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Use of Obeya Visual Room in Entrepreneurial Decision-making

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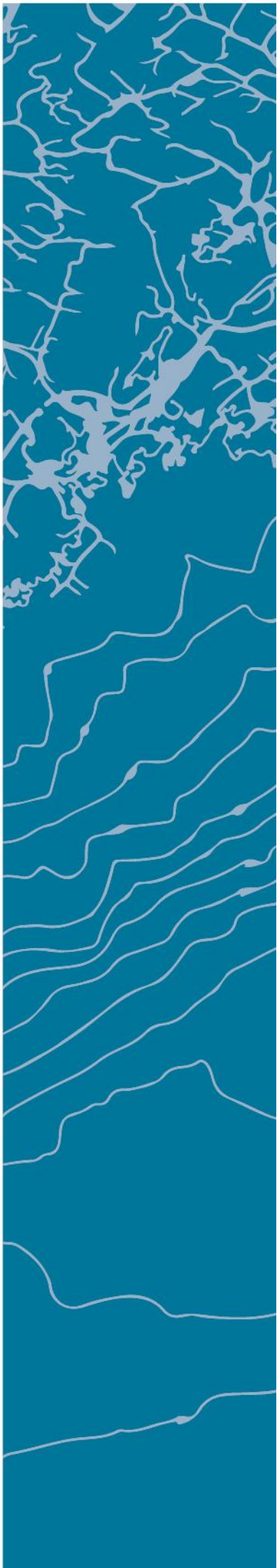

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Preface

The main theme of this research is to adapt and utilise the *Obeya* visual tool to investigate the impact of visualisation on entrepreneurial decision-making. The following study marks the fulfilment of my Master's Programme in Industrial Economics and Technology Management at the University of Agder.

The pre-planning of this master thesis began in autumn of 2016, during which the researcher and external supervisor conducted several meetings to construct the scope of this research. With the help of my internal and external supervisors, and devoting time and effort, I was able to put together this research. Hence, this has been an intensive journey filled with beneficial learning outcomes. Without the supervision, advice, and contribution of my advisors, workshop participants, external interviewees, family and friends, completing this thesis would have been impossible. I would honourably like to express my greatest gratitude to:

John Skaar, my external supervisor, thank you for the confidence, belief and ambition that you granted me from the beginning until the end of this work. You have been helpful, generous and supportive along this road as a supervisor, workshop participant, and interviewee.

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Moreover, I would like to thank Mari Helland Frøysnes and Sigmund Jensen for their participation in the group meetings. I would particularly like to thank Mari for her participation in the workshop sessions and interviews. In addition, I would like to express my gratitude to each respondent, Asle Pedersen, Marianne Trollsås Fenger, and Rannveig Tobiassen, for their contribution in this research.

Nevertheless, I want to address my deepest gratitude to my parents, and brothers, for their constant support and encouragement in the past years. I honourably dedicate this work to them.

Grimstad, 29.05.2017

Ahmad S. M. Alaassar

Summary

Entrepreneurs attempting to develop ideas outside the boundaries of organisations face challenges (e.g. high uncertainty and complexity levels, resource constraints, etc.) that might lead to failure due to different reasons, one of which is poor decision-making. Consecutively, due to constant changes in customer and market needs, entrepreneurial decisions must be taken rapidly. Hence, entrepreneurs need to take rational and effective decisions in order to succeed.

Based on the highlighted problem, this study aims to investigate the impact of two approaches, experimentation and visualisation, to facilitate entrepreneurial decision-making. The primary objective of this research is to explore the impact of visualisation by adapting and utilising the *Obeya* visual tool during the development process of a market opportunity. Whereas, the secondary objective is to examine the impact of experimentation as a method of validating information. Hence, this thesis attempts to answer the following research question: *"how can employment of Obeya impact decision-making in an entrepreneurial context"*.

Furthermore, this study answers the research question by employing the *Obeya* tool in workshop sessions, of which the researcher participates as a process facilitator, participant, and observer. The collected data, composed mainly of five semi-structured interviews from both workshop participants and external informants, is analysed using content analysis. Also, diary notes from held group meetings and workshop sessions are included. Based on the analysed content, the findings confirm that the *Obeya* tool positively impacts the ability to understand and communicate information. Whereas, experimentation improves the validity of data on which visualised material are built on. Hence, the study suggests that visualisation and experimentation are two, of many other, approaches that combined facilitate entrepreneurial decision-making.

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1 Introduction

Entrepreneurship provides an important contribution in the growth and prosperity of communities by establishing and developing businesses. It all begins with a fruitful opportunity that an entrepreneur acts upon. The underlying idea of entrepreneurial opportunities is the introduction of something new to a market. Once entrepreneurs decide to act upon what they believe is an entrepreneurial opportunity, they endure in the entrepreneurial journey that requires making decisions in highly uncertain environments under factors such as time pressure and emotional strain. Such environments force entrepreneurs to make hastened decisions based on irrational thinking without giving the appropriate time to understand the problems they face (Hisrich, Peters, & Shepherd, 2013). Based on this brief background, the issue of interest within this thesis is to find approaches that enhance decision-making in an entrepreneurial context. From a broad literature scope with different approaches, two underlying variables are identified to improve decision-making, these are *experimentation* and *visualisation*.

The first variable, *experimentation* is associated with frequent validation during development of ideas. Traditionally, entrepreneurs seeking to establish new ventures assume market opportunities and required solutions to be known in advance. Based on this, a business plan, which is an extensive document with various projections, is created and presented to investors before moving forward to idea development. The development process starting from creating business plans to launching products may take up to several months or even years, all of which is mainly driven by assumptions. However, once the products or services are launched, entrepreneurs might be confronted with different customer and market needs than initially anticipated. For this reason, statistics indicate that up to 75 percent of start-ups end up failing (Blank, 2013). The Lean Startup methodology by Ries (2011) attempts to solve this challenge by revolutionising the way entrepreneurs develop their opportunities. This method encourages experimentation over extensive planning (Blank, 2013); thus, entrepreneurs are able to retrieve unknown information and assess their products or services prior to making large investments (Kerr, Nanda, & Rhodes-Kropf, 2014).

The other variable, *visualisation* is considered an effective communication method with great benefits when utilised in development processes. However, according to Lindlöf (2014) this topic is somehow undervalued in the management research field. In addition, Tezel et al. (2016) highlight literature findings in relation to visualisation as ambiguous, due to presence of various terms and applications, rather than commonly defined ones. For the interest of this study, visualisation is declared as tools that stimulate the information processing capability in environments characterised as uncertain and

complex. This is made possible by enhancing the ability to understand and communicate information; hence, decision-makers are able to interpret data in a more efficient manner (Bititci, Cocca, & Ates, 2016; Lurie & Mason, 2007). Among various visualisation tools that stimulate the information processing capability, a tool called *Obeya* stands out due to its ability to facilitate decision-making and problem-solving in development processes (Appell, 2011; Liker, 2004; Lindlöf, 2014). The *Obeya* tool obtains these abilities by gathering cross-functional managers with decisive authority in a meeting room that visually illustrates key information. Based on the displays, ongoing activities are discussed and necessary decisions are taken. Hence, meetings carried out in *Obeya* rooms are characterised as highly efficient (Tezel et al., 2016). According to Liker and Morgan (2011), *Obeya* is one of the most powerful visual tools to enhance communication and accountability of functions.

Despite the benefits of the *Obeya* tool, the *first* observed gap in the literature is the application of this functional tool in development processes of entrepreneurships, rather than manufacturing companies. The *second* gap is concerned with the underlying process, i.e. the literature provides weak descriptions of setting up the *Obeya* in practice, even in the manufacturing context where this tool flourishes. Thus, the researcher attempts to fill these identified gaps by adapting and utilising the *Obeya* tool during the development of an entrepreneurial opportunity. The purpose of this research is to investigate whether applying the *Obeya* tool will bring forth similar benefits as proven in the industrial setting. Hence, this thesis investigates how visual tools facilitate decision-making in development processes. Based on the identified literature gaps, it is anticipated that the results of this research will benefit entrepreneurs in specific, but also other management fields. This study answers the following research question:

How can employment of Obeya impact decision-making in an entrepreneurial context?

This thesis is structured in the following manner. *Chapter* 2 is divided into three main parts: first part presents an extensive literature review of entrepreneurship, decision-making, and visualisation; second part, presents the research contributions consisting of the adapted *Obeya* room, and; third part illustrates the research model developed in this thesis. *Chapter* 3 provides a detailed description of the methodological choices, of which, action research and case study research are the chosen research designs; semi-structured interviews and diary notes are applied for data collection; and data is processed through content analysis. In addition, chapter 3 highlights the applied case. *Chapter* 4 presents the findings based on the collected and analysed data. *Chapter* 5 primarily aims to discuss the theoretical findings in relation to the empirical data, based on this discussion, several propositions are suggested. Furthermore, research limitations, data quality and practical applications are discussed as well. *Chapter* 6 highlights concluding comments.

2 Theory

Interpretation of the literature related to the research area of interest is crucial in every research (Easterby-Smith, Thorpe, & Jackson, 2015). Based on the retrieved theoretical findings, this chapter presents the theories and tools adopted in this research. The theory chapter is divided into three main sections. The first section introduces the underlying theories that are considered relevant in relation to entrepreneurship, decision-making, and visualisation. The second section presents the designed *Obeya* room, and how it is adapted to the entrepreneurial context. The last section declares the established research model.

2.1 Entrepreneurship

The following sub-sections highlight characteristics of entrepreneurial environments and presents the main differences between entrepreneurs and managers operating in large organisations.

Entrepreneurship is defined as *"the process by which individuals pursue opportunities without regard to resources they currently control"* (Barringer & Ireland, 2012, p. 6). An entrepreneur transforms an idea to a viable business by putting together and integrating all the necessary resources such as funds, stakeholders, strategy, etc. Entrepreneurship can be associated with both individuals or corporates introducing new products or services to the market. Barringer and Ireland (2012) introduce a four-stage generic entrepreneurial process that is executed in the following sequence: deciding to become an entrepreneur; developing business ideas; transforming the idea into an entrepreneurial venture; and last, manage and scale the venture. This thesis will mainly emphasise entrepreneurship in the context of individual entrepreneurs attempting to launch new businesses, commonly referred to as start-up ventures (Barringer & Ireland, 2012).

The entrepreneurial environment is characterised by high levels of *uncertainty* and *complexity* that both hinder entrepreneurs from developing successful ventures (Busenitz & Barney, 1997). *Uncertainty* in this setting is defined using two dimensions, one related to absence of information and the other concerned with market uncertainty. The first dimension, absence of information, adopts Galbraith (1997) definition of uncertainty: *"the difference between the amount of information required to complete a task and the amount of information already possessed by the organisation"* (Lindlöf, 2014, p. 2). That is, an organisation already contains information from previous experiences, and it is required to seize the remainder of information to be able to develop products. Thus, this dimension of uncertainty considers the action of collecting data and generating information as part of the development process; hence, it is correlated to the information processing capability (Lindlöf,

2014). Although, this definition is concerned with development processes in organisations, such lack of information is considered greater in entrepreneurships (Busenitz & Barney, 1997; Shepherd, Williams, & Patzelt, 2015). The second dimension, market uncertainty, applies two underlying issues. First, market turbulence, which indirectly hinders sustainability as long-term planning of resources is difficult. Second, changes in customer needs, which directly affects the development task causing greater uncertainty (Olausson & Berggren, 2010). The other dimension, *complexity*, is considered important in development processes; however, this thesis only briefly mentions this dimension. A complex system in this context refers to one that consists of many elements collaborating in a complicated manner. For instance, interaction between large number of subtasks with complicated features in the development process (Lindlöf, 2014).

2.1.1 Entrepreneurs Versus Managers in Large Organisations

According to Busenitz and Barney (1997), decision-making varies greatly between entrepreneurs and managers in large organisations due to different levels of uncertainty and complexity. Entrepreneurs in this context are referred to as individuals willing to take risks and manage matters individually. On the other hand, managers in large organisations are described as unwilling to bear risk, process matters systematically, and are somehow foreseeable during decision-making. The purpose of this sub-section is to highlight few differences between entrepreneurs and managers in large organisations.

In principle, the decisions made by managers in large organisation are often more complex and uncertain in nature. However, with the presence of necessary resources, these factors are considerably reduced. This is clarified by the access decision-makers have to numerous resources such as historical data, market reports, future projections, and other relevant information required during decision-making (Busenitz & Barney, 1997). This advantage brings managers of large organisations closest to the rational decision-making process (Bazerman, 1998). Consequently, due to lower uncertainty levels, large organisations are able to reduce expenses related to poor decision-making. On the contrary, entrepreneurs lack similar access to information sources, which implies greater levels of uncertainty during decision-making. Hence, this may result in cumulative failure costs. Regarding complexity levels, large organisations provide well-developed processes and procedures that guide managers towards lower complexity during decision-making. However, entrepreneurs lack such sound infrastructure, which means they invest more time and resources to tackle complex tasks (Busenitz & Barney, 1997).

When comparing differences between production and development processes in the manufacturing context, Liker and Morgan (2006) state development processes as more complex, less precise and

rigid compared to production processes. This reflects the challenging nature of such processes. On the other hand, from an entrepreneurial perspective, these challenges are assumed to be greater due to the lack of resources and information. Hence, entrepreneurial processes driven by individuals outside the boundaries of corporates face higher levels of uncertainty and complexity (Busenitz & Barney, 1997).

2.1.2 Entrepreneurial Context

From various development processes employed in the entrepreneurial context, this thesis attempts to employ the Running Lean process, which is based on the Lean Startup methodology. Ries (2011) first introduced the Lean Startup with the main purpose of helping entrepreneurs build successful start-ups. This method encourages "*experimentation over elaborate planning, customer feedback over intuition, and iterative design over traditional "big design up front" development"* (Blank, 2013, p. 4). Moreover, Lean Startup adapts several practices from lean manufacturing, agile methodology and customer development to the entrepreneurial context through the use of an iterative cycle that focuses on experimentation and learning (Maurya, 2012; Ries, 2011). Lean manufacturing, which is derived from the Toyota Production System (TPS), is mainly based on continuous improvement of processes to reduce non-value adding activities and increase production flow. This is achieved by standardising processes to detect improvements (Liker & Morgan, 2011; Spear & Bowen, 1999). Agile methodology, also based on TPS, is primarily used in software development. This methodology deploys iterative and incremental development cycles based on small solution releases to constantly improve the product through customer feedback (Trimi & Berbegal-Mirabent, 2012). Customer development is a method that introduces hypothesis testing to help entrepreneurs validate their intuition. This method achieves improved decision-making, thus; reduces uncertainty and enables entrepreneurs to capture more market opportunities (York & Danes, 2014).

Moreover, the underlying principles in the Lean Startup method are: *Validated learning*, the process of conducting continuous experiments to validate assumptions instead of investing time and effort into developing products that might later be proven false. This process is achieved through the *Build-Measure-Learn* iterative loop, which enables entrepreneurs to *build* ideas into services or products, *measure* consumer feedback, and *learn* whether to redirect or stay on the same course (Ries, 2011). Last, is the *Pivot* or *Persevere* decision that enables entrepreneurs to alter their path if ideas are not working, or persevere by continuing along the same course (Blank, 2013; Ries, 2011). Figure 1 illustrates this iterative loop.

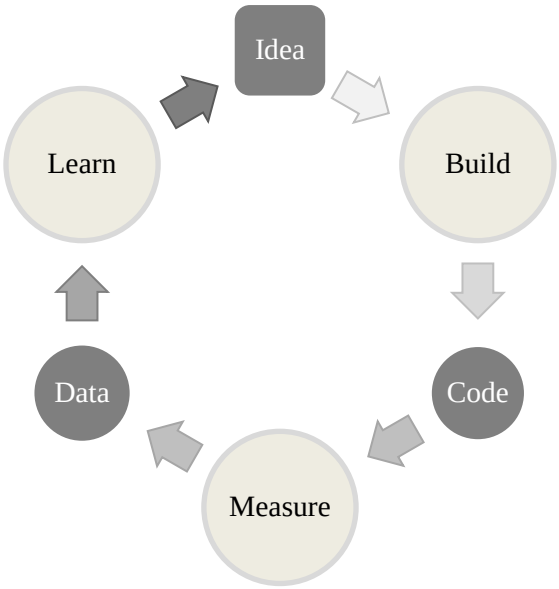

Figure 1: Build-Measure-Learn loop (Ries, 2011)

Following the release of Lean Startup, a practical implementation reflecting this method was introduced by Maurya (2012) in the book, Running Lean. Unlike Lean Startup, which provided an ambiguous methodology, Running Lean provides a systematic process that helps start-ups with every stage of their entrepreneurial journey. Figure 2 illustrates this process which is comprised of the following three stages. *Stage* 1 is about understanding the problem and thereafter defining a solution, if the problem is proven worth solving. *Stage* 2 focuses on testing the defined solution from the previous stage by measuring consumer feedback, this is first achieved by qualitative validation followed by quantitative verification. *Stage* 3 is the final stage, which emphasises scaling the business (Maurya, 2012).

As mentioned in the introduction, the *Obeya* visualisation tool is adopted in the development process of a market opportunity to investigate whether similar benefits can be achieved as stated by the literature in development processes of manufacturing companies. To realise this attempt, the above-mentioned methods are used to guide the development process, Lean Startup with its origins from lean manufacturing, agile methodology, and customer development stands for the core methodology. Running Lean, on the other hand, provides a systematic process that can be followed. Hence, the study attempts to incrementally follow the Running Lean process in order to develop a market opportunity. This market opportunity represents the case in this research, which is further described within the methodology chapter: Case on pg. 26.

