Insights in Lean values

Exploring links to sustainable development

Anna Mårtensson

Main supervisor: Professor Kristen Snyder
Co-supervisor: PhD Pernilla Ingelsson

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Faculty of Science, Technology and Media
Mid Sweden University, SE-831 25 Östersund
Phone: +46 (0)10 142 80 00
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Love to all who supported me, cared for me, inspired me, understood me, took time for me, showed interest in me and facilitated me success! Much love to my amazing supervisors and last but not the least love to my family Lars, Ellen and Mathias!

"Rivers know this: There is no hurry. We shall get there some day"
~ Winnie the Pooh, A.A. Milne

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Abstract

The Quality Management initiative Lean is a popular method used by organisations to engage in organisational development. The Lean philosophy is grounded in numerous values. The organisations must implement and apply these values to achieve the desired results. Lean poses a dilemma in that many organisations fail to implement it because they fail to change, and they fail to maintain their new organisational culture. Lean's values are linked to sustainable development principles, and organisations that have implemented Lean have achieved results consistent with a more sustainable society. Previous studies have shown that more research is needed in areas in which business leaders require more support and knowledge so that they can combine these areas to strive for sustainable development.

The purpose of this thesis is to contribute a deeper understanding of the application of Lean values when implementing Lean, and the potential to interlink to sustainability theory. To achieve this purpose, studies have been conducted in three organisations. Data were collected through a survey, interviews, and a systematic literature review was conducted that was also used to analyse findings from the empirical data. The results have been presented in four different papers.

The findings provide deeper knowledge of Lean values during Lean implementation. They also provide a picture of the complexity in the inter-linkages between the values embodied in Lean and sustainable development principles. This thesis shows that the length of time that Lean has been implemented affects the kind and extent to which values are visible in an organisation: more values are visible in organisations that have worked the longest following Lean implementation. It has also been found that the values articulated in an organisation's vision and strategy for implementing Lean have a greater perceived presence among employees than other Lean values. As well, differences were found in the presence of Lean values between the operational level and the strategic level of an organisation. However, findings indicated that the Lean values that were visible were more often fragmented rather than a pure value as presented in the theory. The findings also showed that interlinkages between some of sustainability principles and Lean values are more visible in one of the two organisational levels. For example, ´Waste reduction´ was only visible at the operational level.

Implementing and applying Lean takes time and requires a change in the organisational culture. This thesis concluded that the Lean values of the 'System view' and 'Long-term thinking' have low presence and are not a part of the values considered most important to employees when implementing Lean. For organisations at the beginning of their implementation, this knowledge may be good to consider as failures with implementation are often due to the fact that change in organisational culture does not happen as intended. This finding indicates that there are gaps in the knowledge among employees about the important links between Lean and sustainable development. It is difficult to draw boundaries between the values when they should be recognized as a system.

Keywords: Lean, sustainable development, organisational development, organisational culture, values

Summary in Swedish

Kvalitetsinitiativet Lean är för organisationer ett populärt sätt att arbeta med organisationsutveckling. Lean, som ses som en filosofi, grundas i ett antal värderingar som utgör dess bas. Dessa värderingar behöver implementeras och tillämpas i organisationen för att önskade resultat skall kunna uppnås. Ett dilemma med Lean är att många organisationer misslyckas med implementeringen på grund av att de inte lyckas ändra och bibehålla den nya förändrade organisationskulturen. Värderingarna inom Lean har kopplingar till principer för hållbar utveckling och organisationer som implementerat Lean har nått resultat i linje med ett mer hållbart samhälle. Tidigare studier har visat att mer forskning behövs inom området då verksamhetsledare är i behov av mer stöd och kunskap för att kunna föra samman dessa områden i organisationer och därmed driva utvecklingen i en hållbar riktning.

Syftet med denna avhandling är att bidra med djupare kunskap i tillämpningen av Lean värderingar vid implementering av Lean, samt kopplingar till hållbar utveckling. För att uppnå syftet har studier genomförts hos tre organisationer. Empiri samlades in genom en enkätstudie och intervjuer. Dessutom gjordes en systematisk litteratur studie, som använts för att analysera insamlad empiri. Resultaten har presenterats i fyra olika artiklar.

Resultaten bidrar med fördjupade kunskaper om värderingar inom Lean under implementeringen av Lean. De ger också en bild över komplexiteten som finns kring kopplingarna mellan värderingar inom Lean och principer för hållbar utveckling. I denna avhandling visar resultatet att tiden för hur länge implementering av Lean har pågått påverkar antalet synliga värderingar i en organisation. I detta fall är fler värderingar synlig hos den enhet som arbetat längst med implementeringen. Det har också framkommit att de värderingar som organisationen valt att lägga till i sin vision och strategi för implementeringen av Lean har högre närvaro hos de anställda än andra Lean värderingar. Det finns skillnader i vilken organisationsnivå, den operativa eller den strategiska nivån, för vilka Lean värderingar som är närvarande på respektive nivå. De Lean värderingar som identifierats som synliga har i de flesta fall endast visat sig vara delar av hur Lean värderingarna presenteras i teorin. Kopplingarna mellan Lean värderingar och principer för hållbar utveckling är många och finns representerade inom all tre hållbarhetsaspekterna: ekonomi, miljö och sociala området. Resultatet

visar att vissa hållbarhets principer som har kopplingar till Lean värderingarna är mer synlig i en av de två organisationsnivåerna. Till exempel eliminering av löserier är mer synlig i den operativa nivån. Systemsyn, som har betydelse ur ett hållbarhetsperspektiv, har av medarbetare rankats som minst viktig av de utvalda Lean värderingarna och har låg synlighet i organisationerna.

Att implementera och tillämpa Lean tar tid och kräver att organisationskulturen förändras. Slutsatser som dragits i denna avhandling är att Lean värderingarna systemsyn och långsiktighet har låg närvaro och tillhör inte de värderingar som ses som viktigast hos de anställda vid en implementering av Lean. Då organisationerna är i början av sin implementering kan denna kunskap vara bra att förhålla sig till då misslyckanden med implementering ofta beror på att förändring av organisationskulturen inte sker som avsett. Hos de anställda finns det luckor i kunskapen kring kopplingar mellan Lean och hållbar utveckling. Att dra tydliga gränser mellan värderingarna är svårt då de snarare ska ses som en helhet.

Nyckelord: Lean, hållbar utveckling, värderingar, organisationsutveckling, organisationskultur

List of papers

This thesis is mainly based on the following four papers, herein referred to by letters:

Paper A — Ingelsson P. and Mårtensson A. (2014), Measuring the importance and practices of Lean values. *The TQM Journal* Vol. 26, Iss. 15, pp 463-474

Paper B — Mårtensson A. and Ingelsson P. (2013), *Managers Basic Assumptions When Applying Lean.* Proceedings of the 16th QMOD International Conference, Quality and Service science. Portoroz, Slovenia, September 2013

Paper C — Mårtensson A., Ingelsson P. and Öberg L-M. (2014), *Can Lean values contribute to Sustainable Development?* Proceedings of the 17th QMOD International Conference, Quality and Service science. Prague, Czech Republic, September 2014

Paper D — Mårtensson A., Snyder K. and Ingelsson P. (2017), *Interlinking Lean and Sustainability: How ready are leaders?*
Submitted 2017-10-04 to Journal of Manufacturing Technology Management

Appendices

- Interview guide Case 1
- Interview guide Case 2 and Case 3

1 Introduction

The purpose of this chapter is to introduce the reader to the subjects and context of this thesis, and to present the purpose and research questions.

1.1 Background

The United Nations (2012), suggests that individuals, companies, and organisations are important to achieving global sustainable development. Business practice, including the goods and services that businesses work with, can have a significant impact on society. Understanding what kinds of practices are in keeping with sustainability and how business and organisational leaders can develop them, is therefore important to fostering the principles and values upon which sustainable societal development is based. Within the field of Quality Management, Lean, a philosophically based management practice (Emiliani, 2010; Liker, 2004; Womack & Jones, 2003), has been a popular way for organisations to improve and develop their business. Research has shown that Lean also has a positive impact on organisational outcomes that is in line with principles forming the philosophy of sustainable development (Piercy & Rich, 2015; Rusinko, 2005; Vincent, 2009), thereby rendering Lean implementation interesting to study more in depth as it relates to sustainability.

Lean and sustainable development interlink on several levels. Lean can contribute with a framework for structured work that is missing when working with sustainability in organisations (Lindsey, 2011; Weingarden & Pagell, 2012). Lean and sustainability have common dimensions based on values and principles that make it both interesting and possible to build interlinkages for business excellence (Lindsey, 2011; Piercy & Rich, 2015). By focusing on values, business leaders can enhance business excellence by building strong organisational cultures (Yukl & Kaulio, 2011). The values and shared beliefs of an organisation´s personnel creates the organisational culture (Martins & Terblache, 2003). Shared values create an organisational culture to reach desired outcome (Chatman & Eunyoung Cha, 2003). According to Schein (2004), a culture's underlying assumptions must be understood and addressed if we are to understand what happens closer to the surface.

According to Rokeach (1979), values are core conceptions that serve as standards or criteria to guide e.g., action, attitude, choice, and rationalization in both individuals and society. Values are also the energy, the fuel that powers every human (Thurén, 2010). According to Yukl and Kaulio (2011), values can unconsciously affect attitudes and behaviour. Urde (2003) associates the values within an organisation with the question *'what we, as an organisation stand for and what makes us who we are'*. To achieve an organisational outcome consistent with sustainability Laszlo and Zhexembayeva (2011) explain that sustainability must be ingrained in the individual mind-set and integrated deep into the inside, i.e., embedded in the organisation.

The Lean philosophy is a set of values and principles (see e.g., Liker, 2004; Womack & Jones, 2003 and Emiliani, 2010), which are practiced through methods and tools. These values and principles are implemented in the organisation for the successful application of Lean (Bhasin & Burcher, 2006; Henderson & Larco, 1999). Managers play a crucial role in organisational development consistent with a Lean philosophy, meaning they must practice a committed leadership that support Lean values (Emiliani, 2010; Liker, 2004). The organisational culture begins with leaders, who are responsible for continuously evolving the culture (Schein, 2004). According to Saratun (2016) organisations require sustainability in their corporate strategy and culture if managers are to have the ability to incorporate and engage employees in sustainability issues.

