in official company register)				Mandatory

<sup>57</sup> Bauck, Sverre, Kristiansen, Olav, Nguyen, Bao, Sandvik, Petter, *Implementeringsveileder Ehandel.no format, Faktura og Kreditnota*. Oslo: Difi, 2010.

register)				
Buyer reference				Mandatory
Payment Code		Mandatory		
Payment Due date			Mandatory	
Supplier account number				Recommended
Delivery address			Mandatory	
Delivery date			Mandatory	
KID number				Recommended
VAT amount per tax scheme (header level)			Mandatory	
VAT Percent (header level)			Mandatory	
Taxable amount per tax scheme			Mandatory	
VAT subtotal		Mandatory	Mandatory	
Invoice subtotal excl VAT		Mandatory		
Invoice subtotal incl VAT		Mandatory		
Total amount due	Mandatory	Mandatory	Mandatory	
Line identifier	Mandatory	Mandatory		
Supplier item identification				Recommended
Item or service description (line level)		Mandatory	Mandatory	
Accounting cost (string, line level)				Recommended
Amount (line level)			Mandatory	
Unit Code				Recommended
Order reference (line level)				Recommended
VAT percent (line level)				Mandatory
VAT category identifier (line		Mandatory		

level)				
Charge type indicator (VAT is the only legal code)		Mandatory		
Item	Mandatory	Mandatory		
Price (line level)		Mandatory	Mandatory	
Line amount	Mandatory	Mandatory	Mandatory	
Line amount total		Mandatory	Mandatory	

Structure set table for eHandel.no format Invoice as presented below.

## Strukturetabell for Ehandel.no format faktura

Kardinalitet	Elementer/Attributter
<b>Invoice</b>	
1 .. 1	Invoice. UBL Version Identifier. Identifier
1 .. 1	Invoice. Customization Identifier. Identifier
1 .. 1	Invoice. Profile Identifier. Identifier
1 .. 1	Invoice. Identifier
1 .. 1	Invoice. Issue Date. Date
0 .. 1	Invoice. Invoice Type Code. Code
0 .. 1	Invoice. Note. Text
0 .. 1	Invoice. Tax Point Date. Date
1 .. 1	Invoice. Document_ Currency Code. Code
0 .. 1	Invoice. Accounting Cost. Text
<b>0 .. 1</b>	<b>Invoice. Invoice Period. Period</b>
0 .. 1	Period. Start Date. Date
0 .. 1	Period. End Date. Date
<b>0 .. 1</b>	<b>Invoice. Order Reference</b>
1 .. 1	Order Reference. Identifier
<b>0 .. 1</b>	<b>Invoice. Contract Document Reference. Document Reference</b>
1 .. 1	Document Reference. Identifier
0 .. 1	Document Reference. Document Type. Text
<b>0 .. unbounded</b>	<b>Invoice. Additional Document Reference. Document Reference</b>
0 .. 1	Document Reference. Identifier
0 .. 1	Document Reference. Document Type. Text
<b>0 .. 1</b>	<b>Document Reference. Attachment</b>
0 .. 1	Attachment. Embedded Document. Binary Object
<b>0 .. 1</b>	<b>Attachment. External Reference</b>
1 .. 1	External Reference. URI. Identifier
<b>1 .. 1</b>	<b>Invoice. Accounting Supplier Party. Supplier Party</b>
<b>1 .. 1</b>	<b>Supplier Party. Party</b>
0 .. 1	Party. Endpoint Identifier. Identifier
<b>0 .. 1</b>	<b>Party. Party Identification</b>
1 .. 1	Party Identification. Identifier
<b>1 .. 1</b>	<b>Party. Party Name</b>
1 .. 1	Party Name. Name
<b>1 .. 1</b>	<b>Party. Postal Address. Address</b>
0 .. 1	Address. Identifier
0 .. 1	Address. Postbox. Text
0 .. 1	Address. Street Name. Name
0 .. 1	Address. Additional_ Street Name. Name
0 .. 1	Address. Building Number. Text
0 .. 1	Address. Department. Text
0 .. 1	Address. City Name. Name
0 .. 1	Address. Postal_ Zone. Text
0 .. 1	Address. Country Subentity. Text
<b>0 .. 1</b>	<b>Address. Country</b>
1 .. 1	Country. Identification Code. Code
<b>0 .. 1</b>	<b>Party. Party Tax Scheme</b>
0 .. 1	Party Tax Scheme. Company Identifier. Identifier
<b>1 .. 1</b>	<b>Party Tax Scheme. Tax Scheme</b>
1 .. 1	Tax Scheme. Identifier

Bold = Simple Element, Bold on grey background = Complex Element, Italic = Attribute, Grey = Group

Occurrence	Element/Attribute
<b>1 .. 1</b>	<b>Party. Party Legal Entity</b>
0 .. 1	Party Legal Entity. Registration_ Name. Name
1 .. 1	Party Legal Entity. Company Identifier. Identifier
<b>0 .. 1</b>	<b>Party Legal Entity. Registration_ Address. Address</b>
0 .. 1	Address. City Name. Name
0 .. 1	Address. Country Subentity. Text
<b>0 .. 1</b>	<b>Address. Country</b>
1 .. 1	Country. Identification Code. Code
<b>0 .. 1</b>	<b>Party. Contact</b>
0 .. 1	Contact. Identifier
0 .. 1	Contact. Telephone. Text
0 .. 1	Contact. Telefax. Text
0 .. 1	Contact. Electronic_ Mail. Text
<b>0 .. 1</b>	<b>Party. Person</b>
0 .. 1	Person. First_ Name. Name
0 .. 1	Person. Family_ Name. Name
0 .. 1	Person. Middle_ Name. Name
0 .. 1	Person. Job Title. Text
<b>1 .. 1</b>	<b>Invoice. Accounting_ Customer Party. Customer Party</b>
<b>1 .. 1</b>	<b>Customer Party. Party</b>
0 .. 1	Party. Endpoint Identifier. Identifier
<b>0 .. 1</b>	<b>Party. Party Identification</b>
1 .. 1	Party Identification. Identifier
<b>1 .. 1</b>	<b>Party. Party Name</b>
1 .. 1	Party Name. Name
<b>1 .. 1</b>	<b>Party. Postal_ Address. Address</b>
0 .. 1	Address. Identifier
0 .. 1	Address. Postbox. Text
0 .. 1	Address. Street Name. Name
0 .. 1	Address. Additional_ Street Name. Name
0 .. 1	Address. Building Number. Text
0 .. 1	Address. Department. Text
0 .. 1	Address. City Name. Name
0 .. 1	Address. Postal_ Zone. Text
0 .. 1	Address. Country Subentity. Text
<b>0 .. 1</b>	<b>Address. Country</b>
1 .. 1	Country. Identification Code. Code
<b>0 .. 1</b>	<b>Party. Party Tax Scheme</b>
0 .. 1	Party Tax Scheme. Company Identifier. Identifier
<b>1 .. 1</b>	<b>Party Tax Scheme. Tax Scheme</b>
1 .. 1	Tax Scheme. Identifier
<b>1 .. 1</b>	<b>Party. Party Legal Entity</b>
0 .. 1	Party Legal Entity. Registration_ Name. Name
1 .. 1	Party Legal Entity. Company Identifier. Identifier
<b>0 .. 1</b>	<b>Party Legal Entity. Registration_ Address. Address</b>
0 .. 1	Address. City Name. Name
0 .. 1	Address. Country Subentity. Text
<b>0 .. 1</b>	<b>Address. Country</b>
1 .. 1	Country. Identification Code. Code
<b>1 .. 1</b>	<b>Party. Contact</b>
1 .. 1	Contact. Identifier

Bold = Simple Element, Bold on grey background = Complex Element, Italic = Attribute, Grey = Group



Occurrence	Element/Attribute
0 .. 1	— <i>Contact. Telephone. Text</i>
0 .. 1	— <i>Contact. Telefax. Text</i>
0 .. 1	— <i>Contact. Electronic_Mail. Text</i>
<b>0 .. 1</b>	<b>Party. Person</b>
0 .. 1	— <i>Person. First_Name. Name</i>
0 .. 1	— <i>Person. Family_Name. Name</i>
0 .. 1	— <i>Person. Middle_Name. Name</i>
0 .. 1	— <i>Person. Job Title. Text</i>
<b>0 .. 1</b>	<b>Invoice. Payee_Party. Party</b>
<b>0 .. 1</b>	<b>Party. Party Identification</b>
1 .. 1	— <i>Party Identification. Identifier</i>
<b>0 .. 1</b>	<b>Party. Party Name</b>
1 .. 1	— <i>Party Name. Name</i>
<b>0 .. 1</b>	<b>Party. Party Legal Entity</b>
1 .. 1	— <i>Party Legal Entity. Company Identifier. Identifier</i>
<b>1 .. 1</b>	<b>Invoice. Delivery</b>
1 .. 1	— <i>Delivery. Actual_Delivery Date. Date</i>
<b>1 .. 1</b>	<b>Delivery. Delivery_Location. Location</b>
0 .. 1	— <i>Location. Identifier</i>
<b>1 .. 1</b>	<b>Location. Address</b>
0 .. 1	— <i>Address. Street Name. Name</i>
0 .. 1	— <i>Address. Additional_Street Name. Name</i>
0 .. 1	— <i>Address. Building Number. Text</i>
0 .. 1	— <i>Address. Department. Text</i>
0 .. 1	— <i>Address. City Name. Name</i>
0 .. 1	— <i>Address. Postal_Zone. Text</i>
0 .. 1	— <i>Address. Country Subentity. Text</i>
<b>0 .. 1</b>	<b>Address. Country</b>
1 .. 1	— <i>Country. Identification Code. Code</i>
<b>1 .. unbounded</b>	<b>Invoice. Payment Means</b>
1 .. 1	— <i>Payment Means. Payment Means Code. Code</i>
1 .. 1	— <i>Payment Means. Payment Due Date. Date</i>
0 .. 1	— <i>Payment Means. Payment Channel Code. Code</i>
0 .. 1	— <i>Payment Means. Payment Identifier. Identifier</i>
<b>0 .. 1</b>	<b>Payment Means. Payee_Financial Account. Financial Account</b>
1 .. 1	— <i>Financial Account. Identifier</i>
<b>0 .. 1</b>	<b>Financial Account. Financial Institution_Branch. Branch</b>
0 .. 1	— <i>Branch. Identifier</i>
<b>0 .. 1</b>	<b>Branch. Financial Institution</b>
1 .. 1	— <i>Financial Institution. Identifier</i>
<b>0 .. 1</b>	<b>Invoice. Payment Terms</b>
0 .. 1	— <i>Payment Terms. Note. Text</i>
<b>0 .. unbounded</b>	<b>Invoice. Allowance Charge</b>
1 .. 1	— <i>Allowance Charge. Charge_Indicator. Indicator</i>
0 .. 1	— <i>Allowance Charge. Allowance Charge_Reason. Text</i>
1 .. 1	— <i>Allowance Charge. Amount</i>
<b>1 .. 1</b>	<b>Invoice. Tax Total</b>
1 .. 1	— <i>Tax Total. Tax Amount. Amount</i>
<b>1 .. unbounded</b>	<b>Tax Total. Tax Subtotal</b>
1 .. 1	— <i>Tax Subtotal. Taxable_Amount. Amount</i>
1 .. 1	— <i>Tax Subtotal. Tax Amount. Amount</i>

Bold = Simple Element, Bold on grey background = Complex Element, Italic = Attribute, Grey = Group