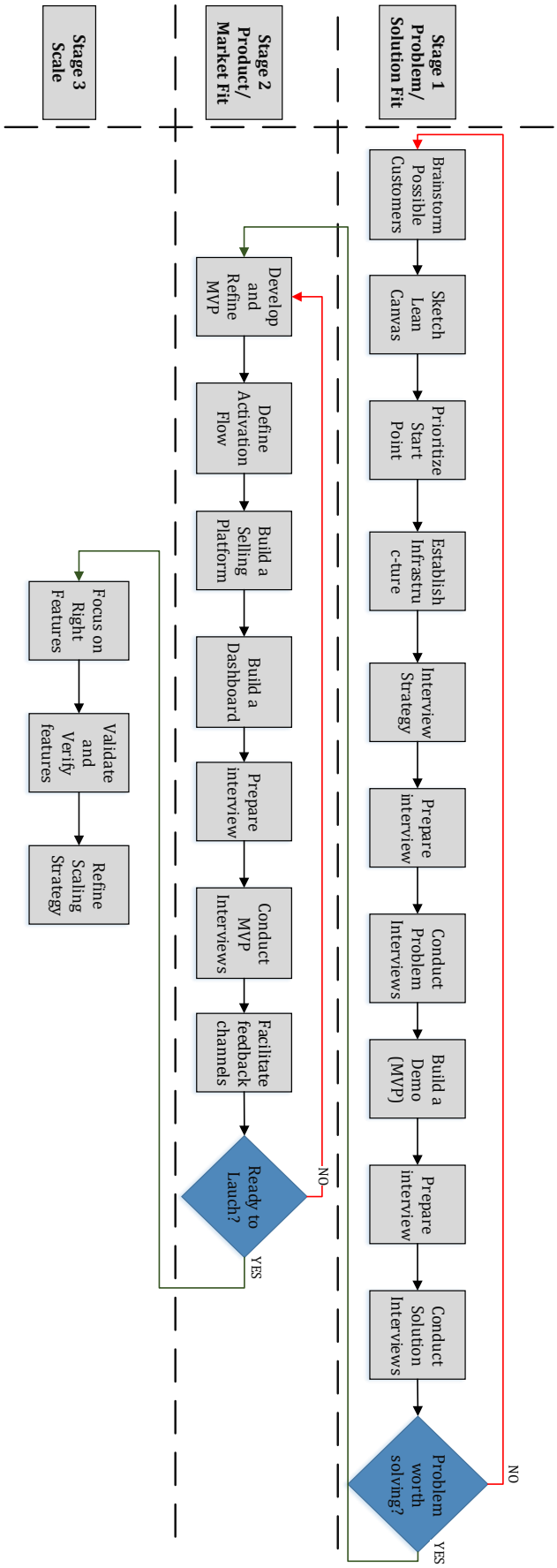

Figure 2: Simple process map of Running Lean, adapted from (Maurya, 2012)

2.2 Decision-making

Decision-making is broadly divided into two groups, *prescriptive* models and *descriptive* models. *Prescriptive* models, utilise mathematical methods to generate decision models that assist decision-makers in forming the most optimal decisions, i.e. prescribe how decisions should be made (Bazerman, 1998). Bazerman (1998) further presents a generic six stage decision-making process characterised as the rational model that achieves the most optimal results by adopting the prescriptive approach. The stages are: define the problem; assess the criteria; weight the criteria; generate alternatives; rate alternatives to each criterion; and last, calculate the optimal decision. *Descriptive* models, on the other hand, are simply concerned with the means by which decision-makers form their decisions (Bazerman, 1998). One of the basic ideas inherent in the descriptive decision-making literature is the well-known concept, Bounded Rationality, first introduced by Herbert Simon. The underlying notion of this concept is that rational behaviour has constraints. That is, a decision-maker with rational behaviour has both necessary resources and cognitive abilities to obtain the most optimal results, as proposed in prescriptive models (Bazerman, 1998; Dillon, 1998). However, such resources or abilities are rarely applicable due to lack of information or human physiological and psychological boundaries. For this reason, the decision-making model, Satisficing, was introduced in pursuance of quick satisfactory alternatives, rather than time-consuming optimal solutions. This strategy assumes that, in situations with inability to complete a rational process, decision-makers can search through existing alternatives until the option that surpasses the required standard is found (Dillon, 1998).

Bazerman (1998) argues that the descriptive model is the most appropriate approach for managers who make decisions frequently as the rational model is time-consuming. This is supported by the fact that most decisions made by managers are based on judgment, instead of following a systematic approach (Bazerman, 1998). Other factors that discourage the use of rational processes are: cost constraints, differences in values of decision-makers, and limits related to the cognitive ability of decision-makers to process large amounts of information (Busenitz & Barney, 1997). Furthermore, Bazerman (1998) states that based on these limitations, decision-makers will not be capable of making optimal decisions by simply utilising the rational model. To overcome these challenges, the use of heuristics and biases mechanisms is proposed to help redirect decision-makers' judgements (Bazerman, 1998). According to Tversky and Kahneman (1975), heuristics and biases can improve judgment under uncertain and complex conditions. The above-mentioned limitations are assumed greater in an entrepreneurial context due to bounded rationality and, higher uncertainty and complexity levels. Hence, this sub-section attempted to investigate the impact of applying the descriptive approach to improve decision-making in an entrepreneurial context. Moreover, heuristics

and biases are investigated based on the theoretical findings that point its ability to achieve more rational and effective decisions (Bazerman, 1998).

2.2.1 Decision-making in Entrepreneurial Context

Shepherd et al. (2015) present different activities in relation to entrepreneurial decision-making. These activities regard the following decisions: opportunity assessment; entrepreneurial entry; exploiting opportunities; entrepreneurial exist; heuristics and biases in decision-making process; characteristics of entrepreneurs; and entrepreneurial environment (Shepherd et al., 2015). Given that many entrepreneurial actions are built on subjective and sparse data, the decision-making process is mostly exposed to errors in judgment (York & Danes, 2014). Therefore, for the interest of this thesis, heuristics and biases are further defined.

The entrepreneurial environment is dominated by uncertainties in, market conditions, product or service success, and capability to operate an entrepreneurship. Due to these uncertainties, entrepreneurs are compelled to make rapid decisions despite lack of information, to capture fruitful opportunities. For these reasons, heuristics and biases are primarily used to increase the speed and avoid pitfalls during decision-making. Heuristics are simple strategies based on common sense to form judgments and make decisions. Biases, on the other hand, are common errors based on certain ways of thinking that can lead to erroneous inference. Heuristics and biases are both effective and efficient mechanisms that assist entrepreneurs to form judgments and make decisions (Shepherd et al., 2015).

Optimism, overconfidence and representativeness are three common heuristics and biases that can influence the entrepreneurial decision-making process either positively or negatively. Optimism refers to *"the tendency to expect positive outcomes even when such expectations are not rationally justified"* (Shepherd et al., 2015, p. 30). Entrepreneurs are commonly optimistic when estimating the valuation and investment of their ventures. Although, optimism can bring improvement to entrepreneurships, it may also bring forth several consequences. For instance, it may slow an entrepreneur's decision to shut down failed projects, in hope of growth. Also, optimism might cause entrepreneurs to select co-workers with optimistic similarities (Shepherd et al., 2015). York and Danes (2014) suggest two activities to reduce optimism bias, one of which is attending entrepreneurial events to compare ideas with other entrepreneurs. Second, try to absorb and reflect over critical inputs gathered from co-workers or external consultants (York & Danes, 2014).

Furthermore, overconfidence refers to *"overestimating the probability of being right"* (Shepherd et al., 2015, p. 31). The impact of overconfidence is considered mostly negative as it causes entrepreneurs to disregard uncertainties. For example, entrepreneurs with overconfidence might embark on new markets despite poor information or expand existing ventures without regard to negative indications, which will exhaust possible resources and eventually lead to bankruptcy. Despite these drawbacks, overconfidence can contribute to increase positive emotions, which promotes the capacity to quickly recover from difficult market conditions (Shepherd et al., 2015). Busenitz and Barney (1997) state that although overconfident entrepreneurs might take actions prior to obtaining required insights, still, overconfidence is considered necessary to encourage rapid action-taking before the window of opportunity is lost (Busenitz & Barney, 1997). Overconfidence can be controlled by, engaging external entrepreneurs or individuals to contribute with new, unbiased perspectives. And, attempting to find root-causes for failure instead of simply presuming success (York & Danes, 2014).

Last, representativeness indicates *"the tendency to overgeneralise from a few characteristics or observations"* (Busenitz & Barney, 1997, p. 10). This heuristic is commonly employed in the entrepreneurial context as information is considered a scarce resource, and entrepreneurs are only able to collect limited number of samples. This is caused due to bounded resources, i.e. time and capital, which in turn might have a negative impact on the entrepreneurial project. However, this limitation can also provide an advantage to entrepreneurs, that is to protect the product or service from getting prematurely revealed to competitors (Busenitz & Barney, 1997). As a mitigation measure, York and Danes (2014) propose to conduct customer interviews in order to validate data samples. This process originates from *customer development,* which is extensively employed in the Lean Startup method and Running Lean process (York & Danes, 2014).

2.2.2 Experimentation

Another technique to support decision-making in entrepreneurial environments is through experimentation (Blank, 2013; Kerr et al., 2014; Ries, 2011). Experimentation through hypothesis testing is scientifically known to be accomplished by employing statistical methods. However, this thesis is not concerned with this aspect, instead, it attempts to investigate the role of hypothesis testing in an entrepreneurial context, i.e. concerned with validating market opportunities through qualitative methods such as customer interviews (York & Danes, 2014).

Based on empirical evidence, use of experimentation is mostly significant for development of products in uncertain situations, that in the industrial setting (Brown & Eisenhardt, 1995; Olausson & Berggren, 2010). However, uncertainty and complexity levels are greater in the entrepreneurial

environment contra large organisations due to limited resources (Busenitz & Barney, 1997). Also, with the presence of bounded rationality and heuristics and biases, the entrepreneurial decision-maker is assumed to benefit from experimentation in terms of validating alternatives. For these reasons, the impact of experimentation is anticipated to be greater in entrepreneurship. Moreover, this sub-section attempts to investigate the impact of applying an experiential approach to the entrepreneurial process.

Since entrepreneurs are defined as individuals who try to develop something new, the success rate would naturally be low, given that it's the first trial. Therefore, to develop successful businesses, entrepreneurs are obliged to experiment their way towards success (Barringer & Ireland, 2012). Kerr et al. (2014) state the following: *"entrepreneurship is essentially about experimentation because the knowledge required to be successful cannot be known in advance or deduced from set of first principles"* (p. 25). In turn, gaining knowledge provides financial efficiency due to the ability to determine whether to continue, alter or terminate development based on the achieved results (Kerr et al., 2014).

The Lean Startup encourages experimentation and learning by creating simple prototypes or so called Minimal Viable Products (MVPs) that aim to test hypotheses and detect entrepreneurial opportunities. Through use of Build-Measure-Learn loop, entrepreneurs can process their ideas or prototypes efficiently. This three-stage cycle is employed to validate assumptions that entrepreneurs develop throughout the development process. The cycle begins by building ideas into testable items, in the form of hypotheses or MVPs. Thereafter, introducing them to customers, and by using qualitative techniques, measure customers' feedback. Following this, the collected information can verify whether the initial hypotheses were true of false, and based on this, build new ideas for the next iteration (Trimi & Berbegal-Mirabent, 2012). This way, entrepreneurs develop products or services that are purely directed towards customer needs. Thus, reducing non-value adding features (Kerr et al., 2014; Trimi & Berbegal-Mirabent, 2012). MVP testing originates from the customer development process that was initially introduced by Steve Blank (Blank, 2013; Trimi & Berbegal-Mirabent, 2012).

2.3 Visualisation

According to Lurie and Mason (2007) the use of graphic displays provides decision-makers with the ability to identify and detect patterns that are usually difficult to observe through statistical methods. In turn, this can improve decision-making. However, it can also hamper it by highlighting non-value adding data (Lurie & Mason, 2007). This sub-section reviews the literature on visualisation concerned with understanding and communicating information.

Visual Management (VM) is the broad term found in the literature that encompass other common terms such as visual controls, visual tools, visual communication, shop floor management, and visual factory (Liker, 2004; Liker & Morgan, 2006; Neese, 2007; Parry & Turner, 2006; Tezel et al., 2016). VM strategies address the use of visual aids to increase accessibility and flow of information in work environments (Tezel et al., 2016). Bititci et al. (2016) state that *"visualisation concerns the representation of data, information and knowledge in a graphic format which is conductive to acquiring insights, creating a vivid picture, developing an elaborate understanding or communicating experiences"* (p. 1573). Based on Bititci et al. (2016), incorporating visual displays to support communication introduces three main benefits in the following areas: *cognitive*, facilitate analysis, remembrance and comparisons; *social*, facilitate mutual understanding and coordination; and *emotional*, enhance involvement and interaction. Other advantages of applying visualisation are improved transparency, increased accountability and ownership, and support of continuous improvement (Bititci et al., 2016). Despite these benefits, visual tools are not risk-free. For instance, they may contain risks such as misinterpretation of visual displays or denial of information. In order to avoid these risks, the designing aspect is considered crucial (Bititci et al., 2016).

2.3.1 Visualisation in Manufacturing

Liker (2004) states visual tools as: *"any communication device used in the work environment that tells us at a glance how work should be done and whether it is deviating from the standard"* (Liker, 2004, p. 169). In TPS and lean manufacturing, use of visual controls is common on the shop floor level as well as to support other management functions, such as development processes (Liker, 2004). Parry and Turner (2006) point out that due to challenges with communication, information flow can be affected, which in turn might affect the operation of processes. Thus, visual controls are considered necessary to facilitate communication across functions in lean manufacturing companies (Parry & Turner, 2006). Initially, visual controls are used to support the Just-In-Time principle that emphasises flow in operation processes (Liker, 2004). Moreover, visual controls can represent a variety of tools such as posters, graphs, drawings, sketches, and even audio signals (Parry & Turner, 2006).

Improvement of communication on shop floor level brings forth numerous benefits that increase productivity in operations. For instance, use of visual tools improves transparency in processes, which again helps detect deficiencies and deviations from standards. By applying simple tools such as 5S, remarkable benefits can be achieved. This tool consists of the following phases *Sort*, *Simplify*, *Sweep*, *Standardise* and *Self-discipline* (Liker, 2004; Parry & Turner, 2006). Also, interactivity and collaboration between individuals can be enhanced through visualised meetings; hence, this enables

creative contributions by sharing different interpretations from working individuals (Henderson, 1991; Kimbell, 2014).

Although research states that application of visualisation tools stimulates information processing in development process Lindlöf (2014), and facilitates decision-making Lurie and Mason (2007), insufficient literature is found discussing the use and impact of visualisation in entrepreneurial processes. Not to mention, Lindlöf (2014) states that use of visual tools is somehow undervalued in the management research field. Tezel et al. (2016) also point to the lack in empirical research on VM. Hence, these literature gaps are highlighted by applying a visual tool during the development of a market opportunity.

2.3.2 Information Processing

Lindlöf (2014) presents a general definition of information processing in relation to communication as: *"gathering of data, transformation of data into information and the communication and storage of information in the organisation"* (p. 11). Moreover, information processing is found to be a viable method that can be employed to manage uncertainty, and is therefore utilised in development processes. According to Lindlöf (2014), accessibility of information is often not the main obstacle, but rather internal transfer of required information within an organisation. Thus, the underlying purpose of information processing is to communicate critical information to decision-makers.

As previously mentioned, Lindlöf (2014) states the common use of visualisation to facilitate the information processing capability. In this setting, the *Obeya* visual tool is proposed to enhance this capability (Appell, 2011; Lindlöf, 2014). Hence, this visual tool is employed to investigate its ability to represent information in development processes. However, instead of investigating the impact of this tool in manufacturing industries where it originates from, this research employs the *Obeya* tool to the entrepreneurial context that operates outside the boundaries of established organisations.

2.3.3 Obeya tool

Obeya, also spelled *Oobeya*, is a Japanese word that translates to "Big room", this tool is commonly described as a meeting room that utilises simple visual tools to support effective decision-making and problem-solving during development processes (Aasland & Blankenburg, 2012; Appell, 2011; Flinchbaugh, 2016; Jusko, 2016; Liker, 2004; Liker & Morgan, 2011). *Obeya* was first introduced by Toyota's chief engineer, Takeshi Uchiyamada in the 1990s while working on the G21 project, which developed the first generation of Prius cars. As Takeshi lacked the necessary authority to make decisions that required approval from other managers, he faced limitations related to the project's

progress. To solve this issue, he created the *Obeya* tool to serve as a venue that gathers managers with decisive authority in a meeting room. As the G21 advanced, this tool was proven effective, and was adopted as a standard tool of the Toyota Product Development System (Aasland & Blankenburg, 2012; Hoppmann, Rebentisch, Dombrowski, & Zahn, 2011; Liker, 2004; Morgan & Liker, 2006).

In contrast to the *Obeya* tool, meeting rooms have similar purposes. In short, a meeting room is identified as an arena that gathers people for a specific purpose (Fast-Berglund, Harlin, & Åkerman, 2016). Such purposes include information sharing, coaching, brainstorming, problem-solving, decision-making, and interaction (A. Allen, Beck, W. Scott, & G. Rogelberg, 2014). Despite these clear similarities with the *Obeya* tool, the apparent difference is the focus on use of visual tools to display information. According to Liker (2004), use of visual tools can facilitate understanding of complex ideas. In addition, Liker and Morgan (2011) emphasise that the use of visualisation tools is necessary to enable individuals to work effectively, which is only possible when problems are made visible along with use of problem-solving methods. Based on certain findings, the authors conclude that the *Obeya* tool is one of the most effective in this context (Liker & Morgan, 2011). Figure 3 illustrates an example of an *Obeya* room.