Lean theory is well developed and it is important that the reason for implementing Lean is well known in the organisation and supported by technical tools and the organisations cultural (Bhasin & Burcher, 2006). However, most attempts to implement and apply Lean philosophy in a sustained manner fail (Bashin, 2012). Even if success factors in Lean implementations are known it seems that it has been difficult for such implementations to achieve their desired results (Bhasin & Burcher, 2006; Yamamoto & Bellgran, 2010). One reason for this is managers' lack of ability to change an organisational culture that reflect and adopt Lean values (Ibid.). Lean´s success depends on both organisational and cultural factors. The key to the successful implementation of Lean is that managers support and actively live Lean culture (Convis, 2001).

Since the values that constitute an organisation´s culture (Chatman & Eunyoung Cha, 2003) are practiced through behaviours, norms language, etc., it is of interest to explore the areas in which the value-based philosophy of Lean connects to sustainable development in organisations. Lean has connections to sustainability and can contribute with outcomes consistent with United Nations' (2012) goal to increase organisational involvement in global sustainability. However, if organisations that implement and apply Lean are to have a chance to contribute to sustainable development, they need to be clear about and work with their values to build a culture for success. Weingarden and Pagell (2012) suggest further the need for studies on Lean practices and sustainability in all three of the sustainability aspects: the economy, the environment and society. Piercy and Rich (2015) highlight that organisations must not see quality and sustainability as an option: they are necessary for development and improvement. All the enablers of sustainability are required to achieve this development (Azevedo et al., 2012). This thesis aims to increase our knowledge of the presence and practice of Lean values both during Lean implementation and in the field where Lean values interlink with the theory of sustainable development to help organisations increase their ability to become more sustainable.

1.2 Purpose and research questions

The purpose of this thesis is to contribute a deeper understanding of the application of Lean values when implementing Lean, and the potential to interlink to sustainability theory.

RQ 1.
What Lean values can be identified in a Lean implementation? And how are those values visible?

RQ 2.

How can we theoretically and empirically understand the potential interlinkages between Lean values and sustainability?

2 Theoretical frames of reference

In this chapter, a theoretical alignment of Lean and sustainability will be presented to show their potential interlinkages. The first part address Lean as a philosophy and practice, focusing on values. This section is followed by a section about organisational culture that is seen as lacking in many organisations that are implementing Lean and have a direct impact on potential interlinkages between Lean and sustainability. Finally, there is a section about sustainability that explores the sustainability dimensions that interlink with Lean.

2.1 Lean, a Quality Management initiative

Lean viewed as a philosophy

Lean also known as Lean management, Lean operations, Lean production etc. is a well-known organisational development practice. It can be viewed as a philosophy intended to develop a business whose main focus is to be robust and successful (Bashin, 2013). The philosophy rests on a platform of values, principles, methods, and tools that support organisational development by combining: Long-term thinking, a Holistic view, Customer focus, Waste reduction, Participation, Continuous improvement and Committed leadership see, e.g., Emiliani, 2010; Liker, 2004; Womack & Jones, 2003.

According to Emiliani (2003), Lean is a management system designed to respond to individuals' needs in business and to deliver better outcomes for stakeholders. Seddon (2005) explains that all organisations' overall need in implementing Lean is to reach perfection. Radnor et al. (2012) defines Lean *'as a management practice based on the philosophy of continuously improving processes by either increasing customer value or reducing non-value adding activities, process variation, and poor work conditions'*. Regardless of their content, several levels within the organisational structure: values, principles, methods, and tools are connected to fulfil Lean´s purpose. Based on the literature, Lean does not seem to have a common definition. It is open to interpretation and evolution.

The residence and origin of Lean

In this thesis Lean is identified as a Quality Management (QM) initiative. According to Flynn et al. (1994) QM is defined *'as an approach to achieving and sustaining high quality output'*, here QM is seen as the collective term for the development of programs and practices that are included in the quality

movement. Examples of QM programs and practices include Total Quality Management, Six Sigma, ISO standard and Lean (Bergman & Klefsjö, 2010).

Before a QM initiative can be implemented and applied, a definition of the term 'quality' is helpful. There have been many definitions of quality, including e.g., '*conformance to requirements'* (Crosby, 1980), '*fitness for use'* (Juran, 1989), and '*Quality should be aimed at the needs of the customer, present and future*' (Deming, 1986). Taguchi (1986) states that, '*quality is the loss a product causes to society after being shipped, other than losses caused by its intrinsic function"*; this definition differs lightly from the other definitions because it includes the losses connected to a product. Taguchi (1986) also explains that his definition should not be interpreted as the opposite of other definitions simply because losses are mentioned. Instead Taguchi wants to direct attention to the fact that value is difficult to estimate. In this thesis, the following definition for quality will be used: *'The quality of a product is its ability to satisfy, or preferably exceed, the needs and expectations of the customers'* (Bergman & Klefsjö, 2010). According to Bergman and Klefsjö (2010), this definition includes not only the quality of the product, but also the underlying organisational culture and the customer, two aspects that are of importance both in Lean and in for organisations striving for sustainability.

The evolvement of QM has been influenced by Japan and Japanese culture (Dahlgaard-Park, 2011). This is also true to Lean, which originates from the shop-floors of Japan (Hines et al, 2005), which suffered from the aftereffects of the Second World War (Kotter, 1997). With few natural resources of its own and a reputation for poor quality (Liker, 2004), Japan was confronted by a seemingly overwhelming challenge. However, with belief in themselves and support from e.g., the United States many Japanese businesses managed to become world leaders in quality in their fields (Deming, 1986). Lean has spread worldwide starting in the auto industry as businesses started to understand the underlying aspects of Toyotas success (Womack & Jones, 1990). Although Lean originated in the production industry it can fit other varieties of organisation for instance healthcare (Joosten, et al., 2009; Mazzocato et al., 2010; Poksinska, 2010), education (Emiliani, 2005) and public service (Radnor et al., 2006; Seddon, 2005).

Values that constitute the Lean philosophy

Lean, like several other QM initiatives, is a value and principle based philosophy (Emiliani, 2010; Liker, 2004; Womack & Jones, 2003). The values

and principles associated with the Lean philosophy are also identified in other philosophies that initiate quality development and it can be difficult to separate them from one another (Dahlgaard-Park, 2011). Here, the values and principles that constitute the Lean philosophy will be seen as synonymous and will be called Lean values.

Lean values are described in more than one way, Womack and Jones (2003) presented five principles of Lean: specifying customer value, identifying and managing the value stream, using the 'pull' mechanism to support flow in the value stream and finally, when the other four principles are in place, pursuing perfection. Liker (2004) uses a '4P' model shown as a pyramid that is influenced by Toyota's internal training document the 'Toyota Way'. In this pyramid the 4Ps are, from the bottom up, Philosophy (Long-term thinking), Process (Eliminate waste), People and Partners (Respect, Challenge and Grow them) and Problem Solving (Continuous Improvement and Learning). The pyramid is further divided into 14 principles. These values are said to be needed in the organisation for the successful implementation and application of Lean (Bhasin and Burcher, 2006; Henderson and Larco, 1999). This thesis focuses on the relationship among seven values: 'Customer focus', 'Continuous improvement', 'System view', 'Elimination of waste', 'Employee engagement', 'Supportive leadership' and 'Long-term thinking'. These values were chosen since they represent a significant amount of Lean´s underlying philosophy.

The reason for applying Lean must be to benefit the customer (Emiliani, 2010). The term 'Customer focus' will be used to represent this value. It is only the ultimate customer who can define value and value is Lean´s primary focus (Womack & Jones, 2003). It is also important to meet the customer with a whole offer, not simply by optimizing a portion of the delivery (ibid). Customer focus can be maintained by working with 'Continuous improvement' that constantly evolve a business through problem solving (Liker, 2004). In Lean Continuous improvement is more than solving problems: it is a way of thinking and learning (Liker & Franz, 2011). Value to customers is created throughout supply chain: it is the essence of Lean to have a 'System view' (Bisheno & Holweg, 2009). A system is a network of independent components that work together to accomplish the system´s goal (Deming, 1994). The parts or properties in a system make sense to the entire system but may seem to have little or no meaning when looked at piecemeal (Adetunji et al., 2003). 'Elimination of waste' is closely linked to creating flow

in the value stream (Liker, 2004; Womack & Jones, 2003). The opposite of value is waste and elimination of waste is constantly ongoing within Lean. It is not enough to eliminate waste when it arises; waste must be prevented (Bicheno & Holweg, 2009). Dedicated employees that have an opportunity to engage in continuous improvement work are the engine that develops the business (Berglund, 2010; Emiliani, 2010; Kanji, 1995). 'Employee engagement' and other values will be realised only if an organisation´s managers are committed to their leadership based on Lean values (Convis, 2001; Emiliani, 2010). The 'Supportive leadership' is practiced through decision-making that involves 'Long-term thinking'. Long-term thinking, which is prioritized at the expense of short-term economic goals (Liker, 2004).

The values that constitutes the Lean platform are needed in the organisation for the successful application of Lean (Achanga et al., 2006; Bhasin & Burcher, 2006; Henderson & Larco, 1999). The choice of values that are represented and practiced affects the organisational outcome. Regardless of which values are present, there are several levels within the organisational structure: values, principles, methods, and tools are connected to fulfil the purpose of Lean. Liker (2004), for example, described this connection when explaining Toyota´s production system. These levels can also be divided into operational and strategic levels (Joosten et al., 2009).

Implementation and application of Lean

To start an implementation of Lean means to start a journey, and there is no one right way to do it (Drew et al., 2004). According to Emiliani (2010), the reason for implementing a Lean practice must be to benefit the customer. In a Lean practice, a strategic vision of what the organisation is moving towards and will become is a management issue, and it is necessary to have a strong line management leadership that is committed to change (Henderson & Larco, 1999). It seems to matter not how an organisation chooses to implement Lean but how managers apply leadership that supports the necessary cultural change that is consistent with the initiative (Hines et al., 2008; Joosten et al., 2009).