Occurrence	Element/Attribute
<b>1 .. 1</b>	<b>Tax Subtotal. Tax Category</b>
1 .. 1	<i>Tax Category. Identifier</i>
1 .. 1	<i>Tax Category. Percent</i>
0 .. 1	<i>Tax Category. Tax Exemption Reason Code. Code</i>
0 .. 1	<i>Tax Category. Tax Exemption Reason. Text</i>
<b>1 .. 1</b>	<b>Tax Category. Tax Scheme</b>
1 .. 1	<i>Tax Scheme. Identifier</i>
<b>1 .. 1</b>	<b>Invoice. Legal Monetary Total. Monetary Total</b>
1 .. 1	<i>Monetary Total. Line Extension Amount. Amount</i>
1 .. 1	<i>Monetary Total. Tax Exclusive Amount. Amount</i>
1 .. 1	<i>Monetary Total. Tax Inclusive Amount. Amount</i>
0 .. 1	<i>Monetary Total. Allowance Total Amount. Amount</i>
0 .. 1	<i>Monetary Total. Charge Total Amount. Amount</i>
0 .. 1	<i>Monetary Total. Prepaid Amount. Amount</i>
0 .. 1	<i>Monetary Total. Payable Rounding Amount. Amount</i>
1 .. 1	<i>Monetary Total. Payable Amount. Amount</i>
<b>1 .. unbounded</b>	<b>Invoice. Invoice Line</b>
1 .. 1	<i>Invoice Line. Identifier</i>
0 .. 1	<i>Invoice Line. Note. Text</i>
1 .. 1	<i>Invoice Line. Invoiced Quantity. Quantity</i>
1 .. 1	<i>Invoice Line. Line Extension Amount. Amount</i>
0 .. 1	<i>Invoice Line. Accounting Cost. Text</i>
<b>0 .. unbounded</b>	<b>Invoice Line. Order Line Reference</b>
1 .. 1	<i>Order Line Reference. Line Identifier. Identifier</i>
<b>0 .. unbounded</b>	<b>Invoice Line. Allowance Charge</b>
1 .. 1	<i>Allowance Charge. Charge Indicator. Indicator</i>
0 .. 1	<i>Allowance Charge. Allowance Charge Reason. Text</i>
1 .. 1	<i>Allowance Charge. Amount</i>
<b>0 .. 1</b>	<b>Invoice Line. Tax Total</b>
1 .. 1	<i>Tax Total. Tax Amount. Amount</i>
<b>1 .. 1</b>	<b>Invoice Line. Item</b>
0 .. 1	<i>Item. Description. Text</i>
1 .. 1	<i>Item. Name</i>
<b>0 .. 1</b>	<b>Item. Sellers Item Identification. Item Identification</b>
1 .. 1	<i>Item Identification. Identifier</i>
<b>0 .. 1</b>	<b>Item. Standard Item Identification. Item Identification</b>
1 .. 1	<i>Item Identification. Identifier</i>
<b>0 .. unbounded</b>	<b>Item. Commodity Classification</b>
0 .. 1	<i>Commodity Classification. Item Classification Code. Code</i>
<b>1 .. 1</b>	<b>Item. Classified Tax Category. Tax Category</b>
1 .. 1	<i>Tax Category. Identifier</i>
1 .. 1	<i>Tax Category. Percent</i>
<b>1 .. 1</b>	<b>Tax Category. Tax Scheme</b>
1 .. 1	<i>Tax Scheme. Identifier</i>
<b>0 .. unbounded</b>	<b>Item. Additional Item Property. Item Property</b>
1 .. 1	<i>Item Property. Name</i>
1 .. 1	<i>Item Property. Value. Text</i>
<b>1 .. 1</b>	<b>Invoice Line. Price</b>
1 .. 1	<i>Price. Price Amount. Amount</i>
0 .. 1	<i>Price. Base Quantity. Quantity</i>
<b>0 .. 1</b>	<b>Price. Allowance Charge</b>

Bold = Simple Element, Bold on grey background = Complex Element, Italic = Attribute, Grey = Group

BiiCoreTrdm010 Faktura

Occurrence	Element/Attribute
1 .. 1	<i>Allowance Charge. Charge_Indicator. Indicator</i>
0 .. 1	<i>Allowance Charge. Allowance_Charge_Reason. Text</i>
0 .. 1	<i>Allowance Charge. Multiplier_Factor. Numeric</i>
1 .. 1	<i>Allowance Charge. Amount</i>
0 .. 1	<i>Allowance Charge. Base_Amount. Amount</i>

**Bold = Simple Element, Bold on grey background = Complex Element, Italic = Attribute, Grey = Group**

BiiCoreTrdm010 Faktura; CENBII 1.0; Norsk

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## **Appendix C**

**e2b and NESUBL (eHandel.no) format  
comparison**

Comparison between the e2b, NESUBL and eHandel.no formats<sup>58</sup>. Note that the NESUBL and eHandel.no formats to a large degree are similar.

Table C.1: e2b, NESUBL and eHandel.no format comparison.

e2b	NESUBL/eHandel.no
The e2b invoice format aims to cover the need for invoicing within the Norwegian market.	NESUBL aims to cover the need for trade in and between the NES-countries, and eHandel.no aims to cover the need for trade in and between CEN BII member countries.
E2b uses code lists only to a small degree when indicating permissible values.	NESUBL/eHandel.no widely uses code lists.
E2b uses Core Components only to a limited degree	NESUBL/eHandel.no is based on use of Core Components
E2b does not p.t. have profiles.	NESUBL/eHandel.no has profiles that, based on the context, limit the amount of content of the messages.
E2b has a number of industry-specific additions on header- and detail-levels.	NESUBL/eHandel.no offers a possibility for additions, but these must be put within the messages (and not e.g. on header level)

<sup>58</sup> Frømyr, Jostein. *Sammenligning av e2b og NESUBL*. Presentation. Oslo: EdiSys, 2007

## **Appendix D**

**Data model implementation in WebRatio.**

A WebRatio data model is an Entity Relationship diagram. Figure E.1, shows the implemented data model. The separate elements are then presented individually.

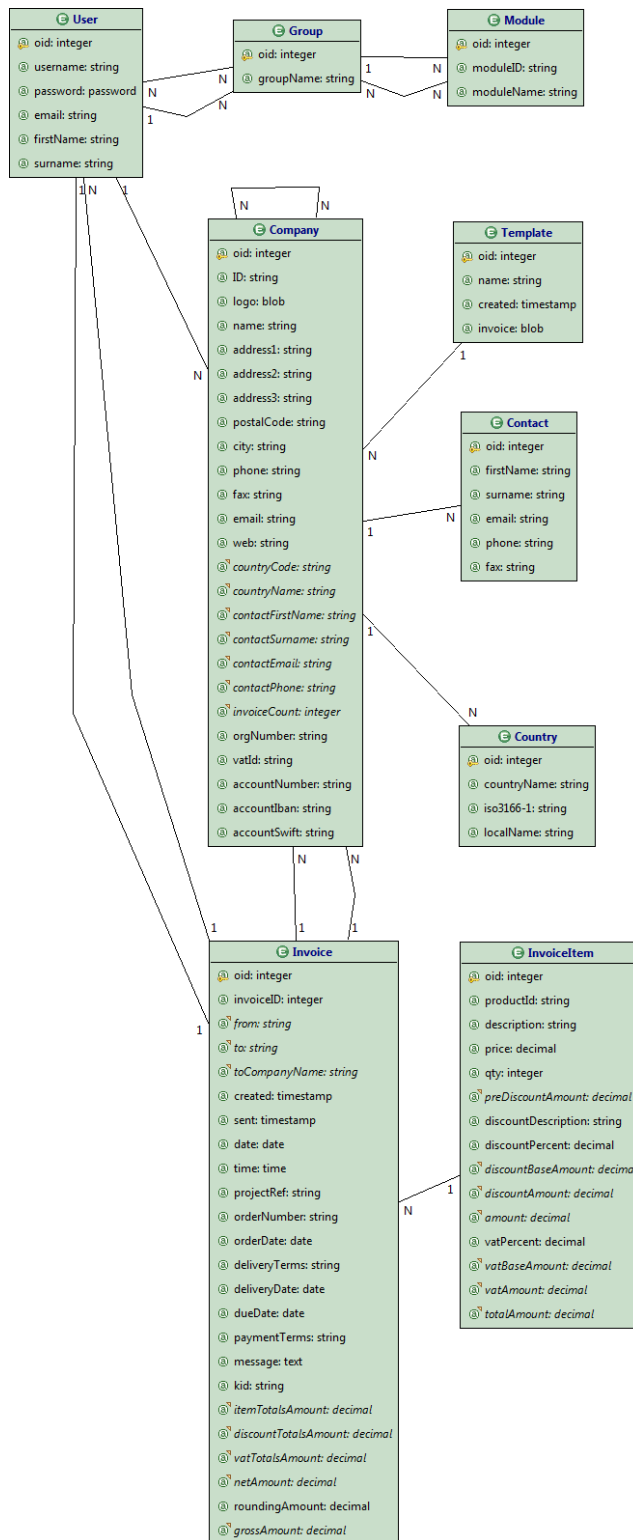


Figure D.1: WebRatio data model, overview

## User

The *User* element represents a user that is permitted to login into the Web Portal. Each user is assigned to one default group and may be assigned to several other groups as well.

The User element is standard in WebRatio when it comes to handling protected modules.

Name	Description
oid	Key ID
username	Username
password	Password
email	Email
firstName	The user's first name, e.g. "John"
surname	The user's surname, e.g. "Doe"

E User	
🔑	oid: integer
@	username: string
@	password: password
@	email: string
@	firstName: string
@	surname: string

## Group

The *Group* element represents a group of users. Each group is assigned to one default module and may be assigned to several other modules as well.

The Group element is standard in Web Ratio when it comes to handling protected modules.

Name	Description
oid	Key ID
groupName	The name of the group

E Group	
🔑	oid: integer
@	groupName: string

## Module

The *Module* element represents a protected module in WebRatio, e.g. a site view, an area or a page which has security activated and thus requires an authorized user to access. Access to the module is controlled by assigning one or several groups to it.

The Module element is standard in Web Ratio when it comes to handling protected modules.

Name	Description
oid	Key ID
moduleID	The internal ID of the site view, area, page or unit in the Web Ratio module that should be protected.
moduleName	The name of the module

E Module	
🔑	oid: integer
@	moduleID: string
@	moduleName: string



























## Company

The *Company* element represents a company in the portal that can be either a sender or receiver of an invoice. Each user is assigned to one company and each company has a list of clients, i.e. companies, available as invoice recipients.



The Company element contains a subset of the “PartyType” used as Supplier and Buyer in the e2b specification.

Name	Description
oid	Key ID
ID	Unique identification number, e.g. association number or GLN (EAN-location number). Corresponds to <i>Interchange.Envelope.From</i> or <i>Interchange.Envelope.To</i> in the e2b specification.
logo	Image data for the company’s logotype
name	The name of the company
address1	Postal address row 1
address2	Postal address row 2
address3	Postal address row 3
postalCode	Postal code
city	City/Postal district
phone	Company’s phone
fax	Company’s fax
email	Company’s email address
web	Company’s web address
<i>countryCode</i>	<i>Imported attribute; see Country.iso3166-1</i>
<i>countryName</i>	<i>Imported attribute; see Country.countryName</i>
<i>contactFirstName</i>	<i>Imported attribute; see Contact.firstName</i>
<i>contactSurname</i>	<i>Imported attribute; see Contact.surname</i>
<i>contactEmail</i>	<i>Imported attribute; see Contact.email</i>
<i>contactPhone</i>	<i>Imported attribute; see Contact.phone</i>
<i>invoiceCount</i>	<i>Calculated attribute; number of invoices assigned to this company</i>
orgNumber	Organization number
vatId	VAT number
accountNumber	The company’s domestic bank account number
accountIban	Account number for international payments
accountSwift	Swift number/BIC for international payments

 Company
 oid: integer
 ID: string
 logo: blob
 name: string
 address1: string
 address2: string
 address3: string
 postalCode: string
 city: string
 phone: string
 fax: string
 email: string
 web: string
 <sup>?</sup> countryCode: string
 <sup>?</sup> countryName: string
 <sup>?</sup> contactFirstName: string
 <sup>?</sup> contactSurname: string
 <sup>?</sup> contactEmail: string
 <sup>?</sup> contactPhone: string
 <sup>?</sup> invoiceCount: integer
 orgNumber: string
 vatId: string
 accountNumber: string
 accountIban: string
 accountSwift: string

### Template

The *Template* element represents an invoice template. Each template is administrated by one company and that company can use the template as a base for new invoices.