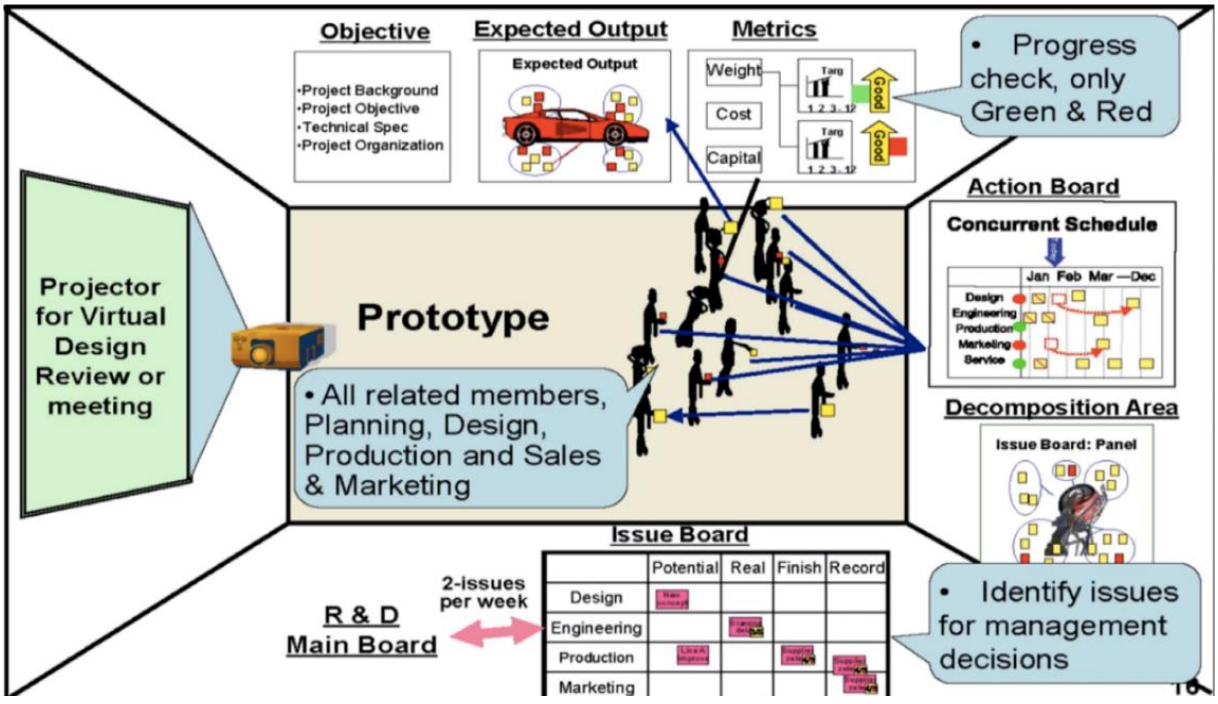

Figure 3: Example of Obeya, retrieved from ("Obeya [Image]," 2014)

Liker (2004) describes the actual *Obeya* as a large conference room that consists of different visual management tools presented on the walls that serve two main purposes, i.e. information management and real-time decision-making. The tools used in the *Obeya* consist of various design graphics,

progress boards with current and target status, quality information, Key Performance Indicators (KPIs) and financial status (Liker, 2004). Other relevant information is displayed in form of charts, graphs and tables (Jusko, 2016). The content of the displays is updated on constant basis by responsible individuals from different functional areas, and only key information is displayed (Appell, 2011; Liker, 2004).

Jusko (2016) describes *Obeya* as a process that consists of the following stages: first, collected information is combined or broken down into more accessible elements; second, analyses and sorting of key information; and finally decisions are taken (Jusko, 2016). An important element of the *Obeya* tool is problem-solving methods, i.e. PDCA learning cycles (Appell, 2011; Liker & Morgan, 2011). The PDCA cycle consists of four main stages: identify the problem through root-cause analysis; create an action plan with countermeasures; implement the plan and check the effects; and finally, learn from the results achieved and further implement valuable information into new PDCA cycles (Liker & Morgan, 2011). Flinchbaugh (2016) states that both the displays and content used must be improved until the appropriate foundation is achieved to enable decision-making and problem-solving.

Aasland and Blankenburg (2012) present two important properties of the *Obeya* tool that promote efficiency. First, *quick decision-making*, fast and accurate decisions are made as cross-functional managers review matters collectively, and take real-time decisions (Jusko, 2016; Morgan & Liker, 2006). Additionally, this benefit shortens PDCA cycles (Andersson & Bellgran, 2009). Second, *reduction in irrelevant discussions*, this factor points out that concise discussions are crucial to eliminate non-value adding discussions (Aasland & Blankenburg, 2012). Other benefits of applying *Obeya* is that *transparency* of processes can be achieved. This in turn exposes hidden deficiencies or deviations from standards; thus, enables decision makers to tackle challenges immediately (Flinchbaugh, 2016; Liker, 2004). Another important feature of this tool is its ability to *drive accountability* among participants, this is obtained by assigning responsibilities to responsible individuals along with an expected due date (Liker & Morgan, 2011). Last, from a collaborative point of view, the *Obeya* tool obligates individuals to *engage*, *interact* and *communicate*; thus, improves synergy and enhances collaboration and ownership (Appell, 2011; Jusko, 2016). Empirical evidence that reflects the benefits of applying the *Obeya* tool in different industrial settings can be found in the literature (Andersson & Bellgran, 2009; Appell, 2011; Javadi, Shahbazi, & Jackson, 2012). On the contrary, Liker and Morgan (2011) point to several challenges concerned with utilisation and choice of displayed content in the *Obeya* room. However, the authors do not consider these challenges as disadvantages, but rather as opportunities for further research.

Based on the above-mentioned advantages, this study attempts to test whether these benefits can support the information processing ability in an entrepreneurial development process to effectively achieve decisions.

2.3.4 Developments of Obeya

As an improvement measure, some literature emphasises the need to convert the traditional *Obeya* into one using digital aids (Fast-Berglund et al., 2016; Jusko, 2016; Terenghi, Kristensen, Cassina, & Terzi, 2014). Other authors urge researchers to investigate the degree of improvement digital tools might bring to *Obeya* (Liker & Morgan, 2011). Terenghi et al. (2014) point out to the following limitations in *Obeya,* lack of real-time data update, difficulty of participation for individuals present elsewhere, and limitation of space i.e. being bounded to one room. Furthermore, the authors present a combination of web applications to tackle these challenges (Terenghi et al., 2014). Additionally, Fast-Berglund et al. (2016) consider use of the *iObeya* tool, which is similar to the traditional *Obeya* in function; however, it relies solely on digital visual tools (Smart Boards) to display information (Fast-Berglund et al., 2016). In contrast, Parry and Turner (2006) state use of digital tools as unfruitful, they relate this statement to difficulties in displaying large amounts of information concurrently using electronic screens. Hence, this limitation will discard the visual advantage found in the conventional *Obeya* room (Parry & Turner, 2006).

2.4 Guidelines in Practice

This sub-section presents relevant underlying rules applied to support the utilisation and design of the *Obeya*. As previously mentioned, the literature does not provide sufficient information on applying the *Obeya* tool or other visual tools in an entrepreneurial context. Thus, the applied rules are retrieved from manufacturing industries that apply visual tools to facilitate communication. Although, the level of abstraction and context are different, these guidelines are considered relevant as they are universal; hence, they are used as a reference point.

Liker (2004) presents general guidelines that Toyota uses to achieve efficient meetings. First rule, identify clear objectives before the meeting is held. It is also important to have a clear agenda focused on the tasks and deliverables to be achieved. Second rule, invite the right individuals to the meeting. Third rule, states that participants should be well-prepared for the meeting, i.e. they need to be informed about the objectives and agenda in advance. Fourth rule emphasises active use of visual tools during the meeting. Fifth rule, states that the meeting should focus on problem-solving and

decision-making; hence, information sharing should be kept to its minimum during the meeting to increase efficiency. Last rule, stresses punctuality in start and end times (Liker, 2004).

Moreover, Bateman, Philp, and Warrender (2016) developed an approach that consists of principles to help manage and enhance design of visual tools on shop floor level. *First* principle emphasises use of suitable graphical tools to express the displayed data, i.e. use of graphs, sketches or tables when appropriate. *Second* principle points out that use of colour should be made moderate, suggesting only to highlight important elements. *Third* principle considers how data should be presented to enhance understanding, the principle proposes use of two and three dimensional displays, animation and colour to highlight data. *Fourth* and last principle addresses the number of displayed elements as well as the flow of data. The principle does not advice use of more than seven separate elements, and emphasises organising information logically to achieve flow (Bateman et al., 2016). Moreover, Tezel et al. (2016) present three parameters that must be considered prior to employing visual aids in an organisation. These include evaluation of: organisational readiness, in terms of building an overarching strategy; contribution to system objectives; and compatibility with ergonomic design principles (Tezel et al., 2016).

Regarding the set-up of the *Obeya* room, few literature findings provide an elaborative description. Appell (2011) indicates that the *Obeya* tool enables development plans to be completed through PDCA cycles. Also, Jusko (2016) describes the *Obeya* as a process comprised of three stages similar to the PDCA cycle (Jusko, 2016). Maskell (2012), on the other hand, provides a more definite set-up of the *Obeya* room that follows the Plan, Do, Check, Act sequence. Such order can contribute to enhance understanding based on the approach by Bateman et al. (2016). Each stage is represented on one of four walls in a meeting room. The first wall, *Plan* serves the purpose of illustrating the overall strategic plans of the organisation, it also displays the improvement plans for each process as well as current operational and financial projections. The second wall, *Do* illustrates the main activities carried out to achieve the plans set in the previous stage. Such activities refer to problem-solving and planning tools. The third wall, *Check* previews all the current results, i.e. the status and outcomes of every initiative. The last wall, *Act* shows the countermeasures that each task or issue is awarded to improve the *Obeya* tool, these are prioritised and assigned to each participant. The tasks remain on the wall until they are completed (Maskell, 2012). Figure 4 illustrates the *Obeya* set-up in an iterative cycle with each element representing a wall. According to Trimi and Berbegal-Mirabent (2012), the Build-Measure-Learn loop is a modernised version of the PDCA. This statement supports the implementation of this set-up approach in the *Obeya* room.

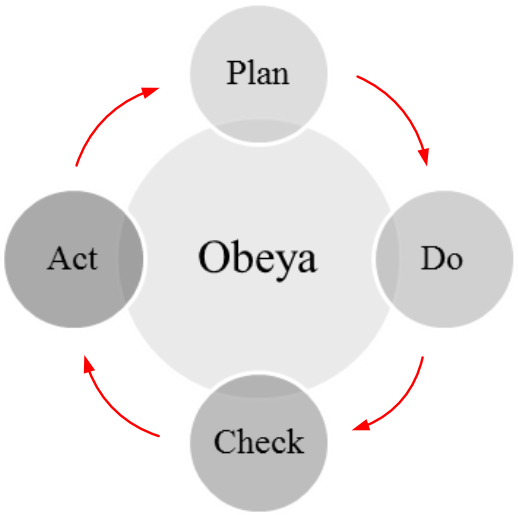

Figure 4: PDCA loop

2.5 Visualising During Entrepreneurial Processes

The following sub-sections attempt to utilise the theoretical findings from the previous sections to create and adapt the *Obeya* tool in practice. As mentioned earlier, this research aims to investigate whether the application of *Obeya* will enhance entrepreneurial decision-making through improving the information processing capability.

2.5.1 Design of Obeya Tool

Several modifications are required to adapt the *Obeya* visualisation tool from the manufacturing to the entrepreneurial context. Not to mention, the tool is applied to the early stages of the development process, which may vary greatly compared to other stages throughout an entrepreneurial process. These variations are considered greatest in terms of displayed content and applied methods, as rules and design principles are assumed to be relatively similar in both settings. For instance, due to lack to information in the early stages of development, the entrepreneurial process will not be display quality information or operational status. Moreover, the *Obeya* room is created with low functionality, and is adapted to the start-up process that follows the Lean Startup and Running Lean. Hence, displayed content is related to the activities inherent in the development process and the employed market opportunity. Nonetheless, the purpose of this initial *Obeya* room is to simply initiate the learning loop (PDCA), and through multiple iterations, this tool can be improved based on the detected needs.

Plan

The *Obeya* is initiated from the Plan wall, which has the purpose of displaying the overall strategic plans of the working team. These plans are illustrated in TPS house, process map of Running Lean,

workshop schedule plan, and an overall schedule plan. The TPS house is used to represent the underlying values and principles defined by the working team with the purpose of employing a new culture based on the one found in TPS (Liker & Morgan, 2006). The main pillars consist of Kaizen, to assist the team in continuous improvement; Just-In-Time, to support flow of information; and Jidoka, to increase transparency and detect deviations. Furthermore, the process map is used to illustrate the main stages and sub-processes of the Running Lean process, this supports transparency and understanding, see Figure 2 on pg. 7. Moreover, two different schedule plans are included to provide participants with an overview of the objectives and issues that will be undergone in each session. The first schedule presents a milestone plan that spans over the whole thesis period. While the second plan is a detailed schedule for every workshop to maintain a high degree of precision. This, reflects the meeting rules presented by Liker (2004). Figure 5 illustrates the designed *Obeya* room.

Now that the elements of the wall are described, the method of function can be explained. Following the sequence of the process map, a single sub-process or one of its underlying activities are picked to be processed to the next wall. This supports the single-piece flow principle common in TPS, i.e. to have small batch sizes of 1 unit (Arnheiter & Maleyeff, 2005). Also, this will help shorten the time it takes to run the PDCA cycles as well as help bring problems to surface; and hence, implement improvements (Liker, 2004; Liker & Morgan, 2011).

Do

On the Do wall, action plans are prepared based on the activities from the Running Lean process. This is achieved by use of various planning tools. As mentioned above, this thesis follows the Running Lean process, starting from Stage 1. For this stage, the preliminary tools considered useful are brainstorming, use of lean canvas, and customer interviews. Lean canvas, is an adaptation of business canvas by Alex Osterwalder, which is a single business plan document that is introduced in the Running Lean process (Maurya, 2012). From the Plan wall, a specific sub-process or activity is forwarded for processing. Depending on the issue faced, one of the planning tools can be used.

After processing each activity, one person is assigned the responsibility of completing the required task, if applicable. This helps increase accountability. For instance, the issue of *"conduct problem interview"* can be forwarded from the Plan wall to the Do wall. Through interviews, the participants can collect data to answer the pre-defined hypotheses.

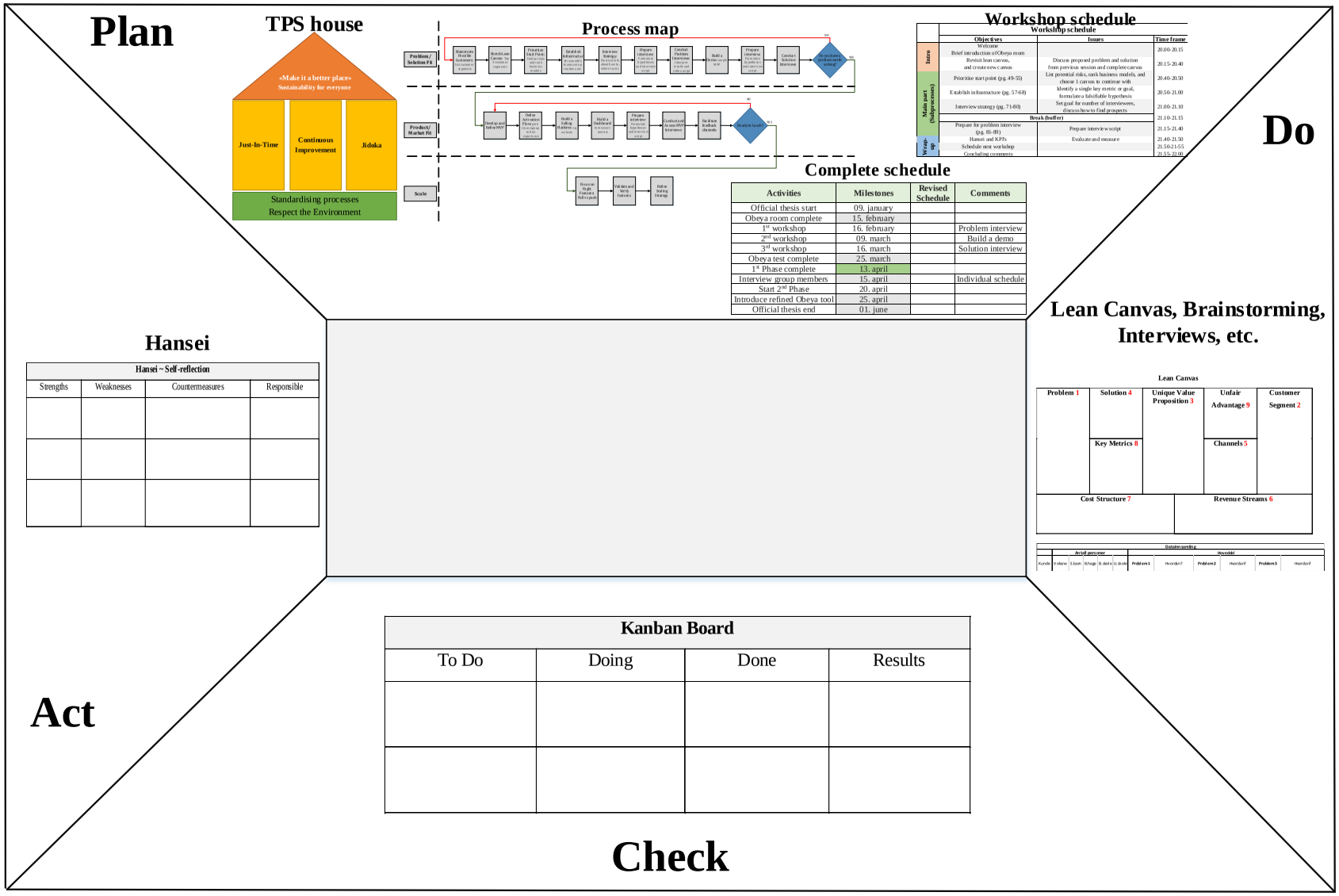

Figure 5: Obeya illustrated

Check

The Check wall servers the purpose of visualising all the current results and issues in queue. This is achieved by listing the status and outcomes of every activity, a simple Kanban board is used for this purpose (Maurya, 2012). By using post-it notes, the processed issues are attached to their related containers, which are To-do, Doing, Done., and Results. The results are documented against the desired targets. From the previous example, the *"conduct problem interview"* activity is written on a post-it note and positioned on the To-do area, until its status changes.

Act

The last stage in this iteration is the Act wall, here countermeasures are made to enhance the *Obeya* tool and improve the flow of processes. This is achieved through use of Hansei, a principle built on acknowledgment of weaknesses and mistakes in order to continuously improve the *Obeya* room (Liker, 2004). Every iteration will allow the improvement of the *Obeya* tool based on real-time feedback. The table consists of, Strengths, Weaknesses, Countermeasures, and Responsible.

2.5.2 Limitations in Obeya

There are several limitations or weaknesses in the designed *Obeya* room. This statement is based on the following assumptions. *First*, the *Obeya* tool is developed to suite the development process in an entrepreneurial context instead of a manufacturing setting. Hence, this eliminates the need to have certain visual tools in the early stages of development, such as operational status. On the contrary, this creates the need to make certain adaptations to only display information that adds value (Parry & Turner, 2006). Such adjustments may have uncertain outcome on the process and are therefore considered as a weakness. *Second*, only few literature findings addressed the design perspective of the *Obeya* tool; hence, developing a functional room is difficult, different areas of literature were considered to fill this gap. *Third*, one major drawback of applying the *Obeya* is that it needs time to mature until the necessary key information can be displayed (Appell, 2011; Flinchbaugh, 2016; Liker, 2004).