Full implementation of Lean can be reached in five to ten years and the application of Lean never ends: the time horizon depends on the organisation´s maturity (Emiliani, 1998). A long time horizon is a consequence of the cultural change needed in an organisation that is implementing a

change initiative (Senge, 2006). The failure of many manufacturers attempting to implement Lean is generally the consequence of a failure to change the organisational culture (Bhasin & Burcher, 2006; Yamamoto & Bellgran, 2010). It is not only manufacturing that suffers from implementing failure but also the public sector (Radnor et al. 2006) and health care (Joosten et al. 2009); the success of Lean is dependent on both organisational and cultural factors.

What we can summarize so far from earlier research on Lean is that the reason for implementing Lean is important: it must be to benefit the customer. To succeed Lean implementation takes time and requires a solid foundation in the organisation's culture. The application of Lean involves work that never ends.

Leadership that supports Lean

Being a manager does not automatically mean that one is a leader: these two terms are intertwined and can be synonymous. According to Yukl and Kaulio (2011) leadership is about consolidating organisational culture by expressing and striving to accomplish the organisation´s underlying values. The practice of management and leadership often overlap, but according to Nienaber (2010), unlike management leadership is not governed by boundaries.

Leaders and leadership are closely connected to organisation´s culture. It is leaders with whom organisational culture begins and who are responsible for continuously evolving that culture (Schein, 2004; Senge, 2006). Leaders have the ability to do this because their actions and behaviour constantly affect the employees, the leader can require them to behave in the same way (Yukl & Kaulio, 2011). In contrast, leadership is a shared responsibility: for leaders to exercise their leadership, they must be supported by their employees (ibid.).

It is difficult for a leader to solve problems, initiate change or inspire commitment unless his or hers leadership is based on a clear understanding of the common values and convictions that constitute organisational culture (Yukl & Kaulio, 2011). In large systems, such as organisations, each change results in a variety of effects, some of which are unintended. To fulfil the leadership commitment, managers must have knowledge of the common values and beliefs that constitutes the organisational culture (ibid.). In addition to knowledge of those values, managers must understand them at a level that allows them to practice the core values and principles that form

Lean (Saratun, 2016). If leadership is not based on a clear understanding of the values that constitutes the organisational culture, it will be difficult for a manager to initiate development or inspire involvement (Yukl & Kaulio, 2011).

When implementing Lean it is essential for managers to be committed to and have deep knowledge about the organisation and the development practice (Emiliani, 2007), and the manner in which they practice leadership is critical to the outcome of the application of Lean (Liker, 2004). Managers in an organisation practicing Lean principles should be both passionate about involving people and have both an in-depth understanding of the work and general managerial knowledge (Liker, 2004). Seddon (2005) argues that leadership is the ability to talk about how the work works with the people who do it. According to for instance Joosten et al. (2009) and Piercy & Rich (2015), for managers work means, among other things, to guide by improving and developing the workforce at the operational level. Yukl (2006) adds structuring and facilitating, both activities and relationships. For a leader making decisions, it is important to understand how different parts of the organisation affect each other (Yukl & Kaulio, 2011).

A manager´s ability to execute leadership is important in a Lean implementation because that ability affects employee behaviour. Managers must be able to apply an organisation´s values so that their actions and behaviours are consistent with expectations.

2.2 Organisational culture: How is the content related?

The surrounding and the organisational culture

Organisations' assignments and goals can vary, as can the challenges they encounter. What they have in common is that they all have their own internal culture: the organisational culture. According to Schein (2004), organisational culture is both a *'dynamic phenomenon that surrounds us at all time, being constantly enacted and created by our interactions with others'* and a set of *'structures, routines, rules, and norms that guide and constrain behaviour'*, which are brought down to the organisational level. Martins and Terblache (2003) define organisational culture *'as the deeply seated (often subconscious) values and beliefs shared by personnel in an organisation'*.

A fundamental part of organisational culture is the values underlying it, which are unique to each organisation (Campbell, 2004). According to

Chatman & Eunyoung Cha (2003) a strong organisational culture is based on two things: a high level of agreement among employees about what is valued and a high level of intensity about these values. A strong organisational culture improves an organisational performance in two ways: it energizes the employees by appealing to their higher ideals and undefined values, and it shapes and coordinates behaviours and decisions (Chatman & Eunyoung Cha, 2003; Grönfeldt & Strother, 2006).

O'Reilly et al. (1991) also state that '*if there is no substantial agreement that a limited set of values is important in a social unit, a strong culture cannot be said to exist*'. Kotter (1996) argues that there must be a sense of urgency if an organisation´s existing culture is to be changed. Organisational culture can also coevolve over time as the organisation goes through different stages of development (Schein, 2004). During the different development stages different things will happen to the culture, which will play a different role depending on what the organisation is exposed to. The establishment of a new or modified organisational culture is a long-term process (Kotter, 1996). By studying the organisational culture, it is possible to see what will occur, how it is created and embedded, and how it evolves (Schein, 2004). It is also possible to find out how it constrains, stabilizes and provides structure and meaning to the organisation's members (Schein, 2004).

Organisational culture consists of the individuals in the organisation. Since the organisation's culture is important for its results, it is important for its individual to share that culture. Organisations are constantly challenged by external factors and therefore need the ability to adapt and change their culture. One important component that grounds the individuals and the organisation is the values that are espoused in the culture.

Values a part of the organisational culture

Values, together with vision and mission, help to drive the organisation forward (Mirvis et al, 2010). Since an organisational culture contains several levels (Martins & Terblache, 2003; Schein, 2004) it is important to understand how these levels associate with and affect one another. Schein (2004), describes culture at three levels. At the bottom there are underlying assumptions that contain unconscious, taken-for-granted beliefs, perceptions, thoughts, and feelings, which are also described as the group's DNA. The middle level is espouses beliefs and values: represented by strategies, goals,

and philosophy. At this level, rules for beliefs, ethical and moral behaviour exist. At the top, there are artefacts: the visible organisational structures and processes and, how people speak and behave (ibid.).

According to Rokeach (1973), values are core conceptions of the desirable within every individual and society as serve as standards or criteria to guide, for instance, action, attitude, choice, and rationalisation. Behaviour can be affected by things other than culture, but a group's behaviour is also based on shared assumptions that are taken for granted (Schein, 2004). The individual values is based on feelings, morals and aesthetic experiences (Thurén, 2010). Values are also the energy, the fuel, which powers every human (ibid.). *'The organisational values answer, in principle, the questions of what we, as an organisation stand for and what makes us who we are'* (Urde, 2003). Core values can contribute to continuity and far-sightedness by also being a part of the corporate vision (ibid.).

Values in themselves gives no idea of how they are connected or how they should be prioritised. To do that, they must be linked to the organisation's vision and strategic work (Yukl & Kaulio, 2011). Rokeach (1973) shares this understanding, arguing that values are capable of being structurally organized in terms of, for instance, priority, extensiveness, and consistency. Senge (2006) describes values in the following: *'most needed are ways to know what is important and what is not important, what variables to focus on and which to pay attention to'*, i.e., a guide to help people in their daily work. Senge (2006) also describes that there is a need for ways to do this that can help groups or teams develop a shared understanding and that values are helpful only if they can be translated to concrete behaviours. If a structure for managing values is missing, those values still have the ability to unconsciously affect attitudes and behaviours (Yukl & Kaulio, 2011).

The connection between values, beliefs and assumptions can start with shared perceptions into a group that evolve to shared values and beliefs, hopefully becoming shared assumptions (Schein, 2004). If values and beliefs are embodied in an organisation's philosophy they can predict much of the behaviour seen in the organisation (Schein, 2004). Behaviours can be described at the operational level of an organisation as what happens in the workplace when specified techniques and tools are used (Hines et al., 2008; Joosten et al, 2009). At the strategic level of an organisation, they can be

described as, the place where strategy, vision and purpose provide guidance, and where leadership (Hines et al., 2008), approaches (Piercy & Rich, 2015), and sociotechnical aspects, i.e., interactions between social and technical elements (Joosten et al., 2009) are found.

It is not uncommon for an organisation to express some values, for example, by having them written down, but when beginning to study how these values appear in the organisation, other values appear to be real (Schein, 2004). This may be because things, for example, values are not derived from the organisation's origins (ibid.) or that they have not been appropriately communicated to the employees (Yukl & Kaulio, 2011). Although modifications of organisational structures can be made relatively quickly, creating a shared understanding of the organisation's vision and values may take longer (Sinkula et al., 1997).

Summarizing the above, it is important to recognize that the culture of an organisation consists of several levels that are intertwined. The first level is the unconscious, inner assumptions. The second level is the values and beliefs. The third level is the behaviours, structures and artefacts. An organisation's cultural values must be connected with vision and, mission and must be consolidated in its goals. If an organisation has deeply rooted values, behaviour in that organisation can be predicted.

2.3 Sustainable development and sustainability

Definition and explanation of sustainable development

The concept of sustainability is often perceived as vague (Kolari, 2008) and unrelatable. Furthermore development can be interpreted in different ways, Gehring (2008) defines development as '*the process of expanding people´s choices, enabling improvements in collective and individual quality of life, and the exercise of full freedoms and rights*'. Together the two concepts form what we should see as the ultimate pursuit: sustainable development. Bugge (2008) describes sustainable development as a principle. In this context sustainable development is defined as the ability to '*meet the needs of the present without compromising the ability of future generations to meet their own needs'*: this is the definition that the Brundtland Committee presented in the report titled 'Our Common Future' (WCED, 1987).