Name	Description
oid	Key ID
name	The name of the template
created	A timestamp that is set at the creation of the template
invoice	Invoice data stored in the template

Template
@ oid: integer
@ name: string
@ created: timestamp
@ invoice: blob

### Contact

The *Contact* element represents a contact person for one company.

Name	Description
oid	Key ID
firstName	The contact's first name, e.g. "John"
surname	The contact's surname, e.g. "Doe"
email	The contact's email address
phone	The contact's phone number
fax	The contact's fax number

Contact
@ oid: integer
@ firstName: string
@ surname: string
@ email: string
@ phone: string
@ fax: string

### Country

The *Country* element represents a country in the world and each company is assigned to one country.

Name	Description
oid	Key ID
countryName	The name of the country in accordance with the ISO 3166 country code
iso3166-1	A 2 character country code in accordance with ISO 3166
localName	The name of the country in the native language


























Country
@ oid: integer
@ countryName: string
@ iso3166-1: string
@ localName: string

### Invoice

The *Invoice* element represents an invoice that has been created in the Web Portal; regardless it is a draft or a sent invoice. Each invoice is assigned two companies, one sender and one recipient. Each invoice is also assigned to the user that is the creator of the invoice as well as the user that is currently editing the invoice.

Name	Description
oid	Key ID
invoiceID	Invoice number
<i>from</i>	<i>Imported attribute; see Company.ID (sender)</i>
<i>to</i>	<i>Imported attribute; see Company.ID (recipient)</i>

<i>toCompanyName</i>	<i>Imported attribute; see Company.name (recipient)</i>
created	A timestamp that is set at the creation of the invoice
sent	A timestamp that is set when the invoice is sent
date	Date of issue
time	Time of issue
projectRef	Project reference defined by Buyer
orderNumber	Reference to the buyer's order number
orderDate	Reference to the buyer's order date
deliveryTerms	Delivery terms in free text
deliveryDate	Date for delivery
dueDate	Date when the invoice is due to payment
paymentTerms	Payment terms in free text
message	General information in free text that cannot be placed in other fields
kid	KID-number (Norwegian payment identification)
<i>itemTotalsAmount</i>	<i>Calculated attribute; Sum total line amount</i>
<i>discountTotalsAmount</i>	<i>Calculated attribute; Sum total discounts on detail level</i>
<i>vatTotalsAmount</i>	<i>Calculated attribute; Sum total VAT amount</i>
<i>netAmount</i>	<i>Calculated attribute; Invoice amount excluded VAT</i>
roundingAmount	Rounding off value
<i>grossAmount</i>	<i>Calculated attribute; Invoice amount included VAT and rounding</i>

 Invoice
 <b>oid</b> : integer
 <b>invoiceID</b> : integer
 <b>from</b> : string
 <b>to</b> : string
 <b>toCompanyName</b> : string
 <b>created</b> : timestamp
 <b>sent</b> : timestamp
 <b>date</b> : date
 <b>time</b> : time
 <b>projectRef</b> : string
 <b>orderNumber</b> : string
 <b>orderDate</b> : date
 <b>deliveryTerms</b> : string
 <b>deliveryDate</b> : date
 <b>dueDate</b> : date
 <b>paymentTerms</b> : string
 <b>message</b> : text
 <b>kid</b> : string
 <b>itemTotalsAmount</b> : decimal
 <b>discountTotalsAmount</b> : decimal
 <b>vatTotalsAmount</b> : decimal
 <b>netAmount</b> : decimal
 <b>roundingAmount</b> : decimal
 <b>grossAmount</b> : decimal

### InvoiceItem

The *InvoiceItem* represents an item that is added to an invoice. Each invoice can have several invoice items.

Name	Description
oid	Key ID
productId	Supplier's article-/product-/service number
description	Description of the article/product/service
price	Unit net price
qty	Invoiced quantity
<i>preDiscountAmount</i>	<i>Calculated attribute; Line amount before allowance</i>
discountDescription	Description of type of discount
discountPercent	Discount percent
<i>discountBaseAmount</i>	<i>Calculated attribute; Base amount for discount calculation = preDiscountAmount</i>
<i>discountAmount</i>	<i>Calculated attribute; Discount amount = discountBaseAmount * discountPercent / 100</i>
<i>amount</i>	<i>Calculated attribute; Line amount without VAT but included possible allowance = preDiscountAmount - discountAmount</i>
vatPercent	VAT-percent
<i>vatBaseAmount</i>	<i>Calculated attribute; Basis for the VAT calculation for the particular rate = amount</i>
<i>vatAmount</i>	<i>Calculated attribute; VAT amount for the particular rate = vatBaseAmount * vatPercent / 100</i>
<i>totalAmount</i>	<i>Calculated attribute; Total line amount including VAT = amount + vatAmount</i>

InvoiceItem	
oid	integer
productId	string
description	string
price	decimal
qty	integer
preDiscountAmount	decimal
discountDescription	string
discountPercent	decimal
discountBaseAmount	decimal
discountAmount	decimal
amount	decimal
vatPercent	decimal
vatBaseAmount	decimal
vatAmount	decimal
totalAmount	decimal

## **Appendix E**

**Logic model implementation in WebRatio.**

The logic model in Web Ratio defines the logic and functions in the portal application. The application is divided into four views; public, user, admin and support. Depending on the user's access rights and login status, one of these views is presented to the user<sup>59</sup>.

### Public View

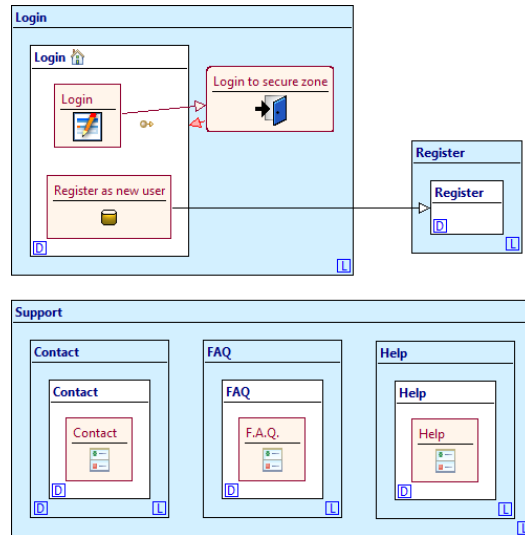


Figure E.1: Logic model – public view.

The *Public View* is the only view that is not secured and is shown for anyone that has not logged in. The home (start) page of the view is the login page containing a form for entering a username and password. There are three main areas (illustrated as light blue boxes in Figure F.1); *Login*, *Register* and *Support*, which builds up the left side menu as shown in Figure F.2. The Support area contains three subareas forming a submenu to Support.

When username and password has been entered, the *Login Unit* in WebRatio takes care of matching the input against the *User* element in the data model. If the user is found

and the password is correct, WebRatio will look up the default group of the user and the default module of the group, and redirect the user to that module, in this case one of the user, admin or support views.

If the user is unknown or the password is incorrect, the Login Unit loops back to the login page.

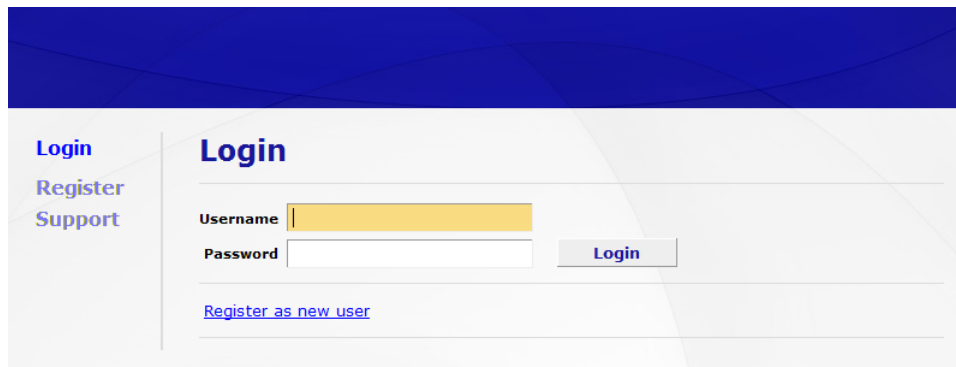


Figure E.2: Public login page.

<sup>59</sup> How to manage users and groups, [http://wiki.webratio.com/index.php/How\\_to\\_manage\\_users\\_and\\_groups](http://wiki.webratio.com/index.php/How_to_manage_users_and_groups)

## User View

The *User View* is a protected module that is available only for authorized users. This view is the default protected module for the groups “Users” and “AdvancedUsers”. Whenever a user in any of these groups logs in, he or she will be redirected to the User View by the WebRatio Login Unit.

Figure F.3., shows the logic model of the User View as created in WebRatio. The home page of the view is the page “*Init and redirect to Home > Start*” which, as indicated by its name, initiates some context parameters with user data and redirects to the *Start* page within the *Home* area.

There are six areas in the User View; *Home*, *Invoice Archive*, *Clients*, *New Invoice*, *Preferences* and *Support*. Each of them corresponds to one item in the left side menu as shown in Figure F.4.

The *MasterPage* is different than other normal pages in that its content is visible all the time within the view regardless of which page the user visits. In other words, the content of the *MasterPage* is merged with the content of the current page. In the User View, the *MasterPage* adds the name of the current logged in user as well as the company name the user belongs to.

The following sections describe each area of the user view model and their contents in more detail.