2.5.3 Technical Description

The adapted *Obeya* is a 3x3 m^2 sized room with eight white boards in different sizes and two flip overs. The hanging white boards can be easily removed or reorganised. Participants stand in the middle zone and rotate from wall to wall as described in the previous sub-section. Post-it notes and markers of different colours are used. Most of the white boards are left empty prior to start of workshop sessions to provide writing space. Figure 6 illustrates the utilised *Obeya* room.

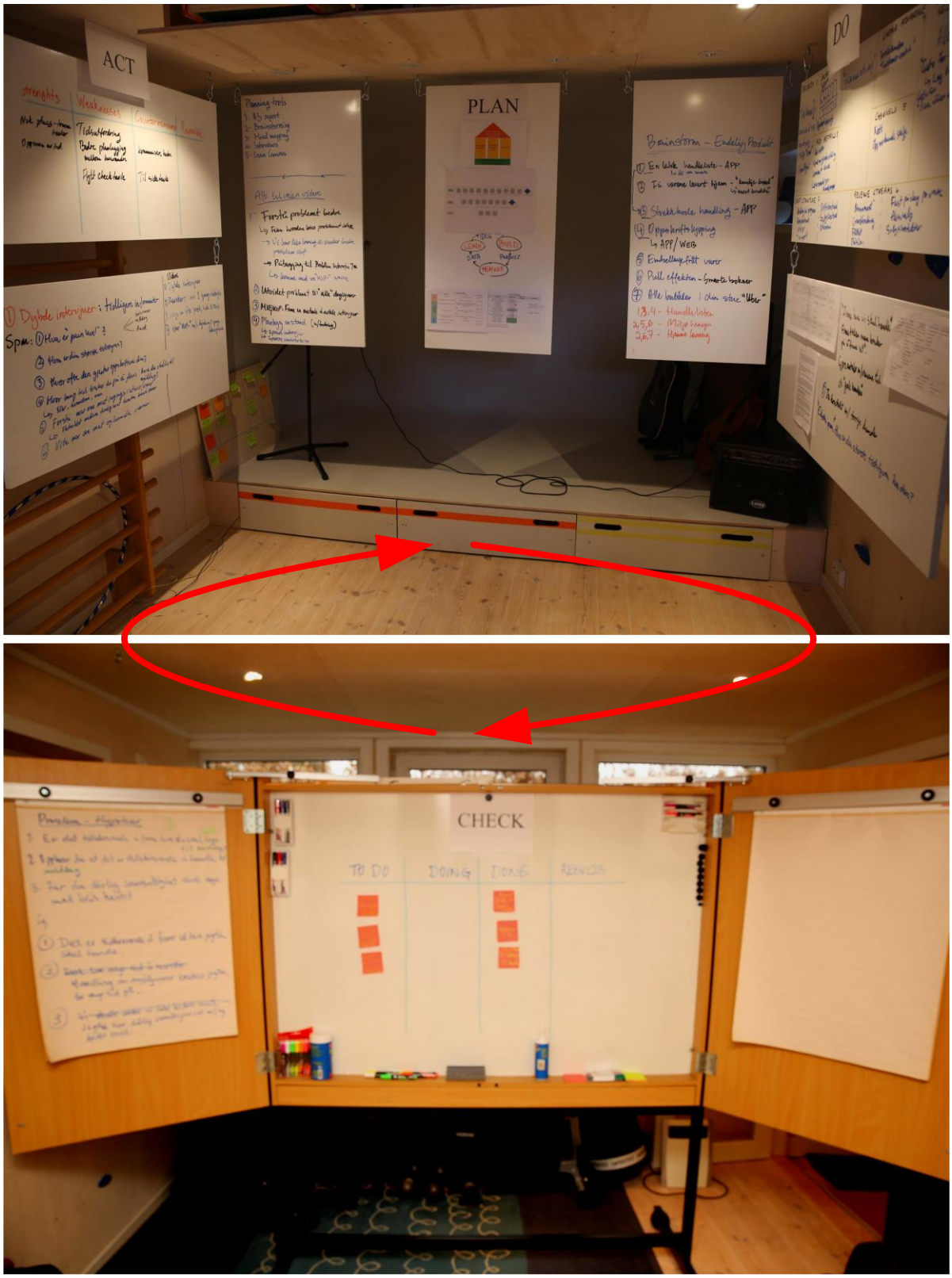

Figure 6: Obeya in practice, images retrieved after completion of 2nd workshop.

2.6 Research Model

After several iterations of modifying the above presented literature, the researcher establishes the research model, which is further used as a research guide for the remainder of this thesis. Hence, the purpose of this section is to describe the developed research model. Based on the theoretical findings and the detected literature gap, four variables, visualisation, experimentation, information processing and market uncertainty, are identified in relation to decision-making. Figure 7 illustrates this model.

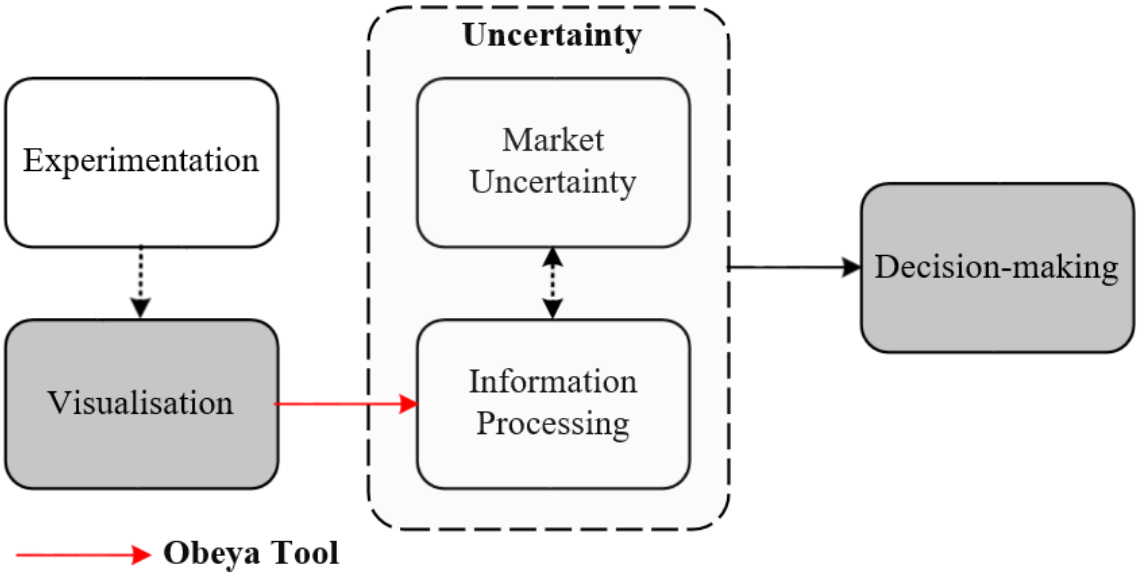

Figure 7: Research Model

In reference to the research question, decision-making and visualisation are highlighted as the main variables in this study. As illustrated in Figure 7, decision-making is influenced by four underlying variables. Based on the theory, uncertainty consists of market uncertainty and information processing that both impact decision-making. These variables are presented with a two-sided arrow to highlight their interrelated relationship. Visualisation, on the other hand, is connected to both experimentation and information processing. As presented in the literature, visual tools can stimulate the information processing ability in uncertain and complex environments (Lindlöf, 2014). Whereas, experimentation is used to validate information in order to make decisions on more complete basis (Blank, 2013; Kerr et al., 2014; Ries, 2011). Also, experimentation provides flexibility in terms of altering the development path, decreasing financial losses (Kerr et al., 2014). The *Obeya* tool is represented as the link between visualisation and information processing, based on its ability to visualise information and enhance decision-making (Liker, 2004). Also, this represents that the *Obeya* is merely a tool, and that other tools can be used to achieve the same purpose. Hence, this research model illustrates how the *Obeya* tool, in theory, will facilitate entrepreneurial decision-making through improving the

information processing capability. The empirical part of this research attempts to investigate this statement in practice.

Moreover, several literature gaps have been identified throughout the theory chapter. The identified gaps are considered in relation to the entrepreneurial context. These gaps indicated that only few empirical research apply visual tools, and no literature presents the application of the *Obeya* tool to this context. Also, few literature findings describe setting up the *Obeya* tool in practice, this is in relation to both manufacturing and entrepreneurial contexts. Hence, this thesis attempts to investigate these gaps by adapting this tool to the development process of a market opportunity. Additionally, this thesis attempts to employ the practices inherent in the Lean Startup method and Running Lean process to investigate their impact on decision-making. That is, these methods claim to reduce the negative aspects of heuristics and biases by validating hypotheses and gathering information. These benefits are particularly crucial in entrepreneurial environments as uncertainty and complexity levels are higher. The following chapters present the employed research process, empirical findings, and finally discussion of the findings.

3 Methodology

The aim of the methodology chapter is to determine which methods will be used to empirically answer the research question. Hence, this section states the selected research design, presents the applied case, and demonstrates how the collection and analysis of data were conducted. The chosen research strategy merges two designs, action research and case study research, to answer the research question proposed in this thesis. Table 1 sums up the main elements of this chapter.

Table 1: Research Methodology, layout inspired from (Bititci et al., 2016)

Research Question	How can employment of *Obeya* impact decision-making in an entrepreneurial context?
Research Design	Action research and case study research.
Research Role	The researcher had two main roles, being a participant in a case study with workshops and meetings, and then assessing the data collected from an external standpoint as an observer.
Sampling Strategy	Snowball and convenience sampling.
Number of Cases	One single case. The case, consists mainly of three group meetings, and two workshop sessions that apply the *Obeya* tool.
Data collection	Qualitative data collected through semi-structured interviews (five informants) and diary notes (workshops). Interview guide based on research model, research design and selected sampling strategy.
Data Analysis	Content analysis through deductive and inductive coding
Supplements	NVivo Pro applied for data analysis

3.1 Research design

Easterby-Smith et al. (2015) state that a *"good research design is fundamental to achieving high-quality research"* (p. 8). With a research design, the researcher can determine which methods are necessary to gather and analyse data, as in what data to collect, how to and where from. This implies the importance of deciding upon a research design prior to data collection as each method requires different strategies of gathering data, which in turn influences the analyses and findings. Based on the scope of this thesis, the research designs considered most suitable prior to data collection were action research and case study research (Easterby-Smith et al., 2015).

Action research was first introduced to social sciences by Kurt Lewin (1948), and is broadly defined as an approach in which both the researcher and client or group of individuals participate in identifying

the problem and development of solution. Thus, the researcher adopts two roles, to participate in the research with the ability to either influence or get influenced, whereas, the second role is to evaluate the findings made throughout the process. Action research is often utilised over a matter that concerns the participants; hence, client involvement is crucial to achieve solutions (Bryman & Bell, 2007; Easterby-Smith et al., 2015). Based on these findings, action research was adopted as it enabled the researcher to take part in the experiment with participants' involvement. Moreover, this provided the researcher with direct access to the study object and ability to retrieve valuable insights through participation. The choice of action research is justified by the detected need to facilitate decision-making in the development process of a business idea, and the personal desire of the researcher to apply theory in practice. The identified need is further elaborated in the following section: Case.

Case study research, on the other hand, is designed to investigate single or multiple cases over time to detect relationships between collected data and research questions. Robert Yin is considered the founder of this research method. Participant observation and interviewing are two qualitative methods considered useful in case study research as they enable researchers to retrieve in-depth data of specific cases (Bryman & Bell, 2007; Easterby-Smith et al., 2015). The choice of this method is justified by its compatibility with action research, and ability to individually examine a single object in detail (Bryman & Bell, 2007; Easterby-Smith et al., 2015). In this thesis, the established case study is based on a series of meetings and workshops that aim to develop a start-up business with the involvement of the researcher as a participant.

3.2 Case

The purpose of this section is to provide an overall understanding of the case applied in this research. The case study in this context refers to the activities held within the early phase of a start-up development process.

The case incorporated in this thesis stems from the growing trend of digitising the grocery shopping industry in means of offering online services, such as home delivery of grocery products to consumers. In Norway, such services can be divided into two main categories targeting the consumer sector, providers of daily grocery products and providers of whole meal ingredients. Statistical findings indicate that the demand for such services is constantly growing each year. These services provide consumers with the leisure of flexibility and comfort (Kjuus & Flaaten, 2015). Based on this brief description, the underlying idea is to develop this market opportunity, i.e. online daily grocery service, to a start-up business. In order to successfully achieve this goal, the Lean Startup method and Running Lean process are implemented to facilitate the development process (Maurya, 2012; Ries, 2011).

Moreover, the objective is to follow the process map of the Running Lean during this thesis, reference Figure 2 on pg. 7.

The case study is divided into three main phases. *First phase* consisted of four meetings that were held between the researcher and the external supervisor prior to the official start of this research. These meetings discussed the application of the Lean Startup method and Running Lean process to facilitate the development process of the online grocery idea. Meanwhile, the *second phase*, which was initiated shortly after the first phase, intended to conduct group meetings with two other participants. Hence, four participants were involved in this start-up, including the researcher. Table 2 provides an overview of the participants. The aim of group meetings was to introduce the concept and initiate the development process. The *third phase* presented in this case is the one of most interest for the thesis, namely, the workshop sessions in which the researcher introduced the adapted *Obeya* visualisation tool. Figure 8 illustrates the phases in an iterative process, phase 1 and 2 are both considered preliminary phases that led to phase 3.

Table 2: Sample, participant overview

Participant	Initials	Industry	Relevant Experience	Knowledge of Lean Startup & Running Lean
Researcher	AA	-	-	Yes
A	JS	Construction	Lean, Project and Engineering Manager	Yes
B	MHF	Newspaper	Entrepreneur, Lean and Project Manager	Yes
C	SJ	Construction	Lean, Purchasing and Logistics Manager	Yes

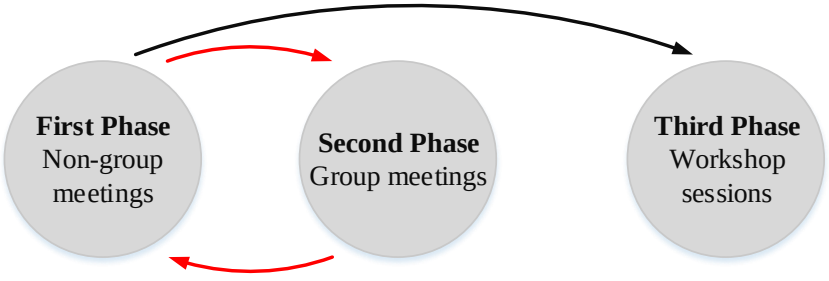

Figure 8: Phase overview

Although the participants followed a systematic process and had good knowledge of the concept, the development process was not very effective due to lack of routines and decision-making procedures. This issue was identified in the first group meeting and it triggered the need to find solutions that could increase the efficiency of the development process. In search for a process or tool that encompasses these necessary features, the *Obeya* visualisation tool was identified as suitable for this purpose.

Moreover, the researcher's task was to adapt this visual tool to the entrepreneurial context of this development process as well as create an environment that was supported by good routines. This case study is particular relevant as both variables, experimentation (Lean Startup and Running Lean) and visualisation (*Obeya* tool) are tested in practice.

3.2.1 First and Second Phase

As mentioned earlier, four meetings were held between the researcher and the external supervisor, during which group meetings were simultaneously initiated. Both phases contributed in identifying the business concept and the research scope of this thesis, i.e. to facilitate decision-making within this entrepreneurial process. The group meetings held prior to the workshop sessions contributed to improve common understanding of the process and established a common culture based on similar values and practices inherent in TPS. The TPS house presented on the Plan wall was created to support presence of an overarching strategy, see Figure 5 on pg. 20. It is also important to note that participants were well-acquainted with TPS. Table 3 presents an overview of the dates and duration of each session.

Table 3: Overview of phase schedule

First Phase – Meetings	**Duration**	**Second Phase – Meetings**	**Duration**	**Third Phase – Workshops**	**Duration**
26.08.2016		08.09.2016	2 hrs 30 mins	16.02.2017	2 hours
22.09.2016	2 hours each	01.12.2016	2 hours	24.03.2017	2 hrs 15mins
09.10.2016	meeting	12.01.2017	2 hours		
23.10.2016					

3.2.2 Third Phase

The last phase of this case focused on applying the visualisation tool to the development process, this was achieved by conducting two workshops sessions. The workshop sessions followed the sub-processes of Stage 1: Problem/solution fit, in reference to Figure 2 on pg. 7, which consisted of all the activities up to *"conduct problem interview"*. To highlight achievements from the *first workshop*, the participants completed one lean canvas (business canvas), whereas, another lean canvas was created during the previous group meetings. From two lean canvases, one was forwarded to the next sub-processes. Based on the canvas, participants established "testable" hypotheses of the problem during the preparation of interviews. These problem hypotheses were the following: it is time consuming to

figure out what to buy; grocery *shopping* is something that I spend much time on; I have bad conscience when I *throw food*. Each hypothesis focuses on the italicised phrases. Moreover, the researcher and participant A were responsible of conducting customer interviews, from fifteen informants, seven accepted to be interviewed. Each interview varied from 10-15mins, these were face-to-face spontaneous interviews held at the door step of interviewees residence. Furthermore, the collected data was sorted and discussed in the *second workshop* session. The results pointed to the first hypothesis as the most frustrating for the customer, whereas, hypothesis 2 was ranged second, and the third hypothesis was least problematic for customers. The data findings improved participants' understanding of the problem, however, the need to retrieve more data was acknowledged as the data basis was poor. Therefore, participants decided to conduct additional problem interviews, with both new candidates and previously interviewed informants. The following steps, yet to come, after conducting more problem interviews, is to arrange additional workshops in which participants evaluate whether to proceed with the development of this market opportunity, alter or terminate it. The next sections present the collection and analysis methods adopted in this thesis.

3.3 Data collection

Following the guidelines by Easterby-Smith et al. (2015), the next stage was to determine how and what data to collect. Two qualitative research methods are adopted to collect data, participant observation and interviewing. Moreover, the underlying data collection methods are writing diary and semi-structured interviews.