The WCED's (1987) definition can be seen as indeterminate and not taking a stand, leaving much room for interpretation. Nevertheless, the WCED´s definition is accepted by actors around the world and is the definition used in this thesis. At the Rio Summit in 1992, the United Nations further explained the above definition and adopted a set of 27 guiding principles, as documented in Agenda 21 to guide future sustainable development. The Rio Summit´s result, the Declaration on Environment and Development, defines the rights of people related to development, along with their responsibilities to safeguard the common environment (Quaddus & Siddique, 2001). Since 1992, environmental and sustainable development issues have been pushed to a higher priority on social agendas.

Sustainable development is often divided into three separate areas: economic development, social development and environmental protection (Winter, 2008). These three areas are connected and cannot be separated from each other in the context of sustainable development: they are seen as a single interdependent unit. Nevertheless, one area—the environment—is seen as more important than the other two. Society and economics that are built on humanity cannot function without the biosphere, whereas the biosphere can function without human impact (Winter, 2008). This difference between the areas is the basis for the depiction of sustainable development as a structure with three pillars, with economic and social development forming two pillars standing on top of foundational pillar—the environment—as the floor.

Sustainable development has been on the global agenda for decades. Although there is room for interpretation in the definition of sustainable development. Its common foundation is the three aspects of environmental, economic and societal development.

Principles of sustainable development

To explore the field of sustainable development its content will be further described. Even if the definition is perceived as there are interpretations that has made it comprehensible and more concrete for people and organisations. In 'Our common future' Bugge (2008) explain the definition through four 'core elements': Social equity and justice meeting basic needs for all, Integration of environmental considerations into all aspects of economic and social development, An absolute prohibition on destroying the environment and natural resources upon which future generations´ lives and well-being depends, and A long term view in decision-making.

Lindsey (2011) describes sustainable development through three core principles that help society develop and implement sustainability: improved sustainability is achieved through reducing wastefulness, improving quality improves sustainability, and sustainability is best achieved through implementing better systems. Stegall (2006) suggests a philosophy for designers to concretise sustainable development by thinking of resources as a never-ending circle. In nature when a life ends, its waste will become food for another. For products this means that their material degrades to nourishment or is reclaimed or recycled. Materials that do not degrade or cannot be reclaimed or recycled cannot be used in a sustainable society (ibid.).

Acting for sustainable development

The United Nations (2012) has resolved that organisations are one of the most important actors in Sustainability. It is organisations together with regional initiatives and citizens' demand that will make sustainable development happen. Sustainable development is everyone's responsibility. For an organisation to be considered sustainable, it is not enough to have a sustainable product or service, as it is also necessary for the organisation to have core values consistent with sustainable development (Lazlo et al, 2005). Worldwide, more than 75 percent of executives claim to believe that sustainability is important to their companies' financial success: however, as of 2010, approximately 30-40 percent are taking serious steps to embed it into their business practices (Mirvis et al, 2010). Credible CEO (chief executive officer) leadership and appropriate organisational infrastructure would help reduce these gaps. But behind them we believe are more foundational considerations: how sustainability features in a company's vision, mission, and values (Mirvis et al, 2010).

Stakeholder value, based on a company's economic, environmental and social performance, is a new and largely untapped source of competitive advantage (Lazlo et al, 2005). Mirvis et al (2010) state that more customer and stakeholder involvement can increase businesses' focus on sustainability and social responsibility. By identifying and acting on stakeholder-related business risks and opportunities, companies can reduce costs, differentiate products and services, enter new markets that serve unmet societal needs, enhance corporate reputation and influence industries *'rules of the game'* (Lazlo et al, 2005).

Organisations play an important role in the global pursuit of sustainable development. Although organisations claim that sustainable development is important, the outcome of the proportion of their actions is significantly lower. What needs to be done is known but still does not happen. It is also known that sustainability must be incorporated into individual and organisational values if organisations are to be considered acting in a sustainable way according to principles of sustainable development.

Interlinkages between sustainable development and Lean

Sustainable development and Lean are interlinked because they share numerous of values and principles that comprise their underlying philosophies (Lindsey, 2011; Piercy & Rich, 2015). According to Tice et al. (2005), '*Lean fosters a continual improvement, waste-elimination culture that involves workers throughout the organisation*', which is conducive to sustainability values. Both sustainable development and Lean take into account a broad concept of development of both the product and service, along with the processes throughout the entire value chain, as a part of their philosophy (Vincent, 2009).

The interlinkages described above span the breadth of sustainable development i.e., through all three aspects: the environment, the economy and society. This breadth is shown in Table 1 on page 17, which is a summary of selected literature with dimensions that include interlinkages between Lean and sustainable development. The term 'dimensions' is used to describe the interlinkages since a dimension includes a field and not a single object. In other words, a dimension in this case is a link and context that includes activities that reflect a value at both the strategic and operational levels in an organisation.

Table 1 Summary of literature that supports dimensions with interlinkages between Lean and sustainability.

Dimensions with interlinkages between Lean and sustainability	**Selection of references in the literature**
Stakeholder requirements/value – also those with third-party interest	Wu et al. (2015), Lazlo et al. (2005)
Quality – improve quality	Piercy & Rich (2015), Lindsey (2011), Rusinko (2005), Weingarden & Pagell (2012)
Reduce waste/resources	Piercy & Rich (2015), Rusinko (2005), King & Lenox (2001), Lindsey (2011), Kleindorfer et al. (2005), Azevedo et al. (2012), Tice et al. (2005)
Transparency – insight into the organisation	Piercy & Rich (2015), Azevedo et al. (2012)
Ethics – employee involvement and engagement, working environment, complying with laws and regulations	Bonavia & Marin-Garcia (2011), Azevedo et al. (2012), Rusinko (2005), Vincent (2009), Tice et al. (2005), Piercy & Rich (2015)
Long term thinking – involvement of community, business decision making	Piercy & Rich (2015), Rusinko (2005)
System view – value throughout the supply chain, consideration of natural systems	Rusinko (2005), Azevedo et al. (2012), Vincent (2009)
Continuous improvement	Asif et al (2011), Rusinko (2005), Vincent (2009), Tice et al. (2005)

In Piercy and Rich (2015) six (1-6) dimensions of sustainable operations where related to Lean operations: the clearest interlinkage was (1) Better quality - product quality and the associated production and supportive processes. Lindsey (2011) also comments on the quality development of products and processes as a necessary key for becoming more sustainable. The other five dimensions that have interlinkages between Lean and sustainability according to Piercy and Rich (2015), are as follows: (2) Waste reduction - generating lower environmental impact (also supported by Rusinko, 2005; King & Lenox, 2001) and reducing the company´s costs; (3) Supply chain – long-term and close relationships with the suppliers with positive effects on environment, and insight into governance, ethical and workforce issues, contributing to ethical behaviour which is also described as social responsibility (Vincent, 2009); (4) Workforce empowerment – a worker-

friendly environment with a focus on safety, engagement, empowerment and worker training; (5) Transparency - information and communication clarifies and supports internal demands; and (6) Community strategy – nurturing a positive reputation in the local community which is often a prerequisite for organisational survival.

Linkages between Lean and sustainability are also presented in Lazlo et al. (2005), who have shown waste reduction to decrease environmental impact supports a mind-set that focuses on stakeholder value (including third-party stakeholders), and stimulates the ability to connect to others and be empathetic. The manner in which Lean is defined affects how strong the linkages to sustainability will be: a full-range, proper definition, which includes both the operational and the strategic level of Lean, is to be preferred (Piercy & Rich, 2015).

As demonstrated above, Lean and sustainable development are interlinked through shared values and principles. The common dimensions are reflected in all three aspects of sustainability: the environment, the economy and society. In this study, eight interlinkages have been chosen to explore based on the literature, as illustrated in Table 1.

3 Research Methodology

The purpose of this chapter is to explain the research methodology used in this thesis. First, however, an introduction to research methodology, approaches, and strategy is provided.

3.1 Introduction to research methodology

Kerlinger and Lee (1999) define scientific research as follows: *'Scientific research is systematic, controlled, empirical, amoral, public, and critical investigation of natural phenomena. It is guided by theory and hypotheses about the presumed relations among such phenomena'*. Olsson and Sörensen (2001) describe scientific work as a human activity that is restricted by human limitations, such as apprehension and imagination. According to Patton (2002) the purpose of research is to *'generate or test theory and contribute to knowledge for the sake of knowledge'*. The knowledge created depends on choices of research method (Arbnor & Bjerke, 2009; Olsson & Sörensen, 2011).

Research methodology is significant because it involves data collection and, analysis, enabling the researcher to provide interpretations (Creswell, 2014). According to Arbnor and Bjerke (2009), *'methodology is a mode of thinking, but it is also a mode of acting*'. By choosing a methodology, the researcher exposes him- or herself to criticism because within science, there are different methodological views with different presumptions concerning understanding, explanation and improvement (ibid.). When choosing a methodology, the researcher has several areas to consider—for instance, paradigm, ethics and aesthetic—the most important of which is how the methodology relates to the researcher's personal development (Arbnor & Bjerke, 2009). That said, research must be free from values (Thurén, 2010), personal beliefs, perceptions, biases, attitudes, and emotions (Kerlinger & Lee, 1999). Ultimately, it is the researcher who is responsible for using methods that are considered moral (ibid.).

3.2 Research Approach

The research approach is the plans and proposals to conduct the research. It involves philosophical worldviews (paradigms), research designs, and specific methods (Creswell, 2014).

Philosophical worldviews

According to Arbnor and Bjerke (2009), the paradigm is relevant when choosing methodology. The paradigm is what Creswell (2014) calls the worldview, which is the '*general philosophical orientation about the world and the nature of research that the researcher brings to a study*'. The researcher's individual beliefs, the field of the subject, and past research experiences are some issues that affect paradigm affiliation (ibid.). The positivist paradigm has been central to science and researchers since the beginning of the 19th century (Alvesson & Sköldberg, 2008). Alvesson and Sköldberg (2008) state that a researcher's primary focus in the positivist paradigm is to collect and systematize, but different alignments in the paradigm have different focuses on these two fields. Data or facts should be observable and measurable by any instrument (ibid.). Positivism was the leading paradigm in science until the 1960s, when social scientists and humanists increasingly argued that scientific insights is not limited to the statistical observation of phenomena (Alvesson & Sköldberg, 2008).