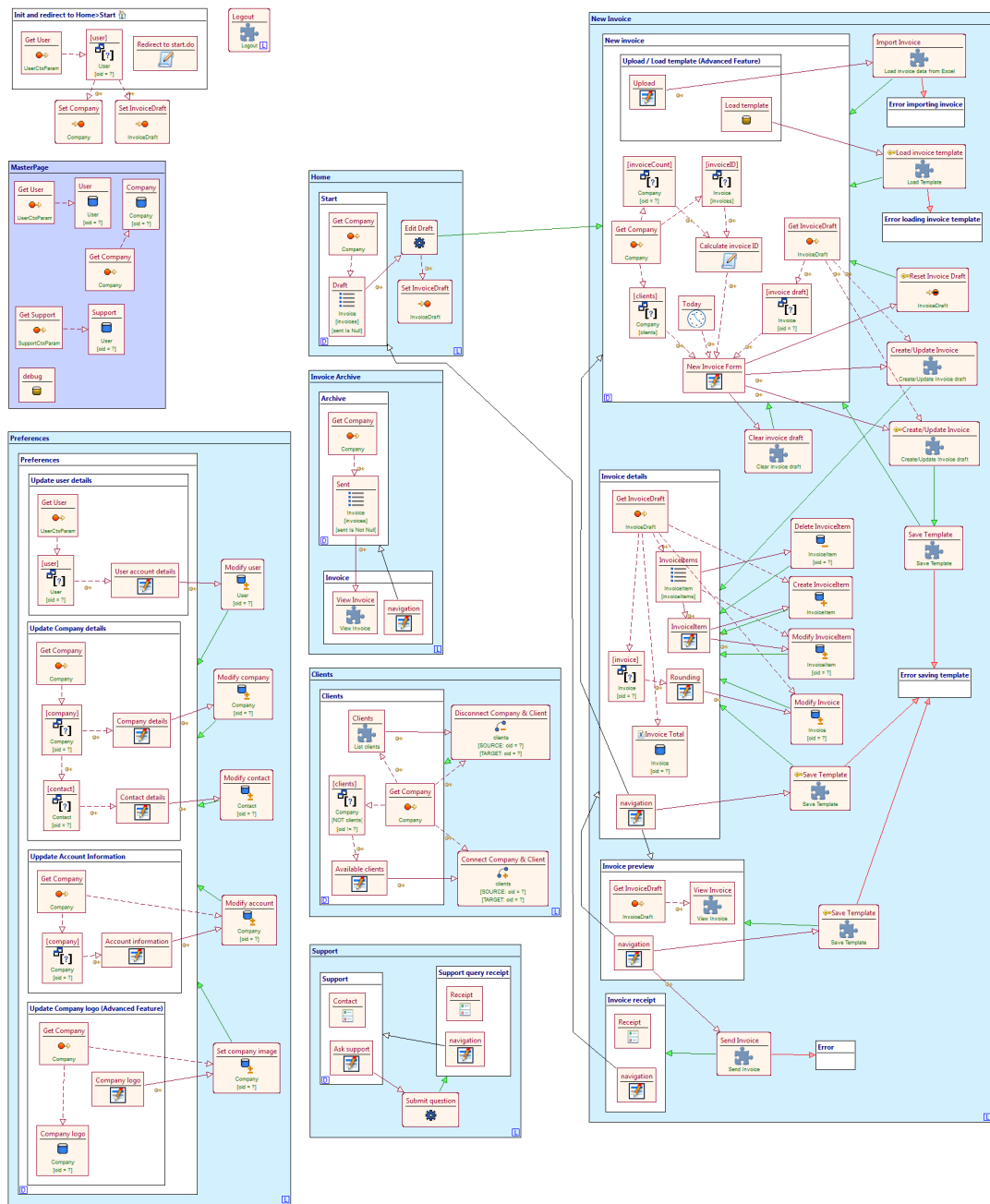


Figure E.3: Logic model – user view.



### Home

The Home area contains a single page, which lists all draft invoices in the company, i.e. all invoices that any user within the company has created in the application but not yet sent to the receiver. From this list it is possible to click on any draft to edit and/or send it. Whenever a draft is sent, it will disappear from this page.

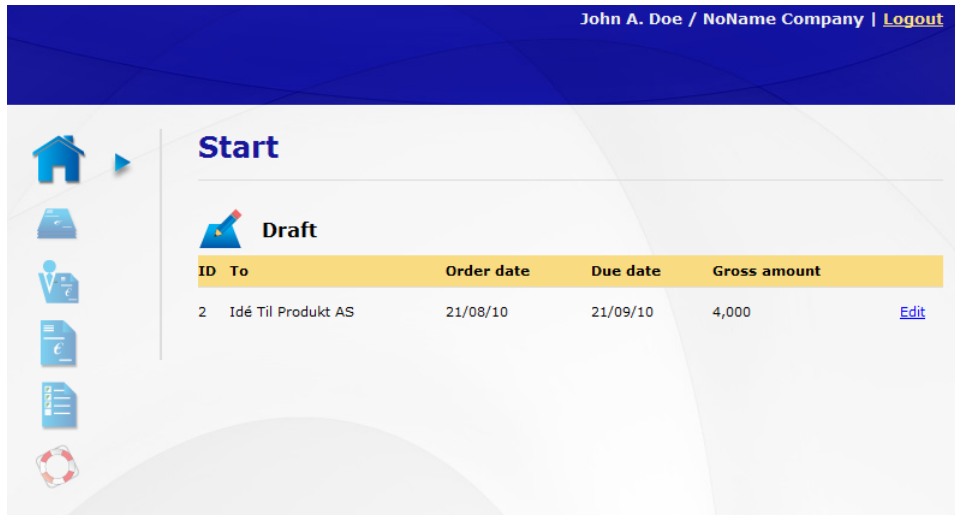


Figure E.4: Home area.

### Invoice Archive

The Invoice Archive area contains two pages where the Archive page is the default, marked as "D" in the left bottom corner in the WebRatio logic model as can be seen in Figure F.3. The Archive page lists all sent invoices in the company, i.e. all invoices that any user within the company has created in the application and sent to the receiver. From this list it is possible to click on any invoice in order to go to the Invoice page which shows all details about the current invoice. The actual viewing of the invoice details is handled by the *View Invoice* user module.

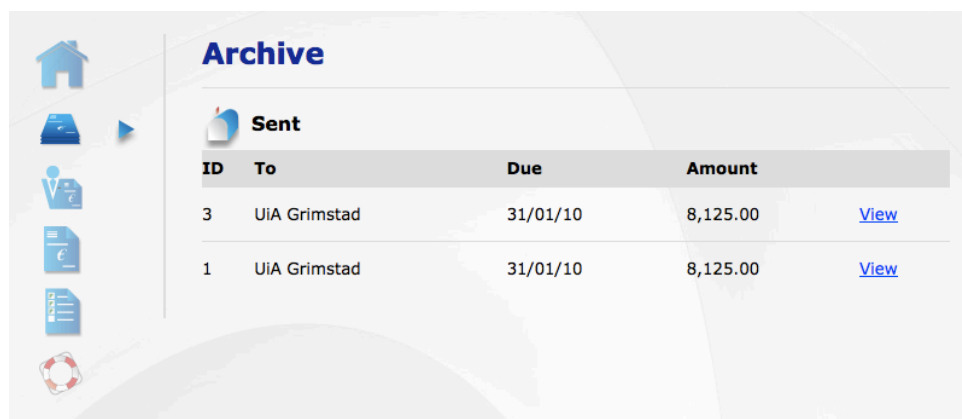
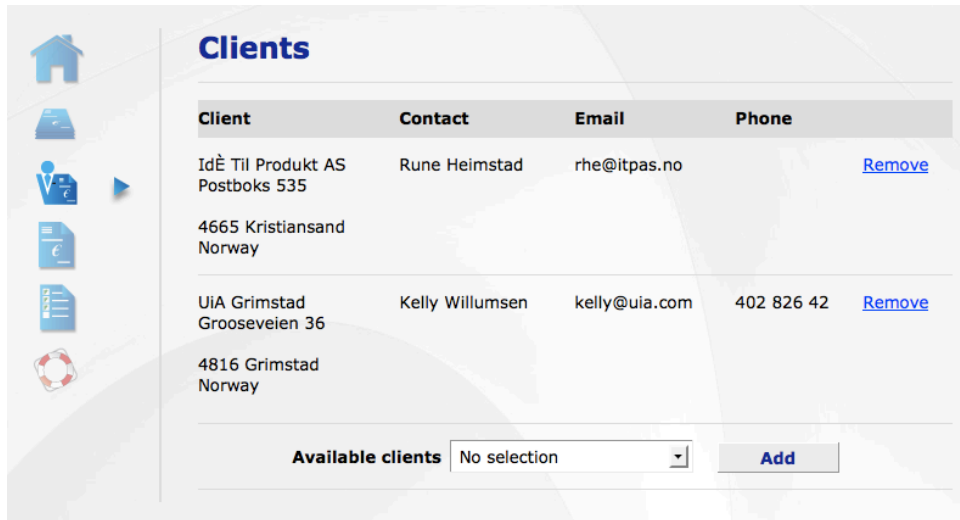


Figure E.5: Archive.

### Clients

The *Clients* area contains a single page, which lists all clients, i.e. companies, that the current user can send invoices to. The list can be compared to an address book with frequently used invoice recipients. At the bottom of the page there is a selection box with a list of all available companies that are registered in the system. From that complete list, the user can choose to add more companies to his or her own frequently used company's client list. It is also possible to remove clients from that list if no longer needed.



Client	Contact	Email	Phone
IdÈ Til Produkt AS Postboks 535 4665 Kristiansand Norway	Rune Heimstad	rhe@itpas.no	<a href="#">Remove</a>
UIA Grimstad Grooseveien 36 4816 Grimstad Norway	Kelly Willumsen	kelly@uia.com	402 826 42 <a href="#">Remove</a>

Available clients:

Figure E.6: Recipients list.

### New Invoice

The *New Invoice* area is the largest area in the view and contains several pages with forms for creating, saving, loading and sending invoices. The default page of the area is “New invoice”, which is step 1 of 3 for creating an invoice. This page suggests the user to enter some invoice information such as client (recipient), order number, order date, project reference, due date, payment terms and a free text message. A button at the bottom left makes it easy to clear the invoice and start over from scratch if needed. When all data on the page has been entered the user continues to the next step by pressing the *Next >>* button at the bottom right.

**New invoice**  
Step 1 of 3 - Enter invoice information

Client: Idé Til Produkt AS

Order number: 10

Order date: 21/08/10

Project reference: Test

Invoice ID: 2

Due date: 21/09/10

Payment terms: 30 days

Message

Clear Next >>

Figure E.7: Invoice creation wizard, step one of three.

If the user is a member of the AdvancedUsers group, an additional form field makes it possible to import invoice data from an Excel file instead of entering it manually. A few extra buttons also makes it possible to create a new invoice (storing the current one in the draft list for later editing) or save the current invoice as a template. If there are previously saved templates, it is also possible to load one of these into the current draft.

**New invoice**  
Step 1 of 3 - Enter invoice information

File (.xls) Blåddra... Import

Client: Idé Til Produkt AS

Order number: 10

Order date: 21/08/10

Project reference: Test

Invoice ID: 2

Due date: 21/09/10

Payment terms: 30 days

Message

Load template...

Clear New Save as template... Next >>

Figure E.8: Invoice creation wizard step one, with extra functionality available.

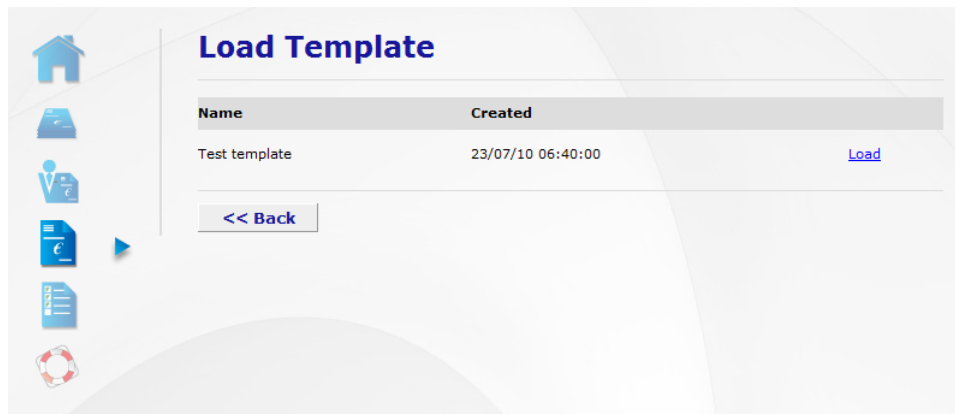


Figure E.9: Load template function.

Most of the actions are modeled as *Operation Modules* in WebRatio. They are described under 'User Modules' section.

The page *Invoice Details* is the next step in the new invoice wizard. This page shows a list of all items that is added to the invoice and shows net amount, VAT and total gross amount of all items. Existing items can be edited or removed and new items can be added by a form with input fields for product ID, description, quantity, price and VAT. If necessary, an input field for rounding amount can add a value to the gross amount to get rid of unwanted decimals.