Qualitative research methods unlike quantitative ones are more explorative in nature, and allow researchers to ask open-ended instead of structured questions to get an in-depth understanding of the research. Application of such qualitative research methods was considered most appropriate due to the nature of this thesis, where most of the gatherable data is in a non-numeric form. From several types of observational research, the most suitable for this thesis was participant-as-observer. In this type, participants of the research are aware of the researcher's role as an observer in the study. Participant-as-observer was selected as it allows the researcher to take part in the research. Also, the participant role is closely associated with diary writing, which is chosen as a data collection method (Easterby-Smith et al., 2015).

Moreover, the researcher adopts two data collection methods, semi-structured interviews and writing a diary. Semi-structured interviews were selected mostly as they are suitable for action research design and qualitative research in general. On the other hand, diary method as in writing field notes was

selected as the most applicable in this context due to participation of the researcher in the study. Hence, writing diary notes based on the observations was most convenient (Easterby-Smith et al., 2015).

Data collection is divided into three different stages that apply different methods. The *first stage* relied on writing diary to collect data from the workshop sessions. In the *second stage*, the researcher interviewed the two participants of the case study using semi-structured interviews, the third participant was not interviewed due to missing both workshop sessions. The *third stage* also relied on semi-structured interviews; but, instead of interviewing participants of the case, three external informants were interviewed to retrieve an independent source of data, in order to seek various point of views with relevant insights. Thus, the grounds of data collection in this thesis consist of five interviews along with diary notes. Figure 9 illustrate these stages visually.

Figure 9: Data collection process

3.3.1 First Stage – Meetings and Workshops

Several meetings were held prior to initiating the workshop sessions, this aligned participants understanding of the case and created a suitable working environment where participants became acquainted with one another. Through these meetings, the participants refined the business idea mainly through discussions and brainstorming, flip overs, post-it notes and white boards were also used. Moreover, meeting protocols were written and shared between participants. At the time these meetings were conducted, the researcher was not yet aware of how these meetings would influence the research topic. Hence, only few notes were taken in addition to meeting protocols.

The workshop sessions, on the other hand, were well-planned by the researcher. Although, the researcher had no prior experience related to conducting workshops of this kind, being acquainted with the participants helped create an informal environment, which facilitated the workshops. The purpose of the workshops was mainly to create an arena were participants could gather and utilise the *Obeya* visualisation tool by following the Running Lean process, reference Figure 2 on pg. 7. Additionally, several guidelines were adopted to support the workshop sessions, reference Guidelines in Practice on pg. 16. The researcher's objectives from these workshops was to observe how visualisation influenced the decision-making ability. More specifically, observe how the variables of

visualisation and information processing changed in comparison to the group meetings that did not employ this visual tool along with the meeting rules.

Moreover, the researcher oversaw all the aspects related to arranging the workshops, and had the role of leading the sessions. Hence, the researcher had the role of being the workshop facilitator, participant, and observer. Both workshops lasted for around 2 hours, and a total of three participants attended the sessions, one of the participants was not able to attend on both occasions. In both sessions, the pre-defined objectives were achieved, and the researcher could test the *Obeya* tool in practice. As the researcher led the workshops, writing notes during the workshop was not possible. Hence, most of the notes were written after the workshop. In addition, pictures of the white boards were taken as a form of documentation. The collected diary notes were further sorted and re-written before being used in the data analyses, these field notes included the personal reflections of the researcher. Appendix 3 and Appendix 4 present the workshop schedules along with few images.

3.3.2 Second Stage – Case Participants

The second phase in data collection was to interview the case participants. Based on Easterby-Smith et al. (2015), the first step in the preparation of interviews is identifying the sampling strategy. As the participants were selected prior to the official start of the thesis, the researcher had little influence on the selection. Hence, the most fit sampling design to choose was convenience sampling, i.e. selecting subjects based on ease of accessibility. Not to mention, the participants were chosen based on their relevant experience and interest in entrepreneurship. Moving on, the second step was to consider the type of interview. As mentioned above, face-to-face semi-structured interviews were selected as they offer a guided, yet open interviews, allowing the researcher to detect non-verbal data.

Following this, the third step was to create interview guides based on the research model, research design and selected sampling strategy. The researcher structured the interview questions around short stories to promote a natural conversation. The primary purpose of these interviews was to understand how the participants anticipated the *Obeya* visualisation tool in relation to decision-making. Appendix 1 presents the utilised interview guide. Several guidelines to create interview guides and conducting interviews were adopted in this process (Bryman & Bell, 2007; Easterby-Smith et al., 2015). The last step was to conduct the interviews, each interview lasted for about an hour. To ensure the capture of inductive data, the researcher adopted the technique of further exploring different questions depending on the responses collected from each informants (Easterby-Smith et al., 2015).

In addition, interviews were audio taped, informants were asked for permission prior to recording. Also, participants were asked if they wish to be anonymised, they said no. During the interview, few notes were taken by the researcher to capture non-verbal actions that were viewed as relevant. Furthermore, the researcher employed the laddering technique to ask follow-up questions such as 'why' questions and ask informants for examples (Easterby-Smith et al., 2015). After conducting the interviews, the researcher set on the process of transcribing, which lasted around six hours for each interview. Following this, the transcribed interviews were translated from Norwegian to English.

3.3.3 Third Stage – External Informants

The third and last stage in data collection has great similarities to its former one. In this stage, the researcher intended to interview three external informants with relevant knowledge and experience in entrepreneurial development. Table 4 provides an overview of the external interviewees. Based on the types of non-probability sampling, snowball sampling was adopted to get hold of the external informants. The first respondent was acquired through recommendation from my university supervisor, while the other two through personal acquaintances and interviewed informants. As in the previous stage, in-person semi-structured interviews were conducted. Different interview guides were created with less focus on the *Obeya* visualisation tool, while highlighting the use of visual tools in a broader sense in entrepreneurial processes and in relation to the variables present in the research model. Appendix 2 presents the employed interview guide. The purpose of conducting these interviews was to strengthen the quality of collected data by getting an independent point of view. Moreover, duration of the interviews was about an hour. Two of the informants requested to receive the interview guide prior to the interview. Moreover, participants were asked if they wish to be anonymised to which they said no to. Following the interviews, raw data was transcribed and translated to English. This marked the last step in the data collection process adopted in this research. The following step was data analysis, as described in the next section.

Table 4: Sample, external informants

Informant	Initials	Industry	Current position	Knowledge of Lean Startup and Running Lean
D	AP	Business Incubator	Entrepreneur	Yes
E	MTF	Consulting	Lean director	Yes
F	RT	Business Incubator	Entrepreneur	Yes

3.4 Data Analyses

After collecting data as presented in the above-mentioned sections, the researcher sets to start data analyses. Both diary notes, including the researcher's personal reflections, and interview transcripts are used in the analysis process. Hence, this section introduces the analytical approach applied to analyse data.

The adopted data analysis method is content analysis using both deductive and inductive coding. Content analysis is an analysis approach used to systematically draw conclusions from qualitative data. As to the adopted coding approach, both deductive and inductive coding were applied. Based on the literature findings and established research model, the following categories were pre-defined: Visualisation and information processing; Obeya tool; Market uncertainty; Experimentation; and Decision-making. Throughout the analysis process, the researcher will inductively identify additional categories. Content analysis using deductive and inductive coding was selected as it can be applied with all kinds of data, and the analysis process is straightforward. Moreover, it provides the researcher with a great degree of flexibility (Easterby-Smith et al., 2015).

From the data collection stage, the interview transcripts and the diary notes were documented and translated. Before the data analysis process was initiated, the researcher thoroughly read and understood each data content (five interview transcripts and diary notes). NVivo Pro, a Computer-assisted Qualitative Data Analysis Software (CAQDAS) was employed by the researcher to facilitate analysis of data. The adopted process of analysis can be explained with two coding cycles that are run simultaneously. The first coding cycle is related to the pre-defined categories. As the data is examined, each chunk of data is assigned to one of these categories, also called "Nodes" in NVivo. The second coding cycle aim to inductively establish new categories or sub-categories based on the findings from the data (Easterby-Smith et al., 2015). Thus, the researcher ended up with a series of categories and sub-categories that were coded.

Throughout this coding process, the researcher started reflecting upon similarities and patterns between the established codes. The last step for categorisation was to create a "Framework Matrix" of which the categories were listed on the header axis. On the vertical axis, the informants' initials and workshop sessions were stated. An "Other" category was added to the header axis, where un-cross referenced codes were added. The matrix is generated based on the nodes from the first and second cycle (Easterby-Smith et al., 2015). From this matrix, the researcher began to perceive connections and relationships between data, which generated the following findings as presented in the following chapter.

4 Findings

The purpose of this chapter is to present the findings retrieved from analysed data. Moreover, the sections represent variables established from the research model, in addition to few inductively created ones. The following chapter will discuss the qualitative results in relation to the theoretical findings and analytical model.

4.1 Visualisation and information processing

Visualisation and information processing are presented under one main category due to the correlations found in the empirical data. The visualisation category emphasises use of visual tools throughout the development process of entrepreneurships, while information processing is mainly concerned with the communication of information in such processes. A sub-category: digital tools, is included within the visualisation category.

All the informants articulated the importance of visualisation in this context. On the one hand, informant A interestingly stated: *"visualisation is important to get the essence of numbers".* This statement is partially reflected by another observation made by informant D: *"when start-ups, such as apps, are launched, it is important … to retrieve numbers and indicators that can reflect customers use … data visualisation becomes more important as visualising this data by mind becomes harder.* Also, interviewee D pointed out that in the beginning of development, the need for visualisation is small as things are straightforward, however, this need increases as one advances. On the other hand, informant F said the following in relation to how business incubators function: *"we use visualisation throughout the development process, for instance, when working with business canvas, or making 3D prototypes. Use of simple visual tools facilitates learning, and it is cost-efficient".* Another important observation made by informant F: *"not much is required to visualise. It can be simple drawings that promote the necessary meaning visually, and have great value".* When asked about the visual tools that are adopted throughout the development process, informant D, E, and F mentioned use of simple visual tools such as, single-page templates, visual charts, white boards, objects (3D prototypes), and reusable whiteboard sheets. Informant E illustrated use of sticky notes that cling to surfaces without glue, this provides an easy-to-move feature. According to the interviewee, such notes are helpful while working on business canvas. Additionally, informant E provided an interesting remark in relation to information processing: *"one should not visualise many objects at once, because then one will not be able to read and understand the effects of what was tested".*

Moreover, several interesting perspectives were observed in relation to the impact of visual aids. For instance, informant E stated that in traditional meetings, which are characterised with protocol writing, participants will not have same sense of ownership as one barely interacts. Informant E continued: *"however, by using visual tools, one can promote interaction and enhance creativity amongst participants".* Another striking impact of visualisation was mentioned by informant F: *"… when many participants attend a meeting and everyone has different thoughts in their minds, we unconsciously tend to make different associations related to the discussed matter. However, by using visual tools, we can focus our thoughts on the visualised objects; thus, our discussions become more efficient … the less focused we are, the more time we use to reach the objective".* A similar observation was made by informant B: *"with visualisation, participants of a meeting become better unified about the discussed topic".* Also, empirical data detected that visualisation can impact involvement and understanding, these important observations were made by informant E, when asked about the effects of visualisation on entrepreneurial processes. This observation was clarified in the following statement: *"use of simple visual tools ensure that everyone from different levels of an organisation are involved and can contribute in the decision, involvement is extremely important"* and *"… employees who are initially in denial as they didn't understand a specific issue or might think that a specific situation isn't that critical, will not understand or be aware of the current situation. However, when data is visualised, they get another perception of the actual state, which in turn will help make decisions".* On the other hand, interviewees A and F stated that visualisation might have counterproductive effects. These statements articulated that visualised material might be based on manipulated data, and one can risk loss of information. To tackle these challenges, interviewee A and E expressed the criticality of understanding the information source. This is reflected in the following statement by informant A: *"… one must understand what is being viewed, and to achieve this understanding, the source of information must be available".* Moreover, the majority of interviewees explicitly state experimentation as a mean to validate the source of information.

Furthermore, the informants were asked about the role of digital aids in visualisation. Informant B, D, E and F mentioned the use of Smartboards and TV screens in this setting. Varied perspectives were observed, most of the interviewees articulated the importance of digital tools. However, only few relied on such tools due to practical constraints. For instance, informant D said the following in relation to working on business canvas: *"we feel that use of a digital screen, where one can write on the screen, is good enough. As we get to the stage of filling out the business canvas, we would already have many answers. Hence, the need to visualise is small".* Moreover, the informant was asked a follow-up question to investigate whether interaction is effected using such tools. The interviewee

responded: *"we still have an interactive process when we use digital tools".* Moreover, informant D and E stated few advantages of digital tools. Interviewee D said: *"… it is more practical and convenient to use digital tools. It is not always convenient to have many white boards due to space or other restrictions".* Also, informant E pointed out to reduction in waste generation and reconstructing costs. Ability to include participants from different parts of the globe was mentioned as well by interviewee E. On the other hand, informant B and E expressed their disapproval of using digital tools due to difficulty in operation and practical issues. Interviewee B interestingly said: *"when operating a digital screen, one is required to be effective in visualising the necessary material. Failing to achieve this requirement, may hamper and interrupt creativity during meetings".* Based on personal experience, informant E said the following about use of digital tools: "… *it ended up being an obstacle for involvement, rather than helpful"*.

4.2 Obeya Room

This category mainly focuses on the workshop sessions held within this research. Hence, presented findings are collected from informant A and B, who participated in the workshops. In addition, this section includes few of the observations noted by the researcher from the diary notes. This category is divided into two sub-categories: Strengths and improvement proposals, and Obeya versus group meetings.

4.2.1 Strengths and improvement proposals

Various observations were made by both informants in relation to the perceived advantages of the *Obeya* tool. For instance, interviewee A said: *"One of the strengths of the Obeya is the available wall space, which provided the ability to visualise a lot of information. Thereby it ensured that the information was available at all times"*. Similarly, interviewee B stated: *"It was useful to have information visualised on walls, because participants can directly refer or go back to the piece of information they require during discussions".* Another interesting observation made by interviewee A was the following: *"when participants stand, they can read other participants' body language, which helps us understand each other much more compared with traditional meetings where participants sit around a table".*

Furthermore, in regard to the structure and set-up, informant A expressed that the adopted PDCA structure had a positive impact. The interviewee said: *"Moving from wall to another, provided participants with more clear signs that now we have moved to something else".* This observation can be related to the previously stated statement by informant F that described how visual objects help in

focusing ones' thoughts. In both workshops, the researcher observed that the participants had most use for the Do wall. Also, there was as few as one complete iteration in each workshop. Another observation was made in relation to ease of adjusting the walls, interviewee A said: *"ability to readjust the white boards provided great flexibility".* The interviewee added: *"the room stimulates creativity by allowing people to try different ways".* Moreover, according to interviewee B, the quality of the workshops was affected due to the frequency and number of sessions. Based on these reasons, the interviewee said: *"I think visualisation has been particularly important because it supported the cognitive memory. Hence, this helped us remember and track our progress".*

Moving on, several improvement proposals were detected based on participants' observations. These will further guide the researcher in applying necessary modifications to the *Obeya* room. Both informants stated that the workshop requires better structure and rules. Interviewee B said: *"we haven't found the most suitable structure and form to use in the Obeya room".* Similarly, informant A highlighted the following: *"… we must be aware of what we do on each wall and how we use the available space".* The interviewee further added: *"I think that we need 10 - 15 iterations … before we become properly adapted to the room".* On the other hand, interviewee A clarified the reason to this weakness by saying: *"we are a new group, new context, new path, etc. These reasons explain why the Obeya room haven't reached its top potential, we are still experimenting".*

Moreover, when asked about the challenges of restructuring and adapting each workshop to the Running Lean process, informant A said: *"until now, we have not repeated many processes. I think as we go further in the process, some repeating tasks will come to surface. Hence, restructuring will decrease".* Another interesting observation made by informant A was: *"we need to standardise in order to detect improvement".* Also, informant A pointed to the importance of storing previously visualised information, as the number of empty boards is limited. This issue was detected in the second workshop, in which most of the boards were used to visualise information. In response to this issue, interviewee B proposed the following: *"I think that having images of previously visualised information taken and illustrated on a digital screen would be beneficial, particularly in our workshop sessions".*

Another interesting observation made by informant A was the importance of being familiar with the visualised information to improve the quality of the workshops. Interviewee B had an interesting suggestion that was proposed when asked about how the workshop planning could be facilitated. The interviewee suggested the following: *"I think planning the workshop jointly is a good idea. The better understanding each participant has on what to do, the greater are the chances they contribute in a*

better way. In practice, we could utilise the end of each workshop to plan the next session, with all participants present". Moreover, in relation to heuristics and biases, participants suggested two proposals. Informant A stated: *"I think we should visualise such biases to improve awareness".* Similarly, interviewee B said: *"discussing these biases would be beneficial".*

4.2.2 Obeya vs group meetings

With the previously held group meetings that did not apply any structured use of visual tools, informants were asked about the difference between the workshops with the *Obeya* tool, and the group meetings. Images from group meetings and workshops were displayed to both informant A and B prior to the interview. Both participants said that the need for visualisation was clear from the first meeting. Interviewee A said: *"looking back at the first group meeting, we used windows to stick post-it notes, this illustrated the need for visualisation".* Moreover, an interesting observation was made by informant A in the following: *"the most important difference is that we were standing during the workshops, while we sat around a table in the group meetings".* Based on this reflection, the interviewee compared the group meeting to traditional meetings, in which participants follow a specific structure where acknowledged rules are applied. The informant added: *"in the Obeya room, we didn't have many pre-defined rules compared with traditional meetings. This made it even harder for the participants as one did not know exactly what should be done, along with not being acquainted with such meetings. However, this contributed to creating a creative environment in the meeting".* One of the observations noted by the researcher from the first workshop was that participants were excited to use this tool. On the other hand, informant B had different observations, the following statement was noted: *"the main difference … was improvement in structure, in terms of content and visualised material, and in regard to time management".* Moreover, informant B interestingly said: "*… failing to incorporate these factors in meetings might lead to greater waste than benefit".*

4.3 Market uncertainty

Market uncertainty is concerned with changes in customer needs and market turbulences, which in turn can lead to greater uncertainty throughout development of entrepreneurships.