During the 1970s new paradigms included the following: structuralism, phenomenology and hermeneutics (Alvesson & Sköldberg, 2008). Significant to the hermeneutic paradigm is the '*hermeneutic circle*', which refers to the idea that a part can be understood only through the whole, and the whole can be understood only through its parts (ibid.). In the hermeneutic paradigm, social context is significant since things that are created are influenced by history, and history looks different from different aspects. The hermeneutic paradigm also provides remarkable freedom to make interpretations linked to other theories for the purpose of seeking understanding and explanations (Alvesson & Sköldberg, 2008). This is further explained by Persson and Sundin (2014) since there is a mutual connection between understanding and the surrounding world. For humans, understanding is a part of the interpretations that must be made by all individuals. It is the interaction between understanding and interpretation that constantly increases individuals' preunderstanding (ibid.).

According to Morgan (2014), the pragmatic paradigm claims that knowledge is acquired through a combination of action and reflection. Biesta (2010) states that pragmatism should be seen as a set of philosophical tools that can be used to address problems, not as a philosophy itself. However, the underlying philosophical thoughts are that '*beliefs must be interpreted to generate action, and*

actions must be interpreted to generate beliefs' (Morgan, 2014). To clarify, this means that the human experience is involved in research because the researchers´ own actions and beliefs become a part of the research experience arch (ibid.). Johnson and Onwuegbuzie (2004) claim that within the pragmatic paradigm, the researcher should consider both the empirical and practical consequences. When using several paradigms to encircle the stated purpose, namely, when using the best available approaches and methods, the paradigm can be identified as pragmatic (Creswell, 2014; Johnson & Onwuegbuzie, 2004). The pragmatic paradigm gives the researcher freedom to choose of for instance, research methods, techniques, and procedures, because what is important is to understand the problem (Creswell, 2014).

3.3 Research strategy

According to Onwuegbuzie and Leech (2006), at the beginning of planning a research method, a goal is set that represents the study's long-term aim. The goal is followed by the research objectives. Onwuegbuzie and Leech (2006) present five ways to use research: to explore, to describe, to explain, to predict and to influence. Exploration and description are further described below.

Exploratory studies aim to explain sequences of events and the relationship among various phenomena (Olsson & Sörensen, 2011). Usually, such studies use several techniques to collect data because they aim to be comprehensive (ibid.). According to Kerlinger and Lee (1999), exploratory studies have three purposes: '*to discover significant variables in the field situation, to discover relations among variables, and to lay the ground work for later, more systematic and rigorous testing of hypotheses'*. An exploratory study is often quantitative, but can also be qualitative (Olsson & Sörensen, 2011). Qualitative methods can be used in exploratory studies to add depth and details, for example, to fill in meaning and details when a quantitative study has previously revealed a pattern (Denzin & Lincoln, 2005).

A descriptive study involves identifying and describing (Onwuegbuzie & Leech, 2006), and the researcher attempts to eliminate all preconceptions when gathering data (Denzin & Lincoln, 2005). Descriptive studies are thorough, detailed, and (usually) quantitative: often, only one source of data is used (Olsson & Sörensen, 2011). Creswell (1994) classifies qualitative research as descriptive in '*that the researcher is interested in process, meaning, and understanding gained through words or pictures'*.

Induction, deduction and abduction

The inductive approach is based on specific facts and moves to a general statement or hypothesis (Kerlinger & Lee, 1999). Explorative studies primarily use inductive methods (Onwuegbuzie & Leech, 2006). In contrast, deductive approach starts with the hypothesis, which will be narrowed and tested on a more specific question (Kerlinger & Lee, 1999). Creswell (1994) states that when the theory has emerged late in the research process, when data have been collected and analysed, the deductive approach is appropriate. Abduction is a mixture of deduction and induction that is based on the empirical data and theory involved in the analytical process; the two alternated during the ongoing process (Alvesson & Sköldberg, 2008). Alvesson and Sköldberg (2008) also claim that an abductive approach is related to hermeneutics.

3.4 Research design

Quantitative design

Historically, quantitative research, by doing experiments, was the accepted and best known way to do research (Creswell, 2014). Quantitative research originates and belongs to the positivistic philosophy (Johnson & Onwuegbuzie, 2004; Creswell, 1994). Quantitative research views reality as `*objective*`, and `*out there*`, independent of the researcher, and something can be measured objectively by using a questionnaire or an instrument (Creswell, 1994). The questions are formulated to determine a relation or to perform a comparison, they specify a multivariate relationship between independent and dependent variables and relate to a theoretical perspective (ibid.). Creswell (1994) also explains that a quantitative research design can either aim to generalize from samples to a population or assess whether special factor affects the sample: it is the best approach for testing a theory or explanation. Quantitative research questions uses variables and can be formulated with, for instance, '*compare*', '*relate*', or '*describe*'. Quantitative designs can be divided into experimental designs and non-experimental designs. Experimental research uses two or more groups determine whether one or more specific treatments influences the outcome. Non-experimental designs, for instance, correlational designs or surveys, are used to describe and measure and association or relationship. They apply to one or more variables (ibid.).

Qualitative design

The qualitative research is said to be raised from anthropology, sociology, the humanities, and evolution (Creswell, 2014) and are structured in four major interpretative paradigms: positivist and post-positivist, constructivist-interpretive, critical- and feminist-post-structural (Denzin & Lincoln, 2005). Qualitative research is interpretative: by taking voluminous amounts of information and reducing it to patterns, categories, or themes, the researcher interprets the phenomenon that has been studied (Creswell, 1994). Qualitative research is an approach to use when the researcher does not know in advance which important variables to examine (ibid.), and questions such as '*what*' and '*how*' follow (Borglin, 2014).

In qualitative research, the assumption is that the only reality is constructed by the individuals involved in the research situation. Thus, multiple realities exist in any given situation: the researcher, the individuals being investigated, and the reader or audience interpreting a study (Creswell, 1994). The researcher's biases, values, and judgement are considered as to be useful and positive, which is openly disclosed if those biases, values, and judgements are stated explicitly in the report. Denzin and Lincoln (2005) describe the qualitative researcher as '*a bricoleur or a maker of quilts*': depending on the subject that the researcher represents, the researcher may need to invent and bring together different tools and techniques to fit her or his strategies, methods and empirical material. It is not always possible to make different choices to explain the method in advance; instead, the choice is based on the prevailing situation (ibid.). Qualitative research is described by Denzin and Lincoln (2005) as '*a situated activity that locates the observer in the world*'. In qualitative research things are studied in their natural settings in attempting to clarify these phenomena. Creswell (1994) places the qualitative method in the exploratory field: because the variables are unknown, context is important and the studies may lack a theoretical base. In qualitative research, the literature should be used in a manner consistent with the methodological assumptions; specifically, it should be used inductively so that it does not direct the questions asked by the researcher (ibid.).

Data collection for the qualitative method can be accomplished through purposeful sampling, which, according to Patton (2002) involves selecting a specific number of cases depending on the purpose of the research and the available resources. If the cases are information rich, a small number of people

may be sufficient to obtain valuable in-depth empiricism, whereas a large number of people may be sufficient to explore a phenomenon, attempt to document diversity, or understand variation (ibid.).

Mixed-method design

A mixed-method research design represent both quantitative and qualitative research and can also be called a triangulation (Creswell, 2014). The triangulation can end up in many different combinations (ibid.). According to Johnson and Onwuegbuzie (2004), mixed methods can be seen as the third research paradigm, which can bridge the quantitative and qualitative paradigms. The use of a mixed-method approach opens the possibilities for the researcher either to integrate quantitative and qualitative data, which can be useful if neither a quantitative nor a qualitative approach has an inadequate answer, or to use the strength from both approaches to provide the best understanding of a phenomenon (Creswell, 2014). According to Borglin (2012), the purpose of mixed methods is to '*obtain the optimal answer to the research question'*. According to Johnson and Onwuegbuzie (2004), a mixed method more likely describes what researches are using in practice.

A mixed-method design originates in the pragmatic paradigm since researchers using mixed methods look into several approaches during the research process (Creswell, 2014). The pragmatic paradigm represents the research methods that are performed in the field between the quantitative method and the qualitative method, namely, research methods that in one way or another are influenced by them both (Johnson & Onwuegbuzie, 2004). According to Creswell (2014), a mixed-method design can be appropriate when a complex reality is studied, not when, for instance, a descriptive or cross-sectional study is done. According to Onwuegbuzie and Leech (2006) the research question in mixed methods research combines or mixes quantitative and qualitative research questions within the same question. This requires that the collected data and analysis be concurrent, sequential, or iterative (ibid.). Within a mixed-method design, the research question can be modified and changed, and new research questions can emerge during the research process (Borglin, 2012).

3.5 The research journey

The worldview

The field of Quality Management originated in factories during the industrialization era (Taylor, 1911). For decades, it has been followed up by hard measurements that focus on finding an explanation for things that have happened—see, e.g., Shewhart (1980) and Deming (1986)—and thus exhibit a positivistic paradigm. Quality Management as a subject is moving, and according to Dahlgaard-Park (2011), it is influenced by, e.g., a holistical view, organisational learning and an ethical mind-set, which can be seen as more consistent with the hermeneutic paradigm. The field of science in which this thesis is written is situated in the science and technical part of the Mid Sweden University. Against this background, both the main subject and the research environment are influenced by the positivistic paradigm. However, this writer´s own interests lie in the hermeneutic paradigm since she is interested in understanding linkages between things that affect us as human beings and the environment in which we are living. At the same time, it is her belief that context is important in different situations and that the same phenomenon can have different meanings based on who is studying it at the time. This view of the author´s own paradigm is more consistent with the hermeneutic paradigm as described earlier in this part. In this thesis, the paradigm is mostly pragmatic, since choices and orientations are influenced by both the positivistic and the hermeneutic paradigms, and the writer´s actions are taken from her own beliefs.

Strategy choices

The research has been descriptive both to examine and describe how Lean values and behaviours are visible, and to discover significant variables and relations among variables. The research was exploratory, using an abductive approach, to examine interlinkages between Lean values and sustainability.