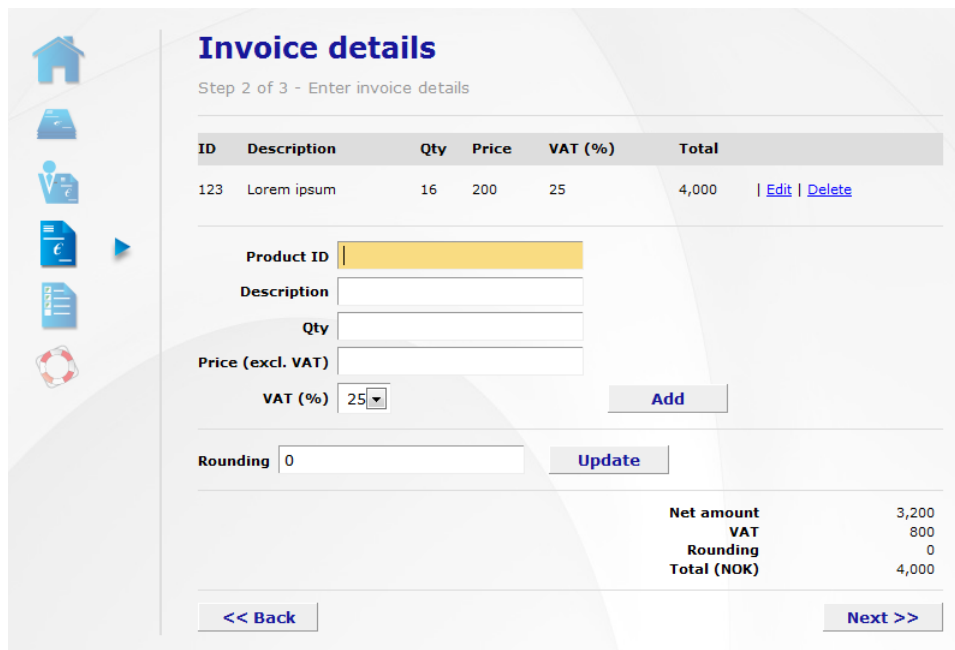


Figure E.10: Invoice creation wizard, step two of tree.

Step 3 of 3 in the wizard is the *Invoice preview* page which uses the *View Invoice* user module to show a preview of the invoice that will be sent.

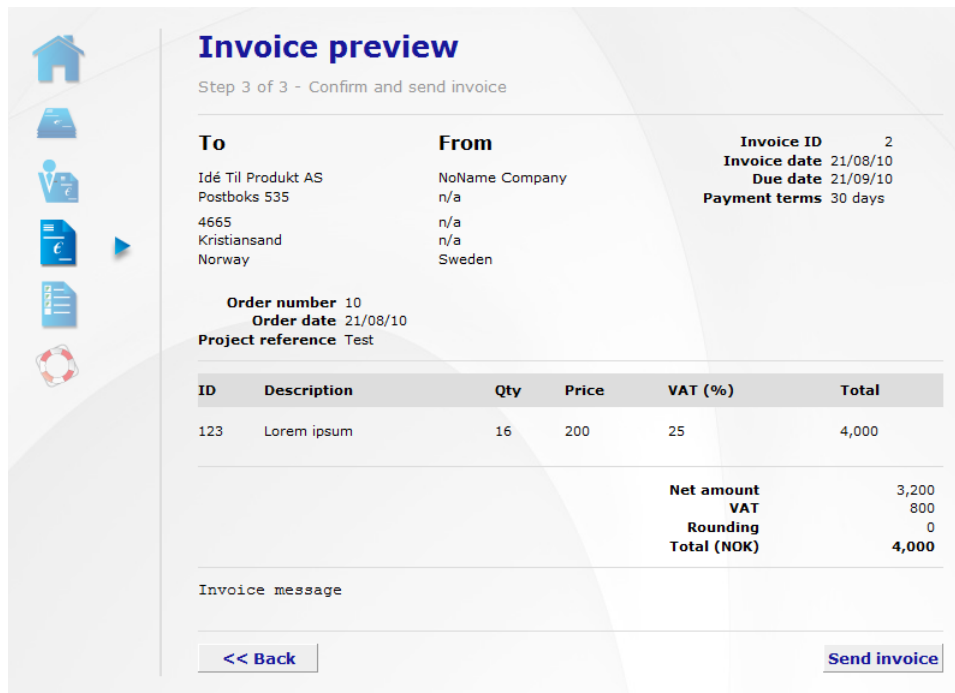


Figure E.11: Invoice creation wizard, step tree of tree.

If the user is a member of the *AdvancedUsers* group, the company logo (if available) will be shown in the invoice preview at the top right.

The user confirms by clicking the *Send Invoice* button, which calls the *Send Invoice* user module and then redirects to the *Invoice receipt* page.

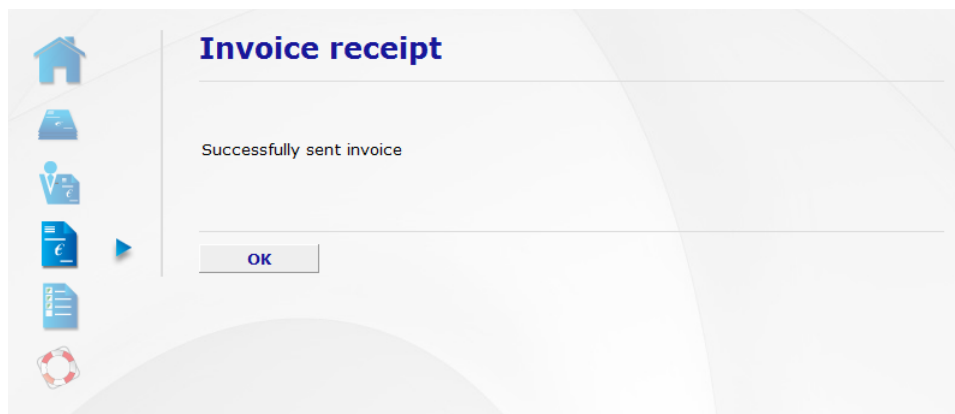


Figure E.12: Invoice receipt.

The OK button on the *Invoice receipt* page is linked back to the *Start* page of the view.

### *Preferences*

The *Preferences* area contains a single page divided into several sub pages, showing input fields for updating user account details, company and contact details, bank account information, and company logo.

**Preferences**

---

**User account details**

First name

Surname

Email

Username

Password

---

**Company details**

ID 456

Company name

Address

Postal code

City

Country

Phone

Fax

Email

Web

Org number

Vat Id

---

**Contact details**

First name

Surname

Email

Phone

Fax

---

**Account information**

Bank account

Iban

Swift/BIC

Figure E.13: Preferences.

The sub page containing the company logo upload form is only available for users that are members of the `AdvancedUsers` group. The currently active company logo is shown at the bottom of the company logo sub page.

**Company logo**

File (image)

---

**NONAME**  
C O M P A N Y

Figure E.14: Company logo, preferences sub page.

### *Support*

The *Support* area contains two pages where the Support page is the default. It contains some general contact information and an input form for submitting questions to the support staff.

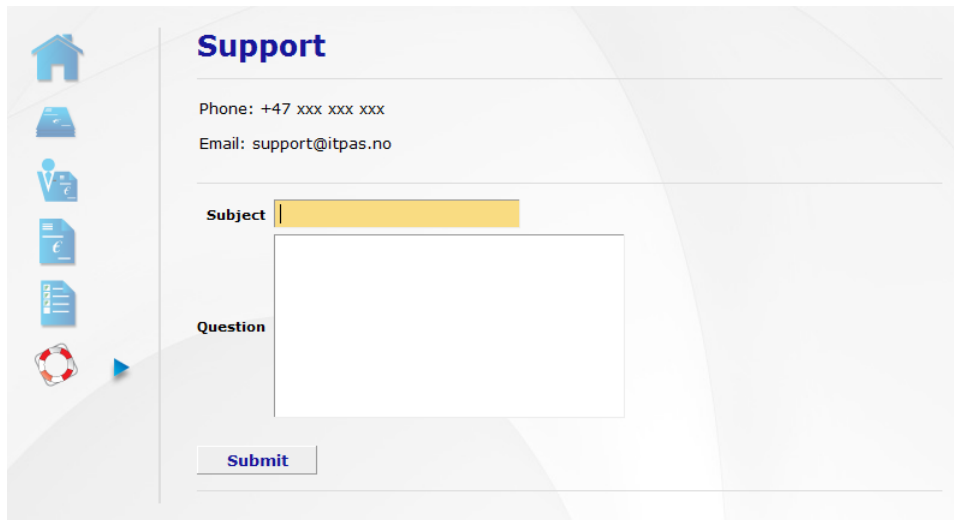


Figure E.15: Support page.

The second page in the Support area is the *Support query receipt* page, which shows a receipt when the user has submitted his or her question.

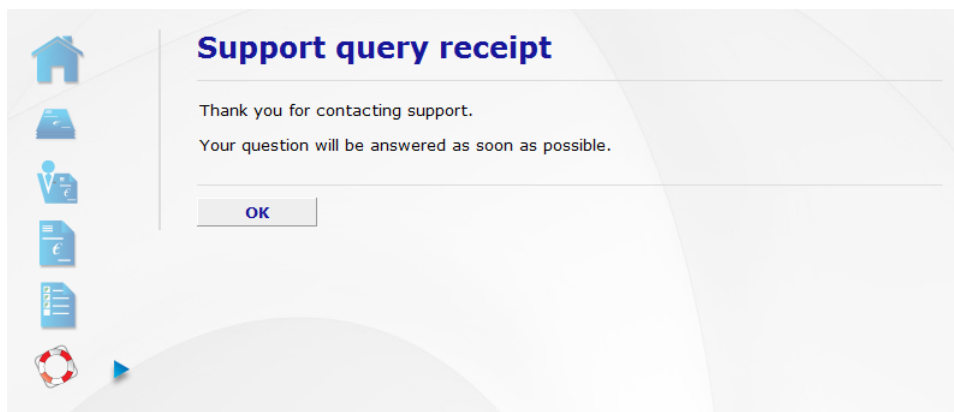


Figure E.16: Support query receipt

Please note that the “Submit question” operation used in the current WebRatio logic design is a *No Op* operation unit and will not really do anything other than redirecting the user to the receipt page. Of course, in a fully functional application, this operation must be implemented for real.

### Admin View

The *Admin View* is a protected module that is available only for authorized administrators. This view is the default protected module for the group “Administrators”. Whenever a user in this group logs in, he or she will be redirected to the Admin View by WebRatio’s Login Unit.

Please note that the Admin View was one of the first parts that was created in the WebRatio design and is thus a bit messier than other more well thought-out parts. No custom presentation model has been applied on the Admin View as it was merely created for showing the concept of an administration view of the application and to simplify some administrations tasks during development/testing. However, as

most administration tasks during development, such as creating users and companies, has been done using SQL scripts, the Admin View has not been updated with recent changes in the database model, and may no longer be fully functional. Of course, in a fully functional application, an admin view should be present and made fully operational.

The figure below shows the logic model of the current Admin View as created in WebRatio.