All the interviewees explicitly stated that one of the main reasons to why entrepreneurs do not succeed is failure to meet customer and market needs. This is illustrated in a statement by informant E: *"one of the main reasons to failure is that majority of entrepreneurs do not develop their ideas based on customer and market needs".* More specifically, interviewee F said: *"… entrepreneurs are late in coming into dialogue with end-users; hence, they do not quite understand what should be solved".*

Put differently, informant D stated the following: *"if you do not talk to many customers to properly understand the problem, then you will spend long time in developing nice-to-have, rather than need-to-have solutions".* Informant F also added an interesting observation: *"the customer is the one who has the key solution"*.

Furthermore, a striking observation was made by informant D and F in relation to identifying customers' willingness to pay. Informant D said: *"the more frustration customers have, the more they will be willing to buy the product or service".* Moreover, informant A pointed out to the importance of involving the customer during development. According to interviewee A: *"I think it is wrong to create the perfect product and simply hand it to the customer. That way, the customer is unaware of all aspects of the product. However, if end-users are part of the development journey, this disadvantage disappears".*

4.4 Experimentation

This category explores the importance of experimentation, i.e. through frequent hypothesis testing, in entrepreneurial processes.

Each of the five informants were asked to provide a statement on how experimentation can facilitate the entrepreneurial process. All the interviewees expressed the importance of experimentation for learning. Interviewee B said: *"I think experimentation is strongly undervalued as it provides great opportunities for learning, testing, and risk reduction".* This statement was further enriched with an example based on previous work experiences: *"through experimentation, we were able to create and run tests, which facilitated the development of new and existing ideas. Hence, we reached our targets faster, with lower risks and resistance from employees. Also, resource use was reduced".* Furthermore, informant B articulated another interesting impact: *"an advantage of experimentation is that it contributes to easier change, by having employees become part of the experiment, i.e. the change process. In this way, resistance to change is decreased and employees get a different view on what the change is".* Interviewee A stated that one of the methods to carry out experiments is to follow the Lean Startup, which promotes validation of assumptions through MVPs and the Build-Measure-Learn loop. Similarly, informant E mentioned the following: *"entrepreneurs must learn to use the PDSA learning wheel (PDCA) and become more effective in running these iterations"*. Moreover, interviewee E also said: *"it is not wise to experiment with many variables simultaneously, so that one can easily read the effects of the conducted experiments".*

On the other hand, experimentation provides entrepreneurs with the ability to alter their direction, this advantage was pointed out by interviewee A, E and F. Informant A expressed this statement in the following: *"without experimentation, one cannot pivot in case of new findings along the development path and can risk being tied to a pre-planned direction"*. This ability is also declared by informant D who said: *"there could be several paths into a market … most likely the route chosen in the beginning is wrong. Hence, one should consider this factor when planning resources throughout the development process, that way one has more flexibility"*. From a business incubator perspective, interviewee D explained that when entrepreneurs seek their help, they approach them with solutions, which entrepreneurs would think are the "right" ones. The role of incubators is to challenge these entrepreneurs to validate their solutions. Moreover, interviewee D added: *"as a rule of thumb, there is always two other alternatives to a solution. We aim to help entrepreneurs find these alternatives".*

4.5 Decision-making

This category investigates the requirements needed to facilitate decision-making, and the impact of visualisation and experimentation on the decision-making ability in entrepreneurial processes. Moreover, heuristics and biases is also presented within this category.

When asked about the most important decisions in the early phases of development processes, interviewee E presented a broad, yet interesting point of view that was illustrated through a funnel with gatekeepers. The statement was further based on the first gate that entrepreneurs face in the narrowing end of the funnel. At this gate, informant E said: *"the most important decision is to filter out ideas in order to be left with the best ones"*. These carefully selected ideas should be then developed throughout the funnel. Moreover, development of few ideas will provide the advantage of time and resource efficiency. In the same setting, interviewee F stated: *"the important decisions that are taken in the beginning are to define job-to-be-done"* (what problems customers need help in doing) *"… and key customer segments"*.

Another observation collected from interviewee A and E, was the importance of understanding the information ground or base on which decisions are made. These statements were initially presented in relation to visualisation and experimentation in entrepreneurial processes, however, they explicitly point to relevance of the information source in decision-making. Interviewee A said the following: *"decisions are dependent on the information source they are built upon. Hence, lacking a good data base will result in decisions of poor character"*. Moreover, the informant adds an interesting observation in relation to data collected from customer interviews, that is, one must try to draw conclusions and make decisions from the available information, despite the poor data base. Also, from

such interviews: *"a great part of the data is based on undocumented experiences such as body language that is also important to consider when making decisions".* Interviewee E similarly said: *"to make rightful decisions, one must be able to rely on the source of information".*

Moreover, several observations were made on the impact of visualisation on decision-making, both positively and negatively, and in relation to heuristics and biases. Interviewee A stated that information availability facilitates decision-making by allowing information to be viewed easily. Additionally, interviewee E mentions involvement and understanding as two contributions of data visualisation that improve decision-making. On the contrary, visualisation can be counterproductive for decision-makers, interviewee A mentioned the following: *"visualised data can be manipulated to influence decisions in one's favour".* Also, in relation to business incubators, interviewee F said: *"when entrepreneurs approach us with finished visual objects, such as prototypes or business plans, this means that many decisions are taken in advance, which makes it difficult to ask questions, understand the solution, and apply changes, because one has already positioned their mind-set in a certain way, and this makes it hard to take a step back".* Furthermore, other observations were related to use of experimentation as means of collecting data to validate hypotheses. Informant A stressed on the relevance of experimentation in decision-making, and said: *"decisions should be based on experiments"*. Moreover, the interviewee added: *"through experimentation, one can arrive at a non-bias data base"*. Also, Informant E said the following statement when asked, in which way can experimentation help decision-makers: *"to make the right decisions, one must rely on the source of information, which must consist of several well-documented experiments to validate the claims and take appropriate decisions".*

Nonetheless, informants were asked about the influence of heuristics and biases, particularly optimism, overconfidence, and representativeness, on decision-making. Interviewee B and E declared that optimism is an essential factor for all entrepreneurs. Informant E further clarified this statement by saying that optimism is necessary as it helps entrepreneurs survive tough times. However, the interviewee added the following: *"it is also important to be open to ideas and to listen to others"* as this ability might be hindered by optimism bias. Moreover, informant E replied the following when asked about entrepreneurs' failure reasons, one of the reasons were: *"because they are in love with their own ideas, developing them without much concern to customer and market demand".* In the same context, informants were asked about methods to prevent such biases. Interviewee A, B and D stated that built-in mechanisms might ensure such biases are kept to a minimal. Informant A and B declared that both Lean Startup and Running Lean have similar mechanisms. In addition, the

interviewees assume that improving awareness of such biases through visualisation and open discussions might be helpful.

4.6 Other

The last category in the findings chapter consists of several interesting insights that were not sorted to the above-mentioned categories. The following content is presented in Table 5. Moreover, none of these sub-categories were pre-defined prior to data analyses.

Table 5: "Other" category

Sub-categories	Statements
Guidelines throughout development Can improve experimentation	*"it is important to have a system that stores ideas that were rejected earlier throughout the development. These ideas can be fruitful later in the process"* Informant E.
Access to resources Benefits large organisations or business incubators may offer.	*"Developing ideas within an organisation gives you access to many resources, such resources help entrepreneurs focus their time and effort on the actual development. Hence, the entrepreneurial process is not interrupted"* Informant E.
Failure Reasons Varied reasons that cause entrepreneurs to not succeed, can increase success if considered.	*"… failure reasons are: economical limitations, ideas are not developed based on customer and market needs, and inability to quickly make changes based on customers or markets"* informant E. *"Often entrepreneurs think huge, at an early stage, instead of doing what is right, which is to build the minimum possible solution"* Informant F. *"Before going to the next step in the development process, entrepreneurs should ask whether they have received as many answers as possible, before one moves forward to the next stage"* Informant D. *"… I think it is important to get the peace and calmness to experiment, and thereafter make decisions"* Informant E.
Efficient Experiments Can enhance experimentation and reduce costs	*"MVE, Minimal Viable Experiment, that is, use of minimal number of experiments to validate hypotheses. There is often a longer time from idea until you have a finished product, because you must verify and test ideas. With MVE one can work much more efficiently"* Informant D.

5 Discussion

The following chapter is divided into three main sections: first section discusses the theoretical and empirical findings, second section presents the research limitations emphasising issues with data and research design, and the last section presents practical applications of this study.

5.1 Discussion of the Findings

The following section discusses the empirical findings in relation to the theory presented in this research. The discussion aims to identify whether results confirm theoretical findings, if not, investigate how these findings deviate. Based on the correlative evidence found, propositions are prescribed to address the research question: *"How can employment of Obeya impact decision-making in an entrepreneurial context?"*.

Visualisation and information processing

One of the main variables that are identified to reduce uncertainty is information processing, which in this research, focuses on the challenges related to communicating information. Based on this observation, the researcher investigated the methods that could enhance the information processing capability, of which visual tools was claimed to facilitate it (Lindlöf, 2014). Nevertheless, the VM literature explicitly states great advantages of applying visual tools as presented in the theory chapter, for instance in terms of enhancing the decision-making process (Lurie & Mason, 2007). Based on these theoretical findings, the research model linked visualisation and information processing together. On the other hand, the empirical findings do, to great extent, confirm this correlation. This statement is further discussed in the following category.

The theoretical and empirical findings are broadly consistent with visualisation's ability to facilitate understanding of data (Bititci et al., 2016; Liker, 2004; Tezel et al., 2016). Taking a closer look at the empirical data, it suggested that use of visual tools promotes involvement, interaction, creativity, ownership, and increases transparency. Similar benefits were also introduced in the theory chapter within three areas: cognitive, social, and emotional (Bititci et al., 2016). In addition to these benefits, the collected data supplemented the theoretical findings with an important benefit, that is the ability to unify and focus ones' thoughts on the visualised material. Other benefits of visualisation, that were identified in the theory, was that use of simple visual tools, such as the 5S tool, can achieve great benefits (Liker, 2004; Parry & Turner, 2006). This finding is consistent with one of the observations that pointed use of simple and cost-efficient visual aids to have great impact. All the above-mentioned

findings are important indicators that applying visual tools in different settings can be advantageous. This is particularly relevant in relation to the identified literature gaps in terms of using visual tools in entrepreneurial processes. Nevertheless, it is important to point to the apparent difference between the manufacturing and entrepreneurial contexts in terms of visual needs. Based on the theoretical findings, and despite the variation in levels of abstraction, development processes in both settings vary in nature. That is, in the manufacturing context, which is compared to large organisations, levels of uncertainty and complexity are relatively lower compared with entrepreneurs due to lack of resources (Busenitz & Barney, 1997). Regardless of this contrast, theoretical and empirical findings are consistent with the ability that visualisation has in understanding data. Hence, one of the propositions is:

P1a: employment of visual tools in development processes may bring forth similar benefits in both entrepreneurial and manufacturing settings.

On the contrary, one of the empirical observations contradict theoretical findings. According to the theory, a disadvantage of visual tools is the possibility of disapproving visualised information (Bititci et al., 2016). On the other hand, empirical findings declared visual tools to improve ones' perception of a specific situation, which in turn reduces their denial of information. Put differently, the literature claims that visual tools may lead to denial of information, while the collected data implies the opposite. To understand the relation between both statements, this claim is related to another observation that was identified from the empirical data, which is the importance of understanding the information source (data basis), when reviewing visual objects. This statement explicitly points to the underlying content on which visualised material are built on. Although this notion is not specified in the presented literature, theory highlighted the design perspective as crucial to reduce both misinterpretation and denial of information (Bateman et al., 2016; Bititci et al., 2016; Tezel et al., 2016). In addition to these risks, empirical data highlighted data manipulation as a common risk, in which knowing the information source can hinder its impact. In this sense, it is assumed that the design perspective and information source are correlated as they both affect interpretation of information. In other words, to improve acceptance of visualised content and reduce data manipulation, the information source and design perspectives should be considered. Moreover, with higher levels of uncertainty and complexity, as identified in the literature, entrepreneurial individuals would face more challenges due to lack of information (Busenitz & Barney, 1997). This in turn implies more difficulties in generating visual objects that rely on incomplete information; hence, this might increase denial of visualised objects. Also, with limited information in this context, decision biases have

stronger influence on entrepreneurs (Bazerman, 1998; Busenitz & Barney, 1997; Tversky & Kahneman, 1975). Based on this discussion, the following proposition is suggested:

P1b: the information source and design of visual objects are both necessary to reduce the risk of denial and misinterpretation of information.

Obeya Room

The *Obeya* tool has been chosen due to its ability to achieve efficient decision-making through use of simple visual tools. This tool is commonly used as a meeting room in development processes, mainly in manufacturing industries. Despite the lack of theoretical evidence of applying the *Obeya* tool in entrepreneurships, and poor theory describing its way of function, this research applied it to an entrepreneurial development process to investigate its impact. The adapted tool was employed to two workshop sessions, in which three participants participated in, including the researcher. Moreover, this category discusses the empirical findings gathered from these workshops in comparison to the literature. Also, based on the retrieved data, several modifications are applied and presented to the *Obeya* room.

The observations collected from workshop participants are somehow coherent with the available literature despite the limited extent of this research. Nevertheless, certain findings fulfil the theory by strengthening its explanatory bases. For instance, the findings indicated that with participants standing in the *Obeya* room, one could better read other participants' body language, which in turn improved understanding. Also, the researcher observed excitement among participants as many aspects were different in the *Obeya* room compared to the group meetings held earlier. This observation is seen to imply emotional benefits, which in turn may have enhanced involvement and engagement (Bititci et al., 2016). Nevertheless, these observations explain broadly, how the *Obeya* is able to enhance synergy and collaboration as stated in the literature (Appell, 2011; Jusko, 2016). Not to mention, being somewhat acquainted with participants prior to the workshops enhanced social benefits (Bititci et al., 2016). Moreover, empirical findings from the workshop sessions declared that visualisation of information positively influenced the quality of discussions as well as supported remembrance; hence, improved the cognitive ability. Not to mention, the impact of visual displays in terms of recalling progress was crucial for the efficiency of workshops as they were held with long time gaps in between. Also, visualisation enhanced real-time decision-making as participants could refer directly to the required information. These observations illustrate how the *Obeya* supported effective decision-making, i.e. through use of simple visual tools as conferred in the literature (Appell, 2011; Liker, 2004; Liker & Morgan, 2011).

Another important feature of the *Obeya* room is to achieve concise discussions (Aasland & Blankenburg, 2012). To fulfil this feature, several design principles were established, for instance, the design principle concerned with flow of data, i.e. organising information in a specific order to achieve flow (Bateman et al., 2016). In the adapted *Obeya* room, this principle was partially employed through the PDCA structure. Nonetheless, empirical evidence revealed that this structure supported participants' ability to switch their thoughts and focus on a specific visual object as they moved from one station to another. Also, as the empirical findings stated, cognitive, social and emotional abilities were improved due to the structure, atmosphere, and visual aids utilised in the room. Hence, the above-mentioned findings are positive indicators of how the *Obeya* room facilitates communication of information, which is the underlying theme for the information processing capability (Lindlöf, 2014). Based on this discussion, the following proposition is offered:

P2a: the adapted Obeya room facilitates the cognitive, social and emotional abilities, which positively impacts information processing in entrepreneurial decision-making.

Despite these benefits, the workshop participants explicitly stated that the *Obeya* room requires more time in development, this was generally justified by poor structure and rules. Hence, the empirical findings highlight that participants need to run several iterations in the *Obeya* room to become familiar with the process. This matter is consistent with the theory declaring that both the process and content must be continuously improved until the appropriate decision-making foundation is achieved (Flinchbaugh, 2016). In other words, the literature expresses the experiential nature of this room, which is perhaps the reason for its creativity as it is built on constantly applying modifications. As to the content in the *Obeya* room, development processes in manufacturing and entrepreneurial contexts emphasise different information, however, they are assumed to require similar tools throughout the development process. Despite this difference, empirical findings do not indicate in which way this contrast affects the *Obeya* room. In both scenarios, theoretical and empirical findings indicate that standardising processes and procedures is essential to detect improvements (Liker & Morgan, 2011). Which in theory, may translate to time-demanding development before one can achieve a good foundation that supports decision-making. On the contrary, observations from the workshop sessions indicate that the decision-making ability was achieved to a certain extent despite the lack of maturity. Nonetheless, with TPS continuous improvement culture, which is inherent in the Lean Startup methodology, the following proposition is suggested:

P2b: the Obeya room requires time to mature in terms of content and process to continuously improve decision-making.

Based on the collected data, and observations of the researcher, several improvement proposals are introduced to the *Obeya* room. The guidelines presented earlier in the literature: Guidelines in Practice on pg. 16, will still be valid. Moreover, the applied changes emphasise improvements in structure and rules, rather than content, this is reasoned with the identified need that empirical data points to in terms of improving the process. Nevertheless, it is important to point that these changes would still require to be validated in practice. Also, the empirical findings indicate that excessive use of pre-defined rules might hamper the ability to apply changes, which in turn will affect creativity in the *Obeya* room. This observation is consistent with the literature that implies importance of continuous improvement (Flinchbaugh, 2016; Liker, 2004). On the other hand, in terms of content, theoretical and empirical findings support that visualisation of many objects will affect the ability to read and understand the displayed content (Bateman et al., 2016). On the contrary, empirical observations stated the criticality of understanding the information source, which in practice will demand that one either displays more information on the walls or ensures that participants are well-informed prior to workshops. Given the theoretical findings that state the importance of limiting information sharing to increase the efficiency, the latter option is considered more convenient. For these reasons, the room must be kept simple in terms of content and process. Moreover, as the *Obeya* room originates from the development processes in TPS, the applied principles are to some extent similar to the entrepreneurial context in this thesis, which is based on the Lean Startup method, as it adapts several practices from the TPS. Figure 10 illustrates the modified *Obeya* room.

Plan

Only one change that is concerned with the schedule is applied to this wall. The proposed improvement is to use the end of every workshop session to plan the forthcoming one. This suggestion was detected from the collected data, and points out that such measure will facilitate the workshop quality and increase the efficiency of workshop planning.