Applied methodology design

The design of the methodology in this thesis is inspired by the model '*Steps in the mixed method research design*' in Onwuegbuzie and Leech (2006), see Figure 1. To clarify, this means that the used methodology is inspired by the mixed method, not to be confused with using the mixed method as a strategy for the study. The steps emphasized in the model are further described in the upcoming parts.

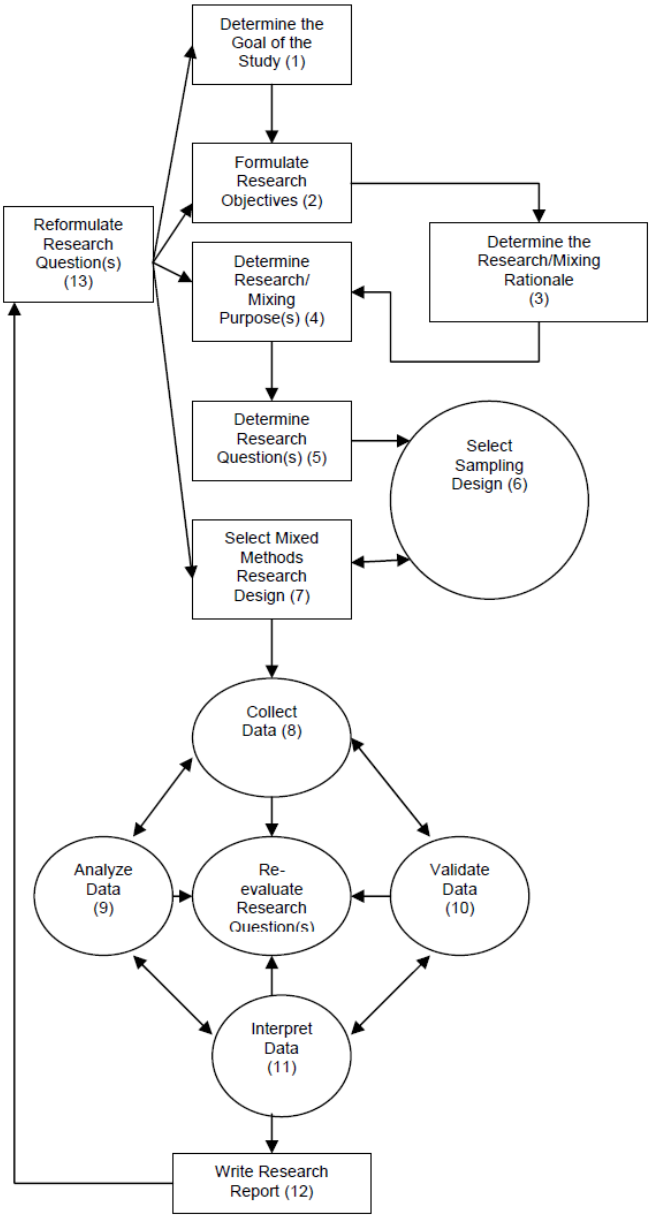

Figure 1 '*Steps in the mixed method research design'* in Onwuegbuzie and Leech (2006).

Steps 1 to 5 in the figure show the paradigm, approaches, strategies, purpose and research questions that are explained earlier in the thesis. The methodology design (step 7) is inspired by several methods. It started with an explanatory sequential mixed method that, as explained in Creswell (2014), starts with a rigorous quantitative sampling and is followed up with a qualitative purposeful sampling. The first quantitative, describing phase is used to formulate the qualitative, exploring in depth phase (ibid.). In this case, the qualitative sampling is inspired only by the quantitative result; it is not a purposeful sampling aiming to build on the previous result. The research is also sequential in the way that each paper is inspired by findings in the previous paper(s) and has inspired to the design of methodology (step 8-11). When the papers were finished, they initiated steps 12-13.

Using a research method inspired by a mixed-method design allowed researchers to move between and combine paradigms during the research process (Leech, 2010) and opened the ability to use multiple methods, different assumptions and different forms of data and analysis (Creswell, 2014).

Research purpose and questions

In this thesis the research purpose guided the development of the methods (Creswell, 1994). The research purpose was '*to contribute deeper understanding of the application of Lean values when implementing Lean and the potential for interlinkages to sustainability theory'*. To address this, three things were important: understanding Lean as a phenomenon had to be clarified, the context of Lean values in organisations had to be examined to increase understanding, and the understanding of sustainability to obtain a deeper understanding in the interlinkages with Lean values had to increase. The purpose was further elaborated by two research questions: *'What lean values can be identified in a Lean implementation? How are those values visible? ´* and '*How can we theoretically and empirically understand the potential interlinkages between Lean values and sustainability?'*. To answer these questions both random sampling and purposive sampling (Collins, 2010) were used.

The research journey in which data were collected, analysed and connected to form this thesis is illustrated in Figure 2. The main purpose and research questions were formulated based on the individual studies presented in papers A-D. This emergent research formulation is in keeping with

Onwuegbuzie and Leech´s (2006) model, *Steps in the mixed method research design,* in which the research question evolved over time through a re-evaluation and reformulation based on the four sub-studies. Formulation of the research questions also took into consideration the qualitative and quantitative nature of the data. Multiple cases are used to answer the research questions, since this potentially leading to replication and the addition of various analytical levels (Collins, 2010).

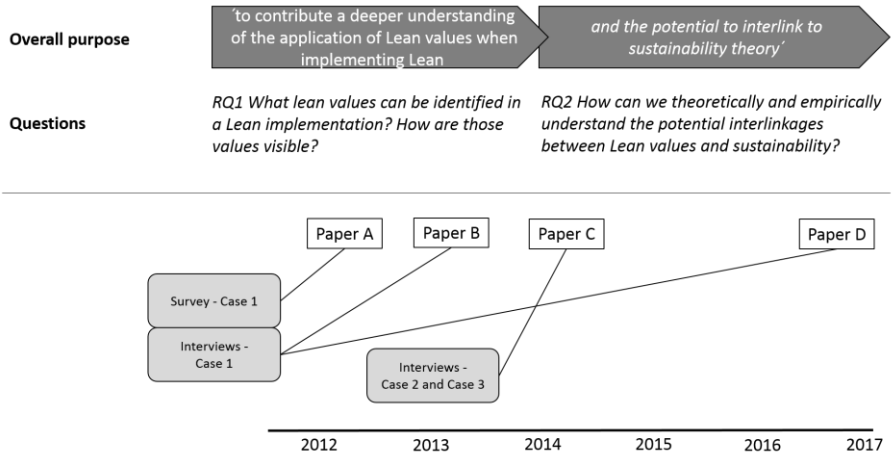

Figure 2 The research journey presented with the research purpose, research questions, collected data and written papers on a time axis.

Data collection

Mixed-method research design allows for the use several of types of data collection. In this study both quantitative, numerical data through questionnaire, and qualitative, verbal data through interviews were collected. As a data-collection method, a questionnaire that provides a numerical description of some fraction of the population was found suitable because it provides the opportunity to gather a rich amount of data to do correlations and from which to generalize (Creswell, 2014). Interviews were used to complement the questionnaire, since interviewing finds out what is in and on someone else´s mind (Patton, 2002). Data from an interview can describe and give understanding to specific phenomena or situations (Danielson, 2014). One questionnaire and two different interview guides were used. The first interview guide was used in Case 1 and the second interview guide was used

in Cases 2 and 3. Both interview guides contained open-ended questions, see Appendix I and II.

Analysing data

It is the research purpose and the research questions that determine the analytical approach (Wallengren & Henricson, 2014). The data analysis follows the recommendations for a mixed-method design, namely, to analyse each set of data following the methodological tradition (Greene, 2007). Each dataset was analysed in sequence in the order of the appended papers. Each analysis is presented below and a more detailed description can be found in the appended papers.

3.6 Case descriptions

Three cases were chosen, which are described below in brief and in more detail in the appended papers. For purposes of anonymity, the cases were given fictitious names. Details about how the cases were used in the different papers are provided in Figure 2 above.

Case 1

The results from Case 1 are presented in Papers A, B and D. Since 2008 Case 1 has been a corporation within a county council; it has approximately 445 employees in 19 clinics spread out over 15 cities. In 2009, the organisation did strategic work and decided to apply Lean as their strategic aim. The opportunities perceived by Case 1 were that it would obtain a structured way of working with continuous improvement along with increased commitment and participation from its employees.

The initial motivation for selecting Case 1 was the corporation's willingness to collaborate on a research project with the purpose of investigating employees' attitudes towards various basic Lean principles (values). The intention was also to investigate whether these settings differ depending on the progress made in the corporation's implementation of Lean. The focus was Lean values, and this case could contribute knowledge about values that are significant to an organisation. Moreover, this case can contribute information about the challenges confronting organisations that are attempting to meet upcoming sustainability requirements.

Case 2 and Case 3

Both Case 2 and Case 3 participated in a research project called KATI—KundAnpassad TeknikInformation (Technical Communication Adapted for Customers)—with the overall purpose to create conditions to efficiently produce customized technical communication in smaller companies in the region. In this project, a deeper study of Lean values and behaviours was carried out, to inventory good examples and to increase knowledge about using Lean methods and tools. As well, there was a connection to sustainability that made this case relevant to the current study. The outcomes of these cases are presented in Paper C.

Case 2

Case 2 is a department in an independent company within a corporate group operating in the global market. The independent company has approximately 1450 employees, approximately 14000 people work in the corporate group. Case 2 provides technical documentation and operations education that is useful to customers, which are both businesses and governments. The respondents in this case are a group of people representing the employees who produce technical communication and educate customers.

Case 2 was selected for empirical investigation because the department was working according to Lean and was verified by an earlier research study as an organisation that does most of its production in house rather than through outsourcing. One of Case 2's leading values is customer focus.