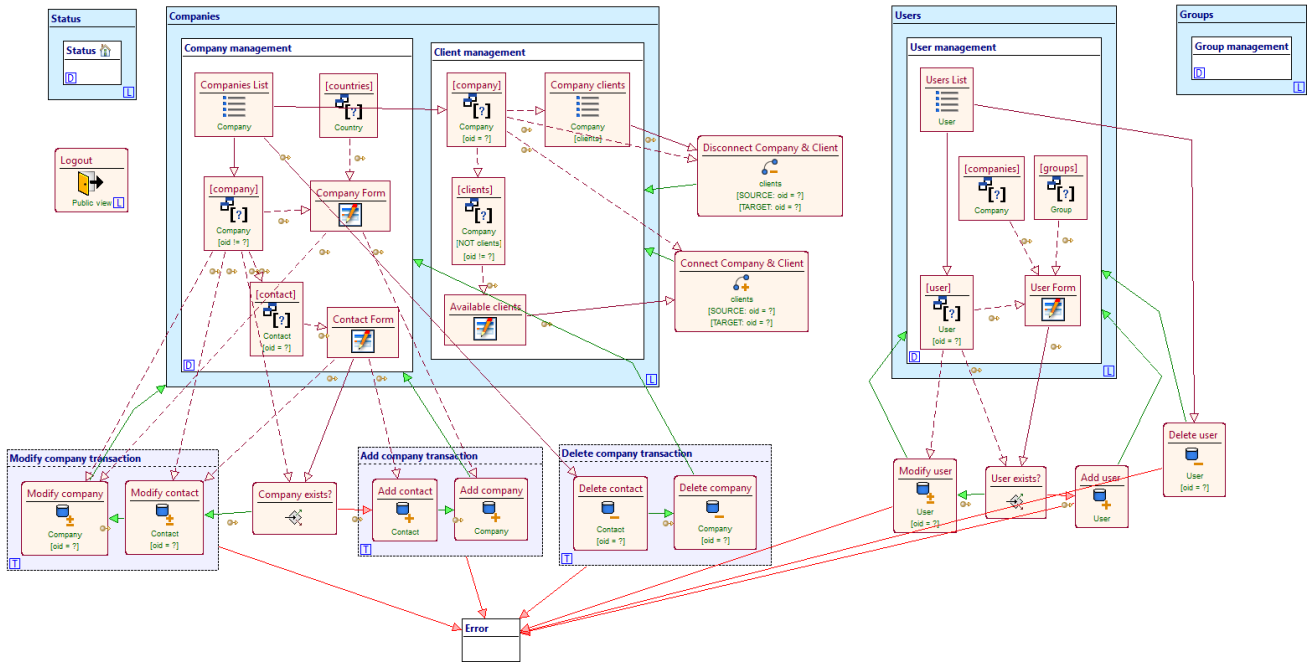


Figure E.17: Logic model – admin view.

At the moment, only basic administration of users and companies (create, modify, delete) are available, as well as adding/removing clients to/from a company.

## User management

[Status](#) [Users](#) [Groups](#) [Companies](#) [Logout](#)

>[Users](#)>User management

### Users List

surname	firstName	username	
Doe	John A.	ouser	<a href="#">Modify</a> <a href="#">Delete</a>
Doe	John	user	<a href="#">Modify</a> <a href="#">Delete</a>
Willumsen Kelly		kelly	<a href="#">Modify</a> <a href="#">Delete</a>
		admin	<a href="#">Modify</a> <a href="#">Delete</a>

### User Form

First name   
 Surname   
 Email   
 Username   
 Password   
 Group   
 Company

Figure E.18: User management.



## Company management

[Status](#) [Users](#) [Groups](#) [Companies](#) [Logout](#)

>[Companies](#) >Company management

### Companies List

name  
 Idé Til Produkt AS [Modify](#) [Delete](#) [Clients](#)  
 NoName Company [Modify](#) [Delete](#) [Clients](#)

### Company Form

Company name   
 Address   
 Postal code   
 City   
 Country

### Contact Form

First name   
 Surname   
 Email   
 Phone

Figure E.19: Company management.

## Client management

[Status](#) [Users](#) [Groups](#) [Companies](#) [Logout](#)

>[Companies](#) >Client management

### Company clients

name city  
 NoName Company n/a [Remove](#)

### Available clients

Clients

Figure E.20: Recipient management.

## Support View

The *Support View* is a protected module that is available only for authorized support users. This view is the default protected module for the groups “Support”. Whenever a user in this group logs in, he or she will be redirected to the Support View by WebRatio’s Login Unit.

The Support View in its current form is very basic and does not contain much content. The view is created to illustrate a concept where support personnel can enter the User View as any user in order to for example guide a user through the new invoice wizard. The support personnel can thus see exactly what the user would see.

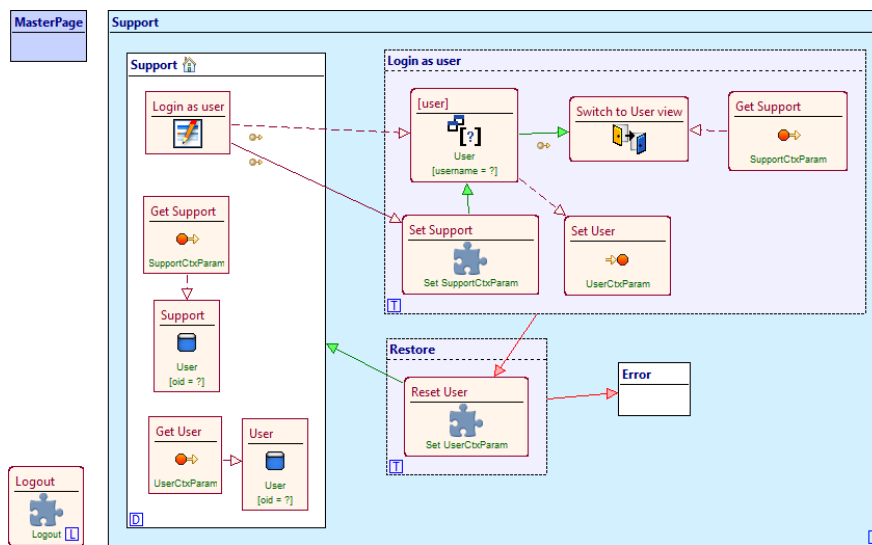


Figure E.21: Logic model – support view

The home (start) page of the Support View is the Support page containing a simple form for entering a username, and the name of the currently logged in support staff user is shown at the bottom.

## Support

[Support Logout](#)

>[Support](#) >Support

### Login as user

Username

### User

**firstName** Kelly  
**surname** Wilmsen

Figure E.22: Support home area

When a username has been entered, the *Login as user* operation group stores the current user (the support staff) in a context parameter and then switches to the user matching the given username, resulting in a redirection to the user's default view, i.e. normally the User View.

When support staff simulates a login as a user, the support staff user name is displayed along with a logout link that restores the user context and redirects the user back to the Support view.

## User Modules

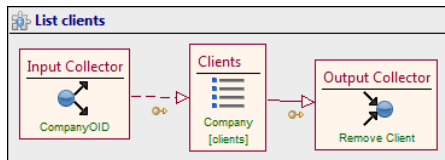
The User Modules are collections of reusable content units, operation units or a mixture of content and operation units used in the User View. Each module can be called from other parts of the logic model or from other modules.

The following sections describe each user module and their contents and/or functions in more detail.

### *Init*

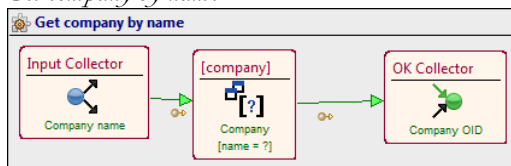
Not used.

### *List clients*



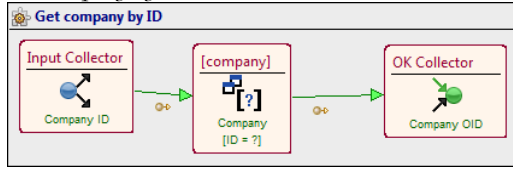
This is a content module that lists all available clients for a company, given the company's OID. The list includes a link for removing a client. The output of the module is the OID of the client to be removed.

### *Get company by name*



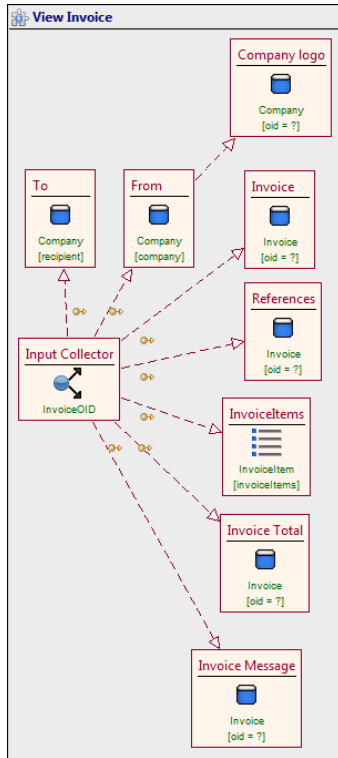
This is an operation module that looks up the OID of a company in the database, given the company's name. The output of the module is the OID of the company.

### Get company by ID



This is an operation module that looks up the name of a company in the database, given the company's OID. The output of the module is the name of the company.

### View Invoice



This is a content module that will preview an invoice from the invoice data in the database, given the invoice's OID.

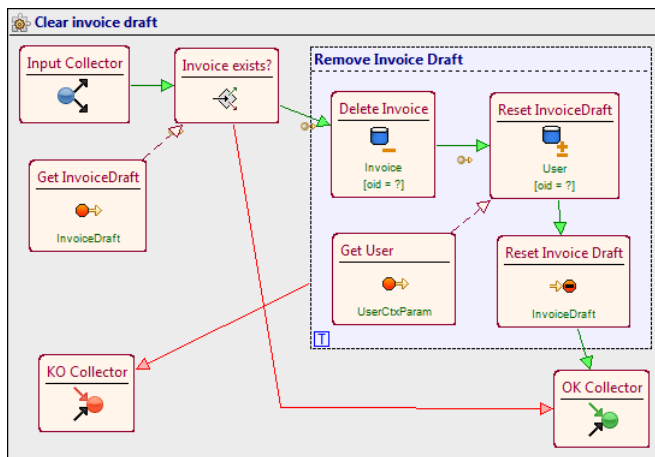
NONAME  
C O M P A N Y

<b>To</b>	<b>From</b>	<b>Invoice ID</b> 2
Idé Til Produkt AS	NoName Company	<b>Invoice date</b> 24/08/10
Postboks 535	n/a	<b>Due date</b> 21/09/10
4665	n/a	<b>Payment terms</b> 30 days
Kristiansand	n/a	
Norway	Sweden	
<b>Order number</b> 10		
<b>Order date</b> 21/08/10		
<b>Project reference</b> Test		

ID	Description	Qty	Price	VAT (%)	Total
123	Lorem ipsum	16	200	25	4,000
<b>Net amount</b>					3,200
<b>VAT</b>					800
<b>Rounding</b>					0
<b>Total (NOK)</b>					<b>4,000</b>