Do

From the workshop sessions, it was observed that more writing space was required, which meant that previously visualised material might be erased to make space for new displays. To solve this issue, a suggestion that proposes use of a digital screen on which pictures from previous walls can be demonstrated is employed. In addition, this measure can be helpful in archiving ideas that can be fruitful later throughout the development process. Another suggestion that is discovered from the collected data, was the use of "traffic light" colour coding to assess ideas. This observation is considered important in relation to the design principles, and is employed to assess both new and older

ideas (Bititci et al., 2016). Furthermore, the researcher observed that discussing the results was more logically right to be placed in the Do wall, instead of the Check wall as initially planned. This observation was apparent in the second workshop, in which interview data was presented. Hence, the results category from the Kanban board in the Check wall is moved to the Do wall. Nevertheless, applying this change requires more space; hence, the Do wall will be stretched over two walls. In terms of the *Obeya* process introduced in the theory, this adjustment deviates from it. However, such changes are made in relation to the perceived demand, which is seen in accordance to the theoretical findings that imply continuous development of the room.

Check

The main changes applied to the Check wall is to modify the Kanban board by removing the Results category and to merge the Check and Act wall together. This is reasoned with the detected need to display results in the Do wall to increase flow and logic order.

Act

Instead of using the Hansei board to merely discuss the strengths and weaknesses of the *Obeya* room, the empirical data indicated the need to discuss the improvements for the actual idea as well. Also, based on the empirical observation, heuristics and biases are discussed to improve awareness.

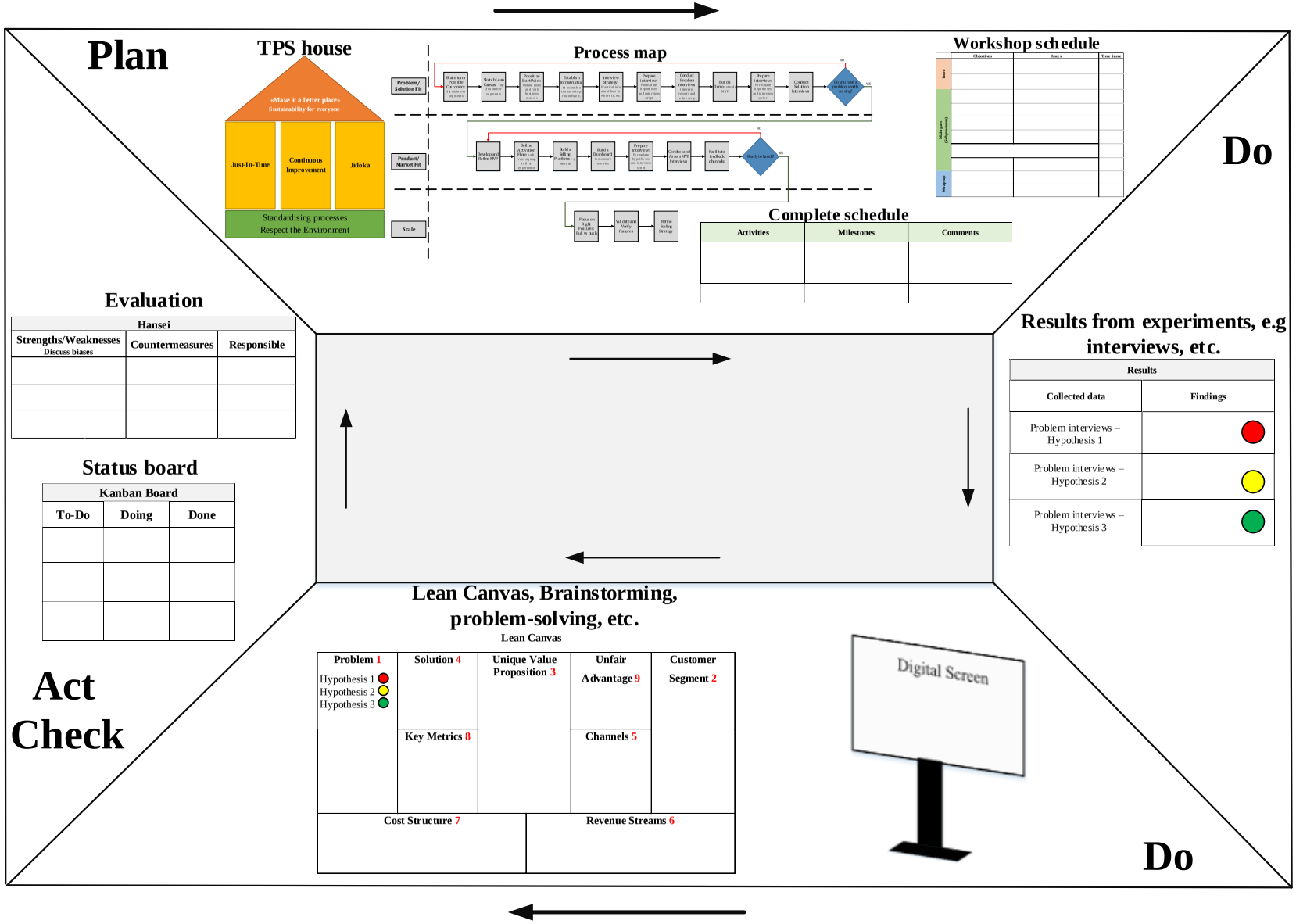

Figure 10: Modified Obeya room

Market uncertainty

As the entrepreneurial environment is characterised with uncertainty, many entrepreneurs fail in the development of products or services as a result of poor decision-making (Busenitz & Barney, 1997; Hisrich et al., 2013). From the literature, market uncertainty was one of the variables identified with the ability to reduce uncertainty (Busenitz & Barney, 1997; Lindlöf, 2014). Moreover, this variable is concerned with the changes caused by market turbulence and customer needs, both of which may disrupt development processes (Lindlöf, 2014; Olausson & Berggren, 2010). This category investigates the relation between the empirical and theoretical findings that reflect the impact of market uncertainty on entrepreneurial development. Based on the researchers understanding of the literature, market uncertainty is highlighted for its importance in relation to decision-making.

The empirical findings related to market uncertainty concur with the literature that state, failure to meet customer and market needs, as one of the main reasons for entrepreneurial failure (Blank, 2013; Maurya, 2012; Olausson & Berggren, 2010; Ries, 2011; York & Danes, 2014). The underlying issue, according to both theory and collected observations, is not talking with the customer to define and understand the problem. As a result of this, entrepreneurs develop solutions based on their assumed perception of customer needs (Blank, 2013; Ries, 2011). Other empirical observations, that are coherent with the theory, reflect methods of customer validation, such as identifying customers' willingness to pay through evaluating their frustration, and getting paid from customers in the early stages of development (Maurya, 2012). Based on this discussion, the following proposition is offered:

P3: Identifying and validating customer needs is essential for reducing the consequences of market uncertainty.

Experimentation

Based on the literature, through experimentation entrepreneurs can collect valuable information that help them learn about the customer, market, and everything one lacks knowledge of (Blank, 2013; Kerr et al., 2014; Ries, 2011). Hence, experimentation is considered to facilitate visualisation, and thereby the information processing capability as well as reduce market uncertainty. As in the previous categories, this sub-section discusses the theoretical and empirical findings.

The empirical findings are strongly consistent with the theoretical evidence presented in this thesis. From the gathered observations, the underlying impact of experimentation is to learn and acquire knowledge, which is crucial for entrepreneurial decision-making (Kerr et al., 2014). Consequently, with information, financial losses are reduced (Kerr et al., 2014; Trimi & Berbegal-Mirabent, 2012).

This is possible through appropriate planning of resources, one based on the current situation, rather than unprecise projections. Not to mention, with access to information, risks can be mitigated. Furthermore, both the theory and empirical data declared an important feature of experimentation, which is the ability to pivot, preserve, or terminate depending on what the collected findings suggest (Kerr et al., 2014; Ries, 2011). This ability provides opportunities that could have been overseen if a specific goal was set prior to development. Another interesting observation from the collected data stated that experimentation can facilitate the change process, that is by involving people in the change process, individuals are able to communicate and contribute; hence, resistance to change is decreased.

Despite the above-mentioned benefits, certain empirical findings declare challenges related to experimentation. For instance, one of the interviewees working in a business incubator mentioned the use of Minimal Viable Experiment (MVE), which is similar to MVP, however, it focuses on experimentation. In other words, MVE is concerned with reducing the number of experiments required to validate an assumption. This statement reflects somehow the resource constraint related to experimentation, i.e. the more experiments entrepreneurs run, the more resources are required. Hence, the number of experiments one can perform are limited, which implies the importance of becoming efficient in running experiments. This limitation is assumed to be greater in the adopted setting of this thesis due to lack of information, i.e. in the context of individual entrepreneurs attempting to launch start-ups.

In reference to the research model in this study, Figure 7 found on pg. 23, experimentation is presented as a method of gathering and validating information, i.e. visualisation is to great extent dependent on experimentation. Not to mention, Lean Startup methodology relies greatly on rapid iterations of experiments to validate assumptions; hence, theoretical findings confirm this link in terms of gaining knowledge (Kerr et al., 2014; Ries, 2011). Moreover, if argued from the standpoint of manufacturing and entrepreneurial contexts, development processes would both benefit from conducting experiments. However, with higher uncertainty and complexity levels, and lack of resources and information, entrepreneurs outside the boundaries of organisations are faced with fewer alternatives to gaining knowledge. Based on this discussion, proposition P4 is offered:

P4: entrepreneurial development processes depend on validated information from experiments to visualise content and facilitate decision-making.

Decision-making

The last category and main variable presented throughout this thesis is decision-making. With limited access to resources, high uncertainty and complexity levels, financial constraints, and other factors, entrepreneurs face difficulties in making rational decisions (Bazerman, 1998; Busenitz & Barney, 1997; Hisrich et al., 2013; Shepherd et al., 2015). Based on this issue, two variables, visualisation and experimentation, were identified, from wide-ranging variables, to have an impact on entrepreneurial decision-making (Kerr et al., 2014; Lurie & Mason, 2007). Other variables that were detected from the literature to impact decision-making, but were not emphasised in this study are: characteristics of entrepreneurs, entrepreneurial environment, accessible capabilities, etc. (Bazerman, 1998; Ries, 2011; Shepherd et al., 2015).

The empirical findings are broadly consistent with the theories related to decision-making. The presented literature focuses on two main issues, one concerned with how decisions are made, i.e. through prescriptive or descriptive models (Bazerman, 1998). Whereas, the second issue of interest considers how decision biases may impact the judgements of decision-makers. When considering the former issue, empirical evidence tried to identify which decision model is commonly employed within business incubators (informant F) or large organisations (informant E), the data pointed to use of models that are similar to prescriptive models (Bazerman, 1998). It was apparent that such organisations were not willing to expose themselves to risk, and would rather follow a systematic model than rely on managers' judgement. Nevertheless, the magnitude of the decision and level of management can be argued to impact which one of the models are employed. However, the factors that discourage use of rational processes are more present in the context of individual entrepreneurs attempting to launch start-ups (Busenitz & Barney, 1997). Hence, in the setting of this research, descriptive models are considered more appropriate. From the held workshops, the researcher observed that participants' decisions leaned more towards descriptive models, which concurs with the presented literature in terms of resource constraints (Bazerman, 1998; Busenitz & Barney, 1997; Dillon, 1998). This observation is supported by the choice of method: Lean Startup, which relies on efficient iterations of experimenting and learning, rather than time-consuming systematic models (Ries, 2011).

Moving on to the latter issue, theoretical evidence state that with lack of information, entrepreneurs risk being exposed to decision biases, which expresses the importance of avoiding errors in judgement (York & Danes, 2014). Also, empirical evidence from the applied case showed that acquiring an appropriate information source to be the main constraint. For these reasons, the impact of decision

biases was observed on the workshop participants without prior notification of such biases. During data collection, both participants mentioned the presence of optimism and representativeness in the development process. Further, the collected evidence declared optimism to positively impact the process. On the contrary, workshop participants acknowledged almost falling into the representativeness heuristic, due to lack of information. However, informant A highlighted that entrepreneurs are somehow compelled to make decisions despite poor information base. This observation can be considered in relation to the Build-Measure-Learn loop or the PDCA learning wheel, both of which require data or assumptions to initiate the iteration. Not to mention, both participants (informant A and B) have many years of field experience, and according to informant B, they are generally more conscious of heuristics and biases. Moreover, empirical observations pointed to the importance of being open minded, listening to people and openly discussing heuristics and biases to avoid them. From the theoretical and empirical findings, the observed theme required to prevent the impact of heuristics and biases, and strengthen ones' judgement, is to gather data from various sources and be conscious of decision biases.

Based on the above-mentioned discussion, experimentation and visualisation are discussed in relation to decision-making. According to the theoretical and empirical findings, experimentation supports decision-making by acquiring knowledge related to the decision (Blank, 2013; Kerr et al., 2014; Ries, 2011). From the collected findings, an observation stated that through experimentation one can establish a non-bias information source to facilitate the decision-making process. Put differently, experimentation facilitates how decisions are made by validating assumptions, which in turn achieves more rational decisions. This observation is consistent with the Lean Startup and Customer Development methods (Blank, 2013; Maurya, 2012; Ries, 2011; York & Danes, 2014). Visualisation, on the other hand, facilitates communication and understanding of information (Bititci et al., 2016; Liker, 2004; Lindlöf, 2014; Tezel et al., 2016). Consequently, empirical and theoretical findings support the correlation between visualisation and decision-making (Liker, 2004; Lindlöf, 2014; Lurie & Mason, 2007).

Despite these benefits, both experimentation and visualisation can have a counterproductive impact on decision-making. Empirical data declared the following findings. In terms of experimentation, due to resource and time constraints, the number of experiments entrepreneurs can achieve are limited; hence, this might impact the learning process as well as diminish the information source. Moreover, the disadvantages of visualisation consist of the following: first, displayed material can be manipulated to influence decision-makers; second, qualitative data such as body language might be difficult to document and visualise, which in turn might lead to loss of relevant information; third,

decision-makers can misinterpret visualised data. Based on the above discussion, the following proposition is suggested:

P5: Experimentation and visualisation are two methods that jointly can facilitate entrepreneurial decision-making.

5.2 Research Limitations

The following section highlights few research limitations, discusses the trustworthiness of data, and presents practical applications of this study.

5.2.1 Practical Limitations

Regardless of how well-planned a research is, limitations are inevitable in any research process (Bloomberg & Volpe, 2012). This sub-section highlights a number of limitations that were faced during this thesis.

Starting with the theory chapter, to ensure validity of the theoretical findings, the researcher relied mostly on journals and books with high number of citations. Also, most journals were marked with the highest level in the NSD database (Norwegian Register for Scientific Journals, Series and Publishers). However, one of the sources wasn't a published journal or book, this refers to the source that employed the PDCA structure in the *Obeya* room, proposed by Maskell (2012). Despite, the weakness of this source, it was selected due to its relevance and lack of other reliable sources. Nonetheless, Brain Maskell authors several publications of books and journals in lean related topics.

In terms of research design, action research and case study research were selected as they provided greater opportunities for the researcher in terms of being a participant and observer who examines a single case. Despite the benefits of these research methods, several limitations were recognized by the researcher. According to Easterby-Smith et al. (2015), action research requires the investigator to have certain skills and characteristics to manage different roles simultaneously. Hence, the first limitation is seen in relation to such facilitation and personal skills. In this thesis, the researcher had three main roles: being the workshop facilitator, participant, and observer throughout the research process. None of these roles were previously exploited to this degree; hence, getting familiar with these actions required time. Not to mention, engaging in three roles at the same time imposed difficulties in focusing on data collection. Second, by being part of the experiment, the researcher could have consciously or unconsciously influenced the research process and findings in a greater extent compared to other qualitative research. Last, conducting several workshops was time consuming, and required the

presence and commitment of participants, both of which are considered to have affected the findings of this study (Stringer, 2004).

A major weakness of this study is not being able to detect whether the decision-making ability has been improved, as this situation has not been compared with and without the *Obeya* tool in a controlled manner. In other words, decision-making could have been facilitated without the employment of the *Obeya* room. For instance, being more familiar with participants prior to utilising the *Obeya* room could have improved communication, which in turn enhanced decision-making. To scientifically verify this study, the researcher should have employed a *classical experiment design* in which two groups are tested before and after the experiment, one given the *Obeya* tool and the other left with a fictive tool (Bryman & Bell, 2007). However, due to the apparent practical limitations in terms of time and resources, realising such a research would have been difficult. To minimise the impact of this weakness, the researcher used the group meetings held in the initial stages of this study as comparative basis during data collection.

Moving on, other implications that have impacted the results of this research are the conducted workshops. The workshop sessions were crucial for the progress of this study as they provided the ability to investigate the impact of the *Obeya* room on decision-making. Initially the researcher aimed to achieve three to four workshops, however, due to time and location constraints, only two workshops were completed. In addition, one of the participants was not able to attend in both workshops. Moreover, an important observation is that only few iterations were completed during these sessions, in contrast to what was assumed prior to starting the workshops. To minimise the impact these factors could have on the validity of data, the researcher decided to interview external informants to strengthen the data base.

Based on this discussion, the need for further research is certain, particularly in terms of conducting several studies across multiple cases. Due to the practical issues related to classical experiments, further studies can attempt to conduct a downscaled experiment with two development teams within the entrepreneurial context as a start point. This experiment, when conducted in a controlled manner and an adequate period of time, would more likely improve the validity of results compared to this study. Moreover, based on the achieved results, the research can be expanded to test this tool in different settings, such as development processes in IT, construction, education, etc. However, prior to performing these experiments, the *Obeya* tool would require development in terms of maturity of the process.

5.2.2 Data Quality

Bryman and Bell (2007) present an evaluation criteria that was first established by Lincoln and Guba (1985), in which they substitute the commonly used criteria in quantitative research: validity, reliability, and generalisability with the following: credibility, dependability, transferability, and confirmability. Based on these criteria, the researcher evaluates the quality of this research. Also, ethical considerations are presented.

Credibility

This evaluation criterion discusses the plausibility of the research findings (Bryman & Bell, 2007; Stringer, 2004). In this study, credibility was supported by applying three measures. First, the researcher was engaged in this study from the beginning of the development process by being an active participant and later a process facilitator. In turn, this provided an in-depth understanding of the applied tools and theories as they were applied in the field. Although this dimension was beneficial, long-term involvement raises the issue of subjectivity and ability to differentiate between the three roles, as presented above. Second, the researcher used two data collection methods, and interviewed external informants to get different perspectives. This initiative enriched the variety of data; however, in terms of validity it might have been counterproductive. Third, the researcher sent copies that highlighted the results and conclusions of the thesis to all participants of this study, and asked them to validate the presented findings. A potential drawback of this measure is to receive participants' approval without their actual reviewal (Bloomberg & Volpe, 2012).