Case 3

Case 3 develops and manufactures a group of products that supplement other trademarked products. Case 3 is the world leader in its field. Case 3 has offices and manufacturing departments in several countries in the northern hemisphere. The organisation has 160 employees and partially out sources production. Its customers are retailers in the private sector. The organisation and its developer have won several prizes for their rapid economic growth and long-term view of entrepreneurship. Both managers and employees are respondents in this case.

The main reasons for selecting this case was the outsourcing of the production of technical communication and the fact that the organisation is known for

taking social responsibility in its location. They do not use the word Lean by themselves when describing their way of working.

3.7 Data collection

The questionnaire

The questionnaire used in Case 1, as presented in Paper A, was designed and validated by another researcher, and was presented in Ingelsson (2013). The questionnaire was used to measure the presence of the following Lean values: 'Leadership commitment', 'Participation of everybody', 'Long-term thinking', 'System thinking', 'Elimination of waste', 'Customer focus', and 'Lean leadership'. Both questionnaires were used to measure the QM culture in organisations that are implementing and applying Lean. The design of the questionnaires supports the researcher's ability to quickly obtain a picture of the whole organisation and can also serve as a tool to use when an organisation is going to work with development of the QM culture (Ingelsson, 2013).

The questionnaire's goals were as follows: to investigate the employees' perceptions of the importance and presence of Lean values and to determine whether there are any differences related to the length of time they had been working with Lean. The questionnaire consisted of 21 statements intended to represent six Lean values: 'Long-term thinking', 'System view', 'Eliminate waste', 'Customer focus', 'Supportive leadership' and 'Continuous improvement'. Each value was represented by three to five statements that were was developed by a research team. The statements were a mix of reused statements from the earlier-described questionnaire and newly designed statements. Some of the reused statements were improved, since their internal consistency reliability had failed in two of the earlier-measured values. Literature reviews were conducted to enlarge the knowledge among the team's researchers. Each researcher gave suggestions to reformulate the reused statements and formulated new statements that could represent the agreed-upon values. All the statements were discussed in the research team until the team reached a consensus about which statements to use to represent each value. When the research team considered themselves finished with the draft of the questionnaire, it was handed to the Lean coordinator at Case 1 and an executive group at a manufacturing company so they could read and comment on the statements. This was done to prevent misunderstandings about how the statements in the questionnaire were formulated.

To measure both presence and importance, the questionnaire was designed to consist of two parts. The first part asked the respondents about the extent to which the statements were represented in their everyday work and the second part asked the respondents to answer whether they value the statements as important. Each statement had to be answered by ranking according to a seven step Likert scale. The statements that represented the first part were answered as follows: 1 represented 'Totally disagree', and 7 represented 'Totally agree'. The second part was answered according to: 1 represented 'Not at all important', and 7 represented 'Very important'. The entire questionnaire is presented in Paper A. By separating the questionnaire into two pieces, it was possible to reduce the risk that the respondents would be influenced by their first answers. Before the questionnaire was used at Case 1, it was tested in a manufacturing company that had applied Lean sporadically for five years.

Administration of the questionnaire

At Case 1, the questionnaire was handed out to two clinics in each of the three selection groups; 'pilot clinics', which –applied Lean for 18 months; 'started clinics', which –applied Lean for 9 month,; and 'not yet started clinics', which had –not started to apply Lean. Ninety-four questionnaires were returned and analyzed from the 137 possible respondents, for a total response rate of 70 percent. The clinics were selected with help from the Lean coordinator. The Lean coordinator also handed out the questionnaires to the clinic managers, who handed them out to the respondents, collected them, and sent them back to the university. An introductory letter with information about the study's purpose, why the employees were asked to participate, and the anonymity their answers followed the questionnaire. The managers also received the introductory letter, but their version also contained instructions about handing it out and returning it. The whole data-collection at Case 1 (i.e., both the survey and the interviews), was conducted during the summer and fall of 2011.

Questionnaire analysis

The result from the questionnaire administrated at Case 1 and presented in Paper A were analysed using SPSS. Mean and standard deviation for the six clinics with respect to the presence and importance of all the factors were calculated first. One-way ANOVA was used for five factors (one value did not

meet the set criteria for internal consistency, see results in Paper A. The reason for this analysis was that the study's purpose was to investigate whether there were any differences between the clinics as a result of the length of time that Lean had been applied. ANOVA was done for both presence and importance. The Wilocoxon Signed-Rank Test was done as a rank test and post hoc analyses with Sheffé's post hoc criterion for significance were performed.

Interviews

Interviews were conducted with five of the organisation's leaders in Case 1 Simultaneous to administration of the questionnaire. The goal of the interviews was to identify what the organisation's managers perceived as the purpose of applying Lean, what they hoped to achieve when using Lean and their view of Lean's basic elements. The sampling was purposeful so that the respondents were picked with help from the Lean coordinator. The Lean coordinator had criteria for choosing respondents: they should be working as managers and they should represent the three groups that also were selected for the survey. It showed that one manager could be responsible for more than one clinic, which means, that one person at the same time can be manager for a 'Pilot' clinic and a clinic 'Started clinic'. The interview guide contained open-ended questions, and follow-up questions were asked to capture the leaders' personal attitudes about perceptions of Lean to the greatest extent possible. The interview guide is shown in Appendix I. The respondents were permitted to participate in both the interviews and the survey. The interviews were recorded and transcribed. The recording of one interview with a leader was in such bad condition that further use of the data was impossible.

Analysis of the interviews in Paper B

Data from two of the four interviews from Case 1 were analysed and presented in Paper B. These two respondents were chosen for representing the two groups; 'Pilot' and 'Not started', which had a significant difference in the survey presented in Paper A, when it comes to presence of the values 'Continuous improvement', and 'Supportive leadership'. The purpose in Paper B was to obtain the results from the interviewed managers to identify their basic assumptions (i.e., purpose and underlying values) about applying Lean. Another purpose was to investigate whether these basic assumptions are consistent with what the literature describes as important for succeeding when applying Lean. The transcribed interviews were read several times by a research team of two persons. Each member of the team chose phrases from

the text that they thought represented a relevant answer that, according to the literature, identified Lean values. The members compared their results with each other, discussed their answers and arrived at a conclusion. During this process, the members returned to the original texts several times to ensure that the selected phrases were not detached from their context.

Analysis of the interviews in Paper D

All four interviews from Case 1 were analysed a second time using a different research question and analytical process, which is presented in Paper D. The transcribed interviews were read through several times, and if a section in the text was interpreted as an indication of existing interlinkages from the framework with the dimensions, it was highlighted. In the next step, only the highlighted sections that were examples from the clinics were selected for further examination in the study. The exact words from the framework were highlighted, and if other words were used to describe the same thing, they were also highlighted. The indicators identified were sorted according to the name of the dimensions, as well as its location in the two organisational levels: strategic and operational. The strategic level is represented by strategies, vision, purpose, approaches and sociotechnical aspects, and the operational level is represented by methods, techniques and tools. The results were interpreted and compiled by a researcher with knowledge of both Lean and sustainability (not the same researcher who formulated the interview guide and conducted the interviews).

Interviews in Case 2 and Case 3

To identify best practices and areas of improvements in Technical Communication based on Lean, interviews were conducted in Case 2 and Case 3. An interview guide (see, Appendix II), was developed by a research team of five persons based on identified Lean categories that represented the following Lean values: Customer perspective, Long-term thinking, System view, Value flows, Standardisation, and Continuous improvement. The interview guide was sent to the companies in advance. Thirteen interviews were conducted—six at Case 2 and seven at Case 3. At each organisation, the research team was assisted by an internal cooperation partner to choose adequate respondents since the sampling was purposeful. The criterion for selection was the respondents' knowledge of Technical communication and/or knowledge in the process in producing and distributing Technical communication. The respondents are a mix of managers, employees and

specialists. Eleven of the interviews were conducted on-site, and the remaining two, both at Case 3, were conducted by telephone. At the on-site interviews, two researchers from the research team participated and contributed with follow-up questions. The telephone interviews were conducted after the on-site interviews, and only one researcher from the research team participated. The researcher had participated in the earlier interviews. All the interviews were recorded and transcribed verbatim. All interviews were conducted during the spring of 2013.

Analysis of the interviews at Case 2 and Case 3

The data that were analysed contained the interviews conducted in Case 2 and Case 3. The transcribed interviews were first read by each member of the research team (five persons) to select phrases that described best practices and areas of improvement. Each interview was then compiled by the research team in a series of analytic workshops, in which the identified best practices and areas of improvement were discussed and then categorized into the six categories representing Lean values. The result from the identified best practices and areas of improvement were related to the model: Interactions between sustainable development values and Lean, see Figure 3 on page 53.

3.8 Literature use

Literature was used throughout the entire research journey to develop an understanding about Lean and sustainability from different theoretical perspectives and to inform selection of relevant study foci for the case studies, in particular as it relates to values, behaviours, organisational culture, leadership and sustainability. The literature was selected from books, research papers, and documents to identify sources for theories. Searches have been made in data bases such as Emerald, Scopus, Google Scholar, and the in-library database Primo. Searches have been done on relevant concepts and writers.

Literature review

In order to do more in-depth studies in the interlinkages between Lean and sustainable development a systematic literature review was done and is presented in Paper C. With support in the snowball technique (Noy, 2008), using reference lists of papers found to further identify relevant sources, the choice finally fell on theory describing sustainability through three principles. The literature was chosen, because it contained all three aspects of sustainable

development: the economy, the environment and society. Literature was also chosen when it described sustainability based on principles. The three sustainability principles were theoretically compared to how literature described the six different Lean categories, as selected by the research team of five people. Literature on Lean was used to identify characteristics representing the three categories in sustainability to compare the values and principles between sustainability theory and Lean theory.

3.9 Quality in research

The assessment of quality in this thesis is made in each separate study, i.e., in Papers A-D. O'Cathain (2010) recommend using one quality framework for the whole study when a mixed-method study is done, but since only the methodological design in this thesis, is inspired by mixed methods, this recommendation will not be followed. The quantitative study is assessed according to the concepts of reliability and validity, and the qualitative studies are assessed according to credibility (Wallengren & Henricson, 2014). Validity shows whether the planned topic of study really will be studied, and reliability demonstrates the instrument's ability to show the same result over and over again, that is, its reproducibility (ibid.). According to Wallengren and Henricson (2014), credibility can be considered an umbrella for trustworthiness, dependability, confirmability and transferability.