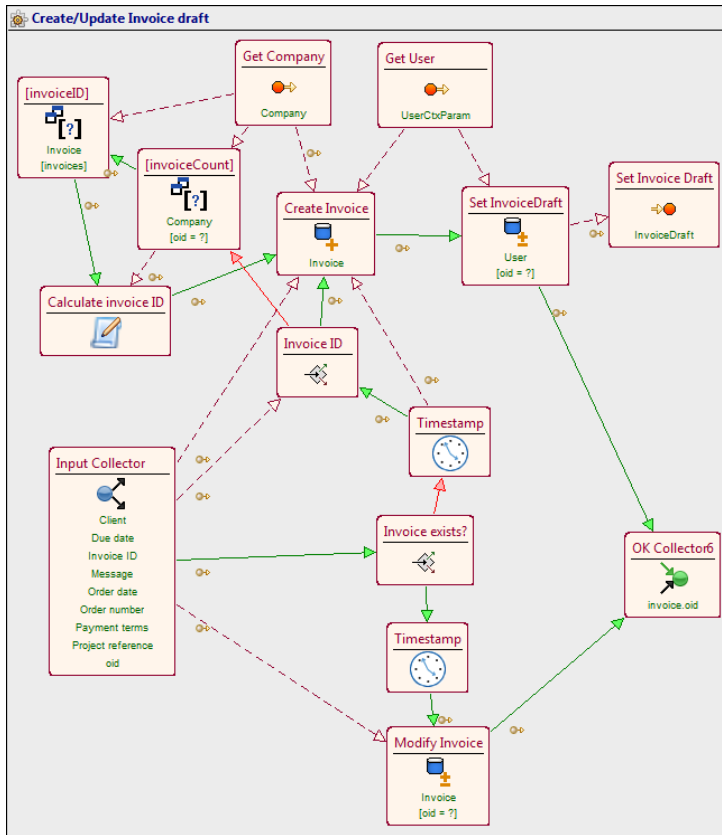
Invoice message

### Clear Invoice draft



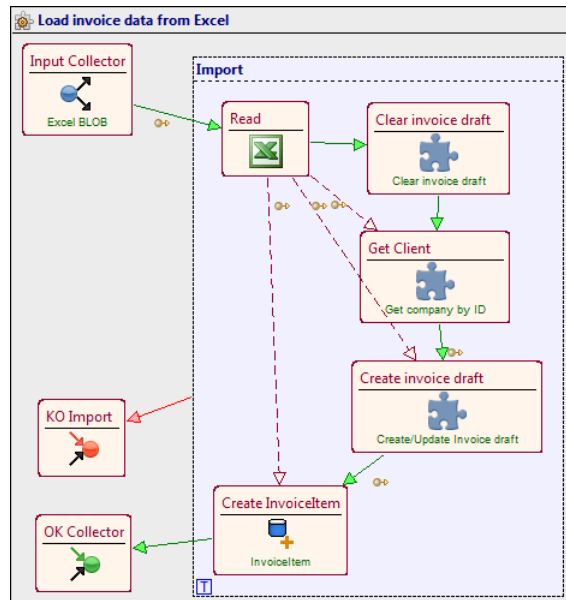
This is an operation module that checks if an invoice draft exists within the current user's context and if it does, the draft is deleted from the database and removed from the user.

### Create/Update Invoice draft



This is an operation module that takes general invoice data as input and either creates or updates an invoice depending on if the OID parameter is set and exists in the database. In either way, the invoice timestamp is updated and the OID of the new/updated invoice is returned. If a new invoice is created, it is set as the current draft for the user that created it.

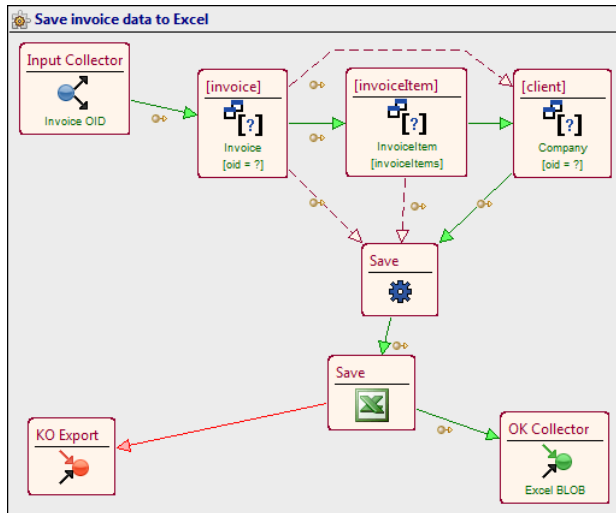
### Load invoice data from Excel



This is an operation module that imports invoice data from an Excel file, given the file as a BLOB input parameter. The actual parsing of the Excel file is performed by WebRatio's *Excel Unit*. A new invoice is created from the data and replaces the previous draft invoice as it becomes the new draft.

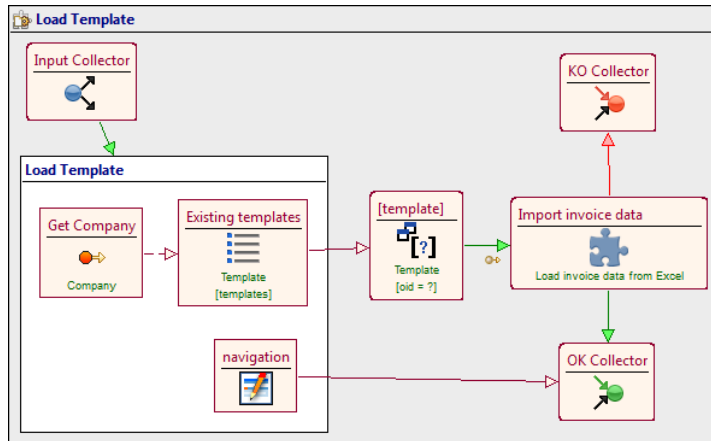
This module utilizes three other modules in order to perform its tasks; *Clear invoice draft*, *Get company by ID* and *Create/Update Invoice draft*.

*Save invoice data to Excel*



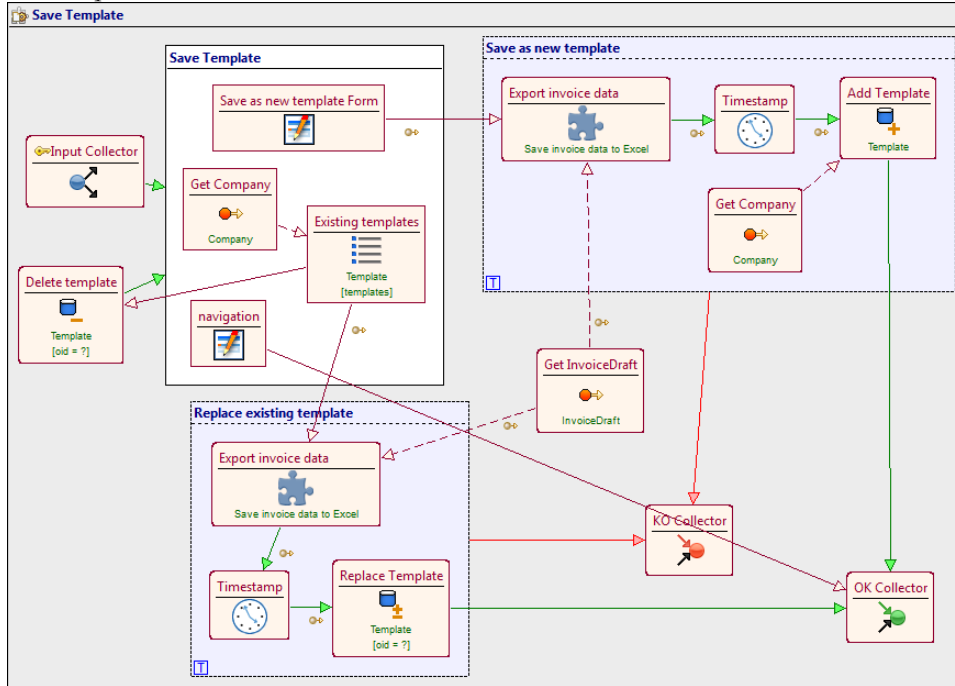
This is an operation module that exports invoice data from the database to an Excel file, given the invoice's OID. The actual creation of the Excel file is performed by WebRatio's *Excel Unit*. The output of the module is an Excel BLOB.

*Load Template*



This is a hybrid module with a mixture of both content and operation units. It presents a list of available invoice templates managed by the current company. If the user chooses to load one of the templates by clicking the "Load" link, the corresponding invoice template BLOB is read from the database and fed to the *Load invoice data from Excel* module to load the template.

## Save Template



This is a hybrid module with a mixture of both content and operation units. It presents a page with an input form for naming a template and a button for saving the template to the database. Existing templates are listed and can either be deleted or replaced.

The module utilizes the *Save invoice data to Excel* module to create a new template or replacing an existing one.

**Save Template**

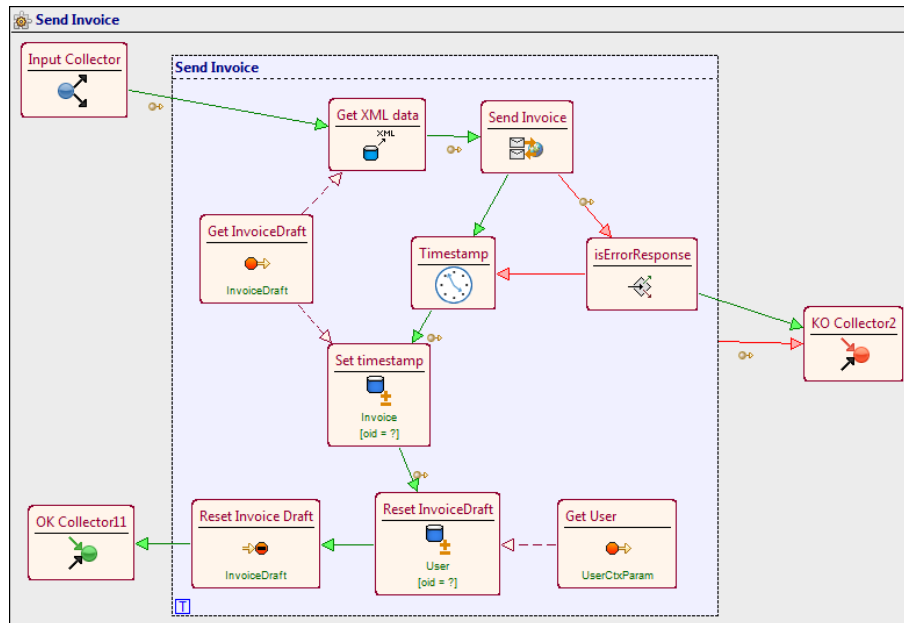
Enter a new template name or replace an existing template

Name

**Existing templates**

Name	Created		
Test template	23/07/10 06:40:00	<a href="#">Delete</a>	<a href="#">Replace</a>

## Send Invoice



This is an operation module that extracts the data for the current invoice draft into an XML document and uses a *Request Response Unit* in WebRatio to send the invoice to a web service in the ediEX backend system. If the backend web service accepts the invoice, the invoice is marked as sent in the database by setting the sent timestamp. The invoice “draft status” is removed.