Dependability

Dependability investigates whether the study can be achieved by reapplying the research process; hence, it is concerned with repeatability (Bryman & Bell, 2007). To enhance this criterion, the researcher attempted to demonstrate the methodological choices reflecting the process applied in this study to the extent that is permissible in such research, and in accordance with the requirements provided by the university. Nonetheless these guidelines impose limitations as the provided research process lacks the degree of detail needed to assist other researchers in achieving the same results (Bloomberg & Volpe, 2012).

Transferability

This evaluation criterion is concerned with the issue of generalisability, i.e. to which extent can the findings from this research be applied to other contexts (Bloomberg & Volpe, 2012; Bryman & Bell,

2007). According to Stringer (2004): *"thickly detailed descriptions contribute to the trustworthiness of a study by enabling audiences to clearly understand the context and the people participating in the study"* (p. 50). Hence, to enhance the ability to transfer this research to different contexts, the researcher provides a detailed description of the context and illustration of the conducted workshops. As this thesis applies the case study research, it faces greater limitations in relation to transferability for the reason that one is limited to a single case. However, Bryman and Bell (2007) state that through this single case, one is able to shed light on different theoretical findings on which one can suggest propositions, which in turn can be validated in different cases to investigate their trustworthiness. Based on these findings, the researcher offered several propositions as presented in the previous section.

Confirmability

Confirmability is an evaluation criterion that deals with the issues of subjectivity and potential biases, and how these factors can impact the research results (Bloomberg & Volpe, 2012). According to Stringer (2004), confirmability can be achieved by an audit trail. Hence, the researcher offers to present the sources of data and the framework matrix used in data analyses, if requested. As stated earlier, being an action researcher implies more challenges in terms of objectivity. Not to mention, the researcher carried out this thesis without having a thesis partner; hence, one could not validate tasks such as data analysis, etc. Despite this limitation, the researcher attempted to minimise subjectivity by ensuring that arguments were discussed in relation to the theoretical findings. Also, the researcher tried to have an objective mind-set while documenting and translating the interviews, as well as writing diary notes.

Ethical considerations

Ethical issues are important to protect the confidentiality of the participants that were part of this research. Two precautionary measures were applied throughout this thesis. First, prior to recording the interviews, participants were asked whether they wished to be anonymised to ensure confidentiality. Also, participants were informed about their right to abandon this research, if they wanted to. Second, a copy of the results was sent to the interview informants for approval prior to thesis delivery. In addition, the researcher has been attentive and careful in processing and storing the interview material (Bloomberg & Volpe, 2012).

5.3 Practical Applications

The findings presented in this research are of practical relevance for development processes in various fields that depend on the involvement of human resources, and require effective decision-making. For instance, IT teams may use the *Obeya* room during the development of projects, involving individuals from different levels of an organisation, and perhaps with the presence of customers. Similar examples are valid for development projects in construction, production, and service industries. Also, Research and Development projects can benefit from the use of the *Obeya* room as a meeting arena to facilitate decision-making. Moreover, the *Obeya* room is portable and easy to set up, which provides opportunities to use it in conferences and workshops that require collaboration and interaction of several individuals.

6 Conclusions

This study has investigated whether the impact of applying the *Obeya* visual tool to a development process in an entrepreneurial setting would have similar benefits as highlighted in the manufacturing context. The underlying theme of this visualisation aid is the ability to facilitate decision-making in terms of time and information management (Aasland & Blankenburg, 2012; Liker, 2004; Liker & Morgan, 2011; Tezel et al., 2016). As the relevant literature was investigated, additional variables were identified in relation to visualisation and decision-making. Hence, this study explored the following variables: market uncertainty, information processing, and experimentation to answer the question of: "*how can employment of Obeya impact decision-making in an entrepreneurial context?"*.

Empirical data consisted of diary notes from the conducted workshop sessions as well as interview transcripts from the workshop participants and external informants. Based on the collected data, and theoretical evidence, the findings of this study confirm that applying the *Obeya* tool can facilitate the decision-making ability in the entrepreneurial context. In practice, the *Obeya* room had an impact on cognitive (creativity and memory), social (collaboration), and emotional (involvement, excitement, and interaction) abilities, which in turn improved communication and enhanced understanding of information. Hence, use of visual aids supported by a specific process that is constantly improved in terms of content and structure was proven to increase the efficiency of entrepreneurial decision-making. These findings concur with other studies that present the effect of the *Obeya* visual room in the manufacturing setting (Aasland & Blankenburg, 2012; Appell, 2011; Flinchbaugh, 2016; Jusko, 2016; Liker, 2004; Tezel et al., 2016). Additionally, several empirical findings supported the theory with descriptions that are considered useful in understanding the underlying mechanisms of the *Obeya* room and visual tools in general. That is, visualisation has the ability to, concentrate participants' thoughts on displayed objects, increasing the efficiency of processing during meetings; and, reduce denial of information by presenting the actual situation, increasing acceptance and involvement.

Despite these benefits, theoretical and empirical findings highlight the risk of manipulation, denial and misinterpretation of data in relation to visualisation. As to practical limitations of the *Obeya* room, the need to continuously update the content and improve the process were identified. In addition, the tool requires time to mature in terms of process. Nonetheless, the main constraint that was identified in relation to visualisation and decision-making is acquiring an appropriate information source, i.e. poor data is equivalent to poor decisions. Consecutively, lack of data may trigger entrepreneurs' decision bias, i.e. they might be driven by heuristics and biases (optimism, overconfidence and representativeness) to satisfy their own needs, rather than customer needs. To reduce the impact of

decision biases and strengthen the information source, experimentation was assessed as a method of validation, commonly derived from the Lean Startup methodology. Based on this assessment, literature and empirical evidence pointed that through experimentation a non-bias information source can be developed by constantly validating assumptions, which in turn achieves more rational decisions. Also, experimentation provides the ability to adjust the direction of development to target customer and market needs, instead of pre-planned objectives. Hence, risk of failure and financial losses can be reduced. Based on these results, this study suggests that visualisation and experimentation are two from a range of other essential variables needed to facilitate decision-making. With both variables, entrepreneurs can ensure that the validity and communication of information are appropriate for decision-making.

In relation to the proposed literature gaps, this study responds to the lack of theoretical and empirical research on the topic of visualisation (Lindlöf, 2014; Tezel et al., 2016). In particular, this research focused on the use of visual aids in entrepreneurial development processes, due to the identified challenges that entrepreneurs face in terms of uncertainty and complexity. Hence, this research shed light on the literature gap of applying the *Obeya* tool to the entrepreneurial context by adapting it to the development process of a market opportunity. Additionally, adjusting this tool in practice reflected another gap, one concerned with the description of the room's set up and way of function. To fulfil this gap, the study relied on theoretical, and empirical evidence from the conducted workshops. Thus, this study attempted to fill both literature gaps. Based on the attained results, this study is considered to have both theoretical and practical relevance. That is, this study contributes to the literature that declares the lack of research on visualisation, and the challenges entrepreneurs face while developing ideas in entrepreneurships.

This study, like any other qualitative research, has highlighted several practical limitations that were faced during the research process. As presented, action research and case study research were both employed to investigate the impact of *Obeya* visual rooms in practice. Despite the challenges of being an action researcher with multiple roles and the issues with transferability that are inherent in single case studies, this study acted in accordance to the methodological procedures. However, there is an apparent need to further investigate this topic in order to benefit the academic and professional fields to a greater extent. For this reason, the researcher suggests several propositions as a starting point for follow-up studies. Due to the identified applicability of *Obeya* visual rooms, the researcher would recommend to apply the offered propositions to different managerial contexts. Furthermore, future research should attempt to conduct studies that lean more towards classical experiments to validate the benefits of visualisation and experimentation in achieving more efficient and rational decisions.

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Appendix

Appendix 1: Interview Guide, workshop participants

This interview guide was utilised to perform interviews with the participants that attended the workshops. The interview guide focuses on the applied *Obeya* room.

1. How would you describe your encounter with the *Obeya* room, what was your impression after these workshops?
    a. Based on your assessment, what were the observed improvements in comparison to the group meetings that did not apply the *Obeya* tool.
        i. Would you say that creativity, understanding, involvement, engagement, etc. changed?
2. Again, in comparison to previous group meetings, how did communication between participants improve?
3. Reconstructing the *Obeya* to the Running Lean process is time demanding as the room must be constantly adapted. What is your opinion on this matter?
    a. Would you point out other key challenges?
    b. How would you suggest to solve these matters?
4. In relation to the previous question, what improvements can be applied to facilitate the planning of every workshop session?
5. Optimism, overconfidence and representativeness are three known heuristics and biases that might influence decision-makers, how would you say these biases have effected your decisions?
6. In which parts of the applied development processes (Running Lean) would you say visualisation is most important, and why? Which additional areas would you have visualised?
7. How does experimentation, through the Lean Startup methodology, facilitate entrepreneurial processes?
    a. How would you view experimentation in relation to decision-making?
    b. How and why does experimentation contribute to more effective and secure decisions?
8. What other changes do you think are necessary to improve the *Obeya* room?

Appendix 2: Interview Guide, external participants

This interview guide was utilised to perform interviews with three external participants to support the data collected and provide different viewpoints to this thesis. The interview guide focuses on the variables introduced in the research model: Decision-making, Information-processing, Market uncertainty, and Visualisation.

1. What are the main reasons to why do many entrepreneurs fail in the development of businesses?
    a. What other challenges do entrepreneurs meet during decision-making?
        i. Change in market or customer demands
    b. How can entrepreneurs operating individually manage such challenges?
    c. How can business incubators facilitate business development for entrepreneurs?
2. From the many decisions entrepreneurs make in the early phases of development processes (in reference to Lean Startup and Running Lean), which decisions are most important, and why?
3. Which decision-making strategies are common in entrepreneurship?
    a. Use of systematic processes to achieve optimal decisions, or based on effective methods to achieve quick, yet satisfactory decisions.
4. Optimism, overconfidence and representativeness are three known heuristics and biases that might influence decision-makers, how would you say these biases effect entrepreneurs' decisions, and how to manage or avoid them?
5. What are the effects of the use of visualisation in entrepreneurial processes, and how can visualisation facilitate development processes?
    a. Improved creativity, communication, understanding, involvement, ownership, etc.
6. In which parts of development processes would you say visualisation is most important, and why?
    a. Which additional areas would you have visualised?
7. Visualisation through use of simple tools can be time- and cost-consuming, how are such challenges handled in practice?
    a. Can use of digital tools be beneficial, how and what are the constraints?
8. How does experimentation, through the Lean Startup methodology, facilitate entrepreneurial processes?
    a. How would you view experimentation in relation to decision-making?
    b. How and why does experimentation contribute to more effective and valid decisions?

Appendix 3: First Workshop

The first workshop was conducted on the 16th of February. Three participants attended including the researcher. One of the participants was not present. Table 6 illustrates the applied schedule. Figure 11 previews few images from the first workshop.

Table 6: First workshop schedule

Objectives (Running Lean process)	Issues	Time frame
Welcome – Brief introduction to Obeya room		20.00-20.15
Schedule next workshop session		20.15-20.20
Sketch Lean Canvas Model	Discuss previous canvas and create new	20.20-20.50
Prioritise start point	Choose 1 canvas to continue with	20.50-20.55
Establish infrastructure	Formulate falsifiable hypothesis	20.55-21.15
Interview strategy	Set goal for number of informants, discuss how to find prospects	21.15-21.30
Prepare for problem interview	Discuss interview guide	21.30-21.55
Concluding comments	-	21.55-22.00

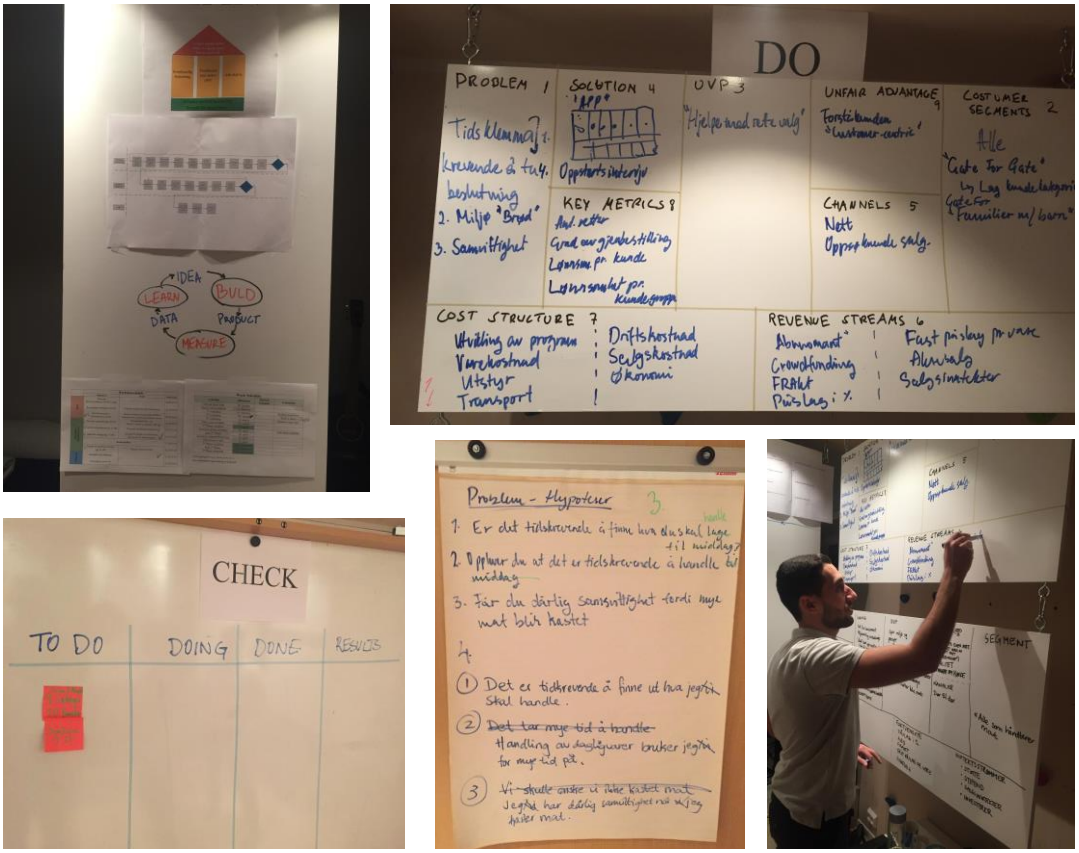

Figure 11: First workshop

Appendix 4: Second Workshop

The second workshop was held on the 24th of March. Three participants attended including the researcher. One of the participants was not present. Also, the workshop session was delayed with 45mins; hence, it lasted for 2 hours 15 mins. Table 7 presents the applied schedule. Figure 12 illustrates few images from the workshop.

Table 7: Second workshop schedule

Objectives (Running Lean process)	Issues	Time frame
Welcome – Introduction of current situation	Re-introduce Obeya	12.00-12.15
Conduct problem interviews	Discuss the interview results	12.15.12.45
Conduct problem interviews	Discuss maturity of problem, do we need to refine hypotheses and collect more data?	12.45-13.15
	Break	13.15-13.30
Build a demo	Discuss possible solutions, build/sketch simple prototype	13.30-14.15
	Break (Buffer)	14.15-14.25
Conduct problem interviews	Prepare new problem interviews for more data	14.25-14.55
Concluding comments	-	14.55-15.00

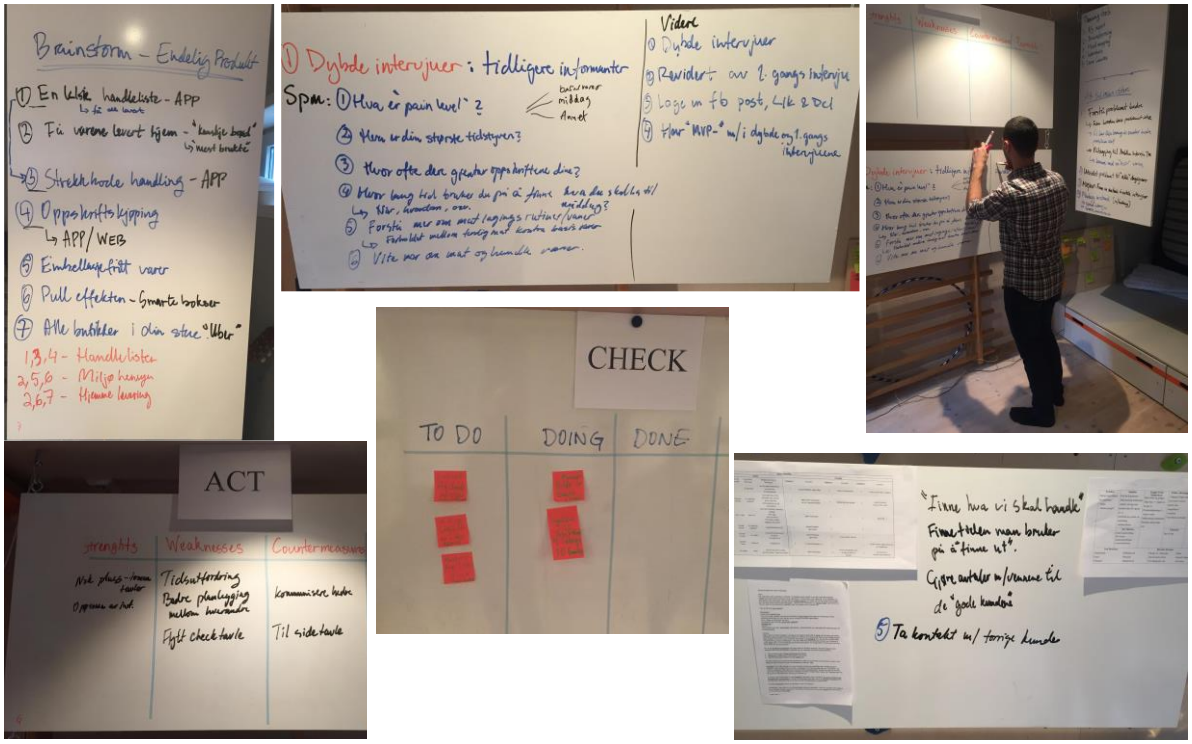

Figure 12: Second workshop