### XML Out;

The XML document that is created by the *XML Out Unit* is a dump of all the database elements containing data for the current invoice draft. This includes *Invoice*, *InvoiceItem* and *Company* (both buyer and supplier). An example output XML is shown below.

```
<Root>
  <Invoice id="ent4">
    <Instance>
      <roundingAmount id="att73">0.00</roundingAmount>
      <from id="att46">456</from>
      <paymentTerms id="att91">30 days</paymentTerms>
      <netAmount id="att45">3200.0000</netAmount>
      <vatTotalsAmount id="att44">800.000000</vatTotalsAmount>
      <date id="att37">2010-08-28</date>
      <orderNumber id="att86">10</orderNumber>
      <grossAmount id="att94">4000.000000</grossAmount>
      <projectRef id="att85">Test</projectRef>
      <dueDate id="att22">2010-09-21</dueDate>
      <to id="att47">980131726</to>
      <invoiceID id="att21">2</invoiceID>
      <oid id="att19">5</oid>
      <orderDate id="att87">2010-08-21</orderDate>
      <message id="att31">Invoice message</message>
      <time id="att55">18:01:00</time>
      <itemTotalsAmount id="att42">4000.000000</itemTotalsAmount>
    </Instance>
  </Invoice>
  <InvoiceItem id="ent5">
```

```

<Instance>
  <vatPercent id="att28">25.00</vatPercent>
  <price id="att27">200.00</price>
  <preDiscountAmount id="att93">3200.00</preDiscountAmount>
  <description id="att26">Lorem ipsum</description>
  <productId id="att92">123</productId>
  <qty id="att24">16</qty>
  <totalAmount id="att71">4000.000000</totalAmount>
  <vatBaseAmount id="att70">3200.0000</vatBaseAmount>
  <vatAmount id="att40">800.000000</vatAmount>
  <amount id="att41">3200.0000</amount>
</Instance>
</InvoiceItem>
<Company id="ent1">
  <Instance>
    <accountNumber id="att82"></accountNumber>
    <fax id="att64"></fax>
    <ID id="att14">980131726</ID>
    <vatId id="att75"></vatId>
    <orgNumber id="att74">980131726</orgNumber>
    <address2 id="att11"></address2>
    <countryCode id="att60">NO</countryCode>
    <contactFirstName id="att49">Rune</contactFirstName>
    <address1 id="att10">Postboks 535</address1>
    <accountSwift id="att84"></accountSwift>
    <postalCode id="att13">4665</postalCode>
    <countryName id="att48">Norway</countryName>
    <accountIban id="att83"></accountIban>
    <name id="att9">Id&#233; Til Produkt AS</name>
    <city id="att12">Kristiansand</city>
    <address3 id="att58"></address3>
    <contactPhone id="att52"></contactPhone>
    <web id="att66">http://www.itpas.no</web>
    <contactSurname id="att50">Heimstad</contactSurname>
    <email id="att67">post@itpas.no</email>
    <contactEmail id="att51">rhe@itpas.no</contactEmail>
    <phone id="att68">815 68 684</phone>
  </Instance>
</Company>
<Company id="ent1">
  <Instance>
    <accountNumber id="att82"></accountNumber>
    <fax id="att64"></fax>
    <ID id="att14">456</ID>
    <logo id="att81"
blob="upload/logo_NoNameCompany.png">iVBORw0KGgoAAAAA ...
AAAAAE1FTkSuQmCC</logo>
    <vatId id="att75"></vatId>
    <orgNumber id="att74">n/a</orgNumber>
    <countryCode id="att60">SE</countryCode>
    <address2 id="att11"></address2>
    <contactFirstName id="att49">John</contactFirstName>
    <address1 id="att10">n/a</address1>
    <accountSwift id="att84"></accountSwift>
    <postalCode id="att13">n/a</postalCode>
    <countryName id="att48">Sweden</countryName>
    <accountIban id="att83"></accountIban>
    <name id="att9">NoName Company</name>
    <city id="att12">n/a</city>
    <address3 id="att58"></address3>
    <contactPhone id="att52">n/a</contactPhone>
    <web id="att66"></web>
    <contactSurname id="att50">Doe</contactSurname>

```



```

    <email id="att67"></email>
    <contactEmail id="att51">john.doe@zlarg.com</contactEmail>
    <phone id="att68"></phone>
  </Instance>
</Company>
</Root>

```

#### XSL Transformation;

The portal is expected to send a proper xml document to the backend web service in accordance with the supplied WSDL<sup>60</sup>. To achieve this, the *Request Response Unit* is configured to apply an XSL transformation file on the xml output described above before calling the web service. The XSL used for the transformation can be found at *WebContent/transformation/xmlout\_to\_e2b.xsl* in the WebRatio project.

#### e2b Invoice Message;

The XML message generated by the XSL transformation from the XML invoice data is a complete SOAP message containing an e2b Invoice Interchange message according to the e2b invoice format specification<sup>61</sup>. However, the message uses just a subset of all available fields in the e2b invoice format. An example SOAP message sent to the backend web service is shown below.

```

<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:xalan="http://xml.apache.org/xalan">
  <soapenv:Header>
    <ns:Producer
xmlns:ns="http://broker.hermes.itpas.com/">00000001</ns:Producer>
  </soapenv:Header>
  <soapenv:Body>
    <Interchange xmlns="http://www.e2b.no/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.e2b.no/XMLSchema
e2b_Invoice_Interchange_v3p4.xsd">
      <Envelope>
        <InterchangeId>5</InterchangeId>
        <From>456</From>
        <To>980131726</To>
        <Date>2010-08-28</Date>
        <Time>22:02:25</Time>
        <NumberOfMessages>1</NumberOfMessages>
        <TestIndicator>1</TestIndicator>
      </Envelope>
      <Invoice MessageVersion="3.4" MessageOwner="e2b"
MessageType="Invoice" language="NO">
        <MessageNumber>1</MessageNumber>
        <MessageTimestamp>2010-08-28T22:02:25</MessageTimestamp>
        <NumberOfLines>1</NumberOfLines>
        <InvoiceHeader>
          <InvoiceType codetext="Invoice">380</InvoiceType>
          <InvoiceStatus codetext="Test">53</InvoiceStatus>
          <InvoiceNumber>2</InvoiceNumber>
          <InvoiceDate>2010-08-28</InvoiceDate>
          <Supplier xmlns="">

```

<sup>60</sup> ediEX backend broker WSDL, <http://172.20.1.7:8180/broker-webapp/e2b?WSDL>

<sup>61</sup> e2b Invoice Format – Message Description v3.4, [http://www.e2b.no/sfiles/6/29/24/1/file/e2b\\_Invoice\\_Format\\_Message\\_Description\\_v3p4.pdf](http://www.e2b.no/sfiles/6/29/24/1/file/e2b_Invoice_Format_Message_Description_v3p4.pdf)

```

<Name>NoName Company</Name>
<ContactInformation>
  <PhoneNumber/>
  <FaxNumber/>
  <EmailAddress/>
  <WebAddress/>
</ContactInformation>
<PostalAddress>
  <Address1>n/a</Address1>
  <Address2/>
  <Address3/>
  <PostalCode>n/a</PostalCode>
  <PostalDistrict>n/a</PostalDistrict>
  <CountryCode>SE</CountryCode>
  <CountryName>Sweden</CountryName>
</PostalAddress>
<ContactPerson>
  <Name>Doe, John</Name>
  <FirstName>John</FirstName>
  <LastName>Doe</LastName>
  <ContactInformation>
    <PhoneNumber>n/a</PhoneNumber>
    <EmailAddress>john.doe@zlarg.com</EmailAddress>
  </ContactInformation>
</ContactPerson>
<OrgNumber>n/a</OrgNumber>
<VatId/>
<AccountInformation>
  <AccountNumber/>
  <IbanNumber/>
  <SwiftNumber/>
</AccountInformation>
<ProjectRef>Test</ProjectRef>
</Supplier>
<Buyer xmlns="">
  <Name>Id&#233; Til Produkt AS</Name>
  <ContactInformation>
    <PhoneNumber>815 68 684</PhoneNumber>
    <FaxNumber/>
    <EmailAddress>post@itpas.no</EmailAddress>
    <WebAddress>http://www.itpas.no</WebAddress>
  </ContactInformation>
  <PostalAddress>
    <Address1>Postboks 535</Address1>
    <Address2/>
    <Address3/>
    <PostalCode>4665</PostalCode>
    <PostalDistrict>Kristiansand</PostalDistrict>
    <CountryCode>NO</CountryCode>
    <CountryName>Norway</CountryName>
  </PostalAddress>
  <ContactPerson>
    <Name>Heimstad, Rune</Name>
    <FirstName>Rune</FirstName>
    <LastName>Heimstad</LastName>
    <ContactInformation>
      <PhoneNumber/>
      <EmailAddress>rhe@itpas.no</EmailAddress>
    </ContactInformation>
  </ContactPerson>
  <OrgNumber>980131726</OrgNumber>
  <VatId/>
  <AccountInformation>

```

```

        <AccountNumber/>
        <IbanNumber/>
        <SwiftNumber/>
    </AccountInformation>
</Buyer>
<InvoiceReferences>
    <BuyersOrderNumber>10</BuyersOrderNumber>
    <BuyersOrderDate>2010-08-21</BuyersOrderDate>
</InvoiceReferences>
<Payment>
    <DueDate>2010-09-21</DueDate>
    <Currency>NOK</Currency>
    <PaymentTerms>30 days</PaymentTerms>
</Payment>
<Attachments>upload/logo_NoNameCompany.png</Attachments>
</InvoiceHeader>
<InvoiceDetails xmlns="">
    <BaseItemDetails>
        <LineItemNum>1</LineItemNum>
        <SuppliersProductId>123</SuppliersProductId>
        <Description>Lorem ipsum</Description>
        <UnitPrice>200.00</UnitPrice>

<LineItemPreDiscountAmount>3200.00</LineItemPreDiscountAmount>
        <LineItemAmount>3200.0000</LineItemAmount>
        <QuantityInvoiced>16</QuantityInvoiced>
        <VatInfo>
            <VatPercent>25.00</VatPercent>
            <VatBaseAmount>3200.0000</VatBaseAmount>
            <VatAmount>800.000000</VatAmount>
        </VatInfo>
    </BaseItemDetails>
    <FreeText>Invoice message</FreeText>
</InvoiceDetails>
<InvoiceSummary xmlns="">
    <InvoiceTotals>

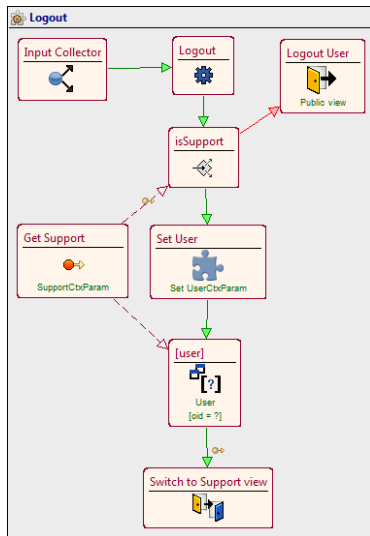
<LineItemTotalsAmount>4000.000000</LineItemTotalsAmount>
        <GrossAmount>4000.000000</GrossAmount>
        <VatTotalsAmount>800.000000</VatTotalsAmount>
        <NetAmount>3200.0000</NetAmount>
        <RoundingAmount>0.00</RoundingAmount>
    </InvoiceTotals>
    </InvoiceSummary>
</Invoice>
</Interchange>
</soapenv:Body>
</soapenv:Envelope>

```

Response;

In the current implementation of the backend web service, there is no response message sent back to the client unless there is an error. This makes it a bit tricky to correctly handle the result of the web service call in the WebRatio model. It is suggested that the backend web service is changed so it always returns a status message.

### Logout

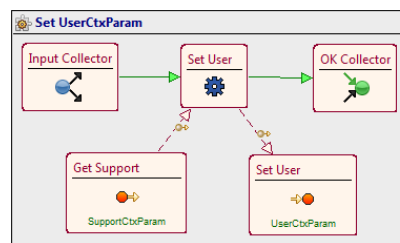
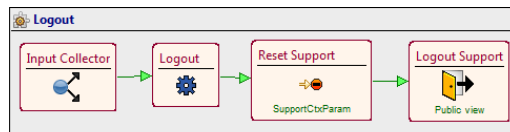
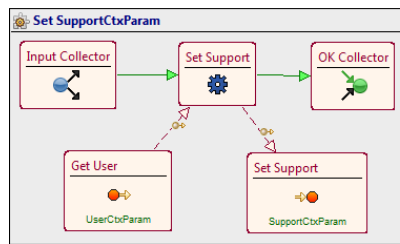


This is an operation module that makes sure the user will be correctly logged out. If the user is logged in via the Support View he/she will be logged out by restoring the user context to the originating support user and switching back to the Support view via Webratio's *Change Group Unit*. Otherwise the user is logged out via Webratio's *Logout Unit*, redirecting the user to the default Public View.

The module is utilizing the *Set UserCtxParam* module of the *Support Modules* collection.

### Support Modules

The Support Modules are collections of reusable operation units mostly used in the Support View. Each module can be called from other parts of the logic model or from other modules.



### Set SupportCtxParam

This is an operation module that copies the user context parameter value to the support context parameter.

### Set UserCtxParam

This is an operation module that copies the support context parameter value to the user context parameter.

### Logout

This is an operation module that resets the support context parameter value and logs the user out via Webratio's *Logout Unit*, redirecting the user to the default Public View.