Quality in Paper A

The questionnaire used in Case 1, presented in Paper A, was developed from an earlier version presented in Ingelsson (2013). The result from the questionnaire from Case 1 has not been compared with other measurements as part of testing the criterion validity (Gunnarsson & Billhult, 2014). The questionnaire was divided into two parts: the first part measured presence of Lean values, and the second part measured importance of Lean values. Within each part, the statements were randomized. Representatives from the organisation where the survey was conducted contributed relevant organisational nomenclature. The internal consistency reliability was tested for all factors with Cronbach´s Alpha coefficient. This was a single measurement, so the respondents can be said not to be influenced by earlier measurements within the same field (Olsson & Sörensen, 2011). A random purposeful selection of the clinics that responded to the questionnaire was made with help from the Lean coordinator, who was knowledgeable about which clinic was in each selection group. The use of random selection ensured

that every member of the population would have an equal chance of selection (Collins, 2010).

Quality in Paper B, C and D

To visualize the credibility of the qualitative studies the four elements of credibility from Wallengren and Henricson (2014) are used. Credibility is summarized in Table 2, in which each qualitative study in this thesis is documented. Some of the degraded quality indicators are the same in several key quality indicators, for example, in both trustworthiness and confirmability, the respondents reading through the results and critical friends are degraded indicators. In this case, the degraded quality indicators are only represented once in the table.

Table 2 Summary of research quality for the collection and analysis of qualitative data for the studies in this thesis. Key- and degraded indicators are a summary from Wallengren and Henricson (2014).

Quality indicator (key indicator)	**Description of quality indicator (degraded indicator)**	**Paper B**	**Paper C**	**Paper D**
Trustworthiness	Let the respondents in the study review the research result with the intention of assessing compliance with their own experiences.	No	No	No
	Have a critical friend to show and discuss the results with.	Yes, a research college.	Yes, a research team.	Yes, a research team.

	Triangulation – see the problem from different angles.	Yes, managers from different parts of the organisation are interviewed. ´With parts´ means that different clinics have been implementing Lean for various times.	Yes, the respondents are a mix of managers, co-workers and specialists.	Yes, managers from different parts of the organisation are interviewed. ´With parts´ means that different clinics have been implementing Lean for various times.
Dependability	The writer shows his or her preconceptions.	Yes, this is integrated with the theoretical framework.	Yes, this is integrated with the theoretical framework.	Yes, this is integrated with the theoretical framework.
	The writer shows how previous experience and knowledge affects the research.	Yes.	Yes.	Yes.
	Account of used instruments and technical advises.	Yes.	Yes.	Yes.
	Account of who has done the data collection and processing for example transcribing.	Yes.	Yes.	Yes.

Confirmability	Description of selection of respondents. Description of data collection.	Yes. Yes.	Yes. Yes.	Yes. Yes.
Transferability	Has the writer discussed the possibility of transferability of the results to other groups, situations or contexts?	Yes.	Yes.	Yes.

To choose suitable respondents in each organisation the researcher/researcher team received help from each organisation. In Case 1 and Case 2 their Lean experts was the internal partner and in Case 3 the manager for the department responsible for Technical Communication was the partner. In purposive sampling, the number of samples is dependent on the study's purpose and rationale (Patton, 2002). Collins (2010) presents a minimum of six participants when interviewing is used for data collection. This was fulfilled in all cases, but in Case 1, a recording failed and was unusable; in addition one interview was excluded because the category of employment was unsuitable for the study. This weakens the credibility in this case.

In all the interviews open-ended questions was used, allowing the respondents to answer in their own words. It reduces the researcher impact on collected data. If different results are obtained from different researchers that does not necessarily mean that the result not is credible, since the experience of reality is depends on the researchers' interpretations (Wallengren & Henricson, 2014).

3.10 Delimitations and limitations

Delimitations involve how the scope of the study will be narrowed, and limitations identify potential weaknesses (Creswell, 1994).

The research has been delimited to focus on Lean values within organisations during the implementation stage and to explore interlinkages between Lean values and principles for sustainable development. The only benchmark for implementation used is Emiliani's (1998) explanation of how long Lean implementation takes, which he says is five to ten years depending on the maturity of the organisation. The implementation stage is not determined through any scientific measurements. Consequently, the findings cannot be determined to be in an initial implementation phase based on the standard measure.

One limitation of this thesis is that only two methods of data collection are used: questionnaires and interviews. With several different methods other results could have been obtained. The results in this thesis cannot be seen as generalizable to other organisations based on how data is collected, a questionnaire in one organisation, and interviews in a few other organisations. The data describe only the unique situation in these organisations. Organisations are domiciled in Sweden; national culture is an aspect of how to assess values in the country, as there may be differences between different countries' value bases.

3.11 Ethics in research

Vetenskapsrådet (2017), a Swedish agency that supports researcher and PhD students with the goal of developing research in a national context, describes ethics as follows: *'ethics provide a theory for morals, which are their practical expression*'. Research should always be conducted with the aim of increasing knowledge (ibid.).

Independent of which form of research is done, the respondents have the right to obtain information about the research in a way that enables them to understand its goal and how the data will be used (Cohen, et al., 2000). They also must be able to choose whether they wish to participate (ibid.). A respondent can unconditionally refuse to answer a question and suspend his or her participation at any time during the data collection (Bryman, 2013/2008).

The use of a questionnaire always affects the respondent in that they spend time to complete the questionnaire (Cohen, et al., 2000). The level of sensitivity also can invade their privacy (ibid.) Qualitative researchers are guests in private spaces (Denzin & Lincoln, 2005). When portraying persons, there is a

risk of exposing them in a way that can harm them through, e.g., embarrassment, loss of standing and loss of self-esteem (ibid.). Denzin and Lincoln (2005) recommend involving advisers and reviewers to help extend the protective system.

Ethics in this thesis

The people who participated in the studies have done so based only on their professional status, not as individuals. For both the questionnaire and the interviews, all the respondents were informed in advance about the data collection, how the data would be used and why the data were being collected. The respondents had the ability to decide whether they wished to participate. They also had the opportunity to cancel ongoing data collection. In all three cases, the researchers were helped from people who employed and active in the organisation to help select respondents and translate and disseminate information into familiar, easy-to-understand language. The researchers have been available for further questions after the data collection.

No respondents have been identified based on their professional title that would enable information to be back to them as individuals. In cases in which a respondent's profession is stated, for example, a manager, there are other people in the organisation who play the same role. The organisation discussed in Paper 1 consented to have its name published.

All four papers have been (or will be, as Paper 4 has been submitted) reviewed by external researchers before publication or presentation. The overall assessment is that the information requirement, the consent requirement, the confidentiality requirement and the usage requirement, according to Bryman (2013/2008) have been complied in this work.

4 Summary of appended papers

In this chapter, my contributions are described and a short summary of each paper is presented.

Table 3 Summary of appended papers and presentation of my contribution to each paper.

Appendix, Authors, Year and	Title	My contribution
Paper A **Ingelsson, P. & Mårtensson, A. (2012)**	Measuring importance and practice of Lean values	30%, Parts of the theoretical frame. Minor contribution to the questionnaire. Contribution to Analysis, Implications for management and Discussion/Conclusion
Paper B **Mårtensson, A. & Ingelsson, P. (2013)**	Managers basic assumptions when Lean is applied	60%, Compiling most of the results, analysis and discussion. Approximately half of the theoretical frame.
Paper C **Mårtensson, A. & Ingelsson, P. (2014)**	Can Lean values contribute to Sustainable Development?	80%, Contributed to the interview guide, performed four of the interviews. Compiled the result and conducted the analysis. Wrote the main part of the paper.
Paper D **Mårtensson, A., Ingelsson, P. & Snyder, K. (2017)**	Interlinking Lean and Sustainability: How ready are leaders?	90%, Compiled the result and performed the analysis. Wrote the main part of the paper.

4.1 Paper A

Ingelsson, P. and Mårtensson, A., (2014). *Measuring importance and practices of Lean values*. The TQM journal, Vol. 26 Iss 5 pp. 463-474

Introduction

Lean has become a well-spread concept in many different types of organisations and not only within the automotive industry from where it originates (Hines et al., 2004). When Lean became known in the west, companies' focus lay on implementing the tools, i.e. focusing on continuous improvement and reducing cost and many companies have been successful when applying Lean (Drew et al., 2004). Later many expressed the need for organisational culture change and many manufacturers fail to apply Lean especially in the area of cultural change (Bhasin & Burcher, 2006; Yamamoto & Bellgran, 2010).

Lean can be seen as being founded on a number of principles and values (see e.g. Emiliani, 2010; Liker, 2004; Womack & Jones, 2003). These values or principles are said to be needed in the organisation for the successful application of Lean (Bhasin & Burcher, 2006; Henderson & Larco, 1999). Despite this, the measurements for organisational effectiveness and success have primarily been focused on financial results or hard measurements, such as cost of quality, reduced inventory and delivery dependability (Motwani, 2001). Therefore, measuring the softer sides when applying improvement initiatives, like e.g. Lean, in terms of organisational behaviours and organisational changes are needed as a compliment to the traditional measures (McAdam & Bannister, 2001; McNabb & Sepic, 1995).

Purpose

The purpose of this paper was to present the result from a study carried out at an organisation, which had recently started applying Lean, to examine changes in the importance and presence of Lean values within the organisation in relation to when they started to apply Lean.

Methodology

A questionnaire was further developed from an earlier version used to measure the presence of the Lean values 'Long-term thinking', 'System thinking', 'Elimination of waste', 'Customer Focus' and 'Lean leadership' and

the TQM values 'Leadership Commitment' and 'Participation of everybody' in an organization (Ingelsson et al., 2010). The new questionnaire consisted of 21 statements intended to represent six Lean values: 'Long-term thinking', 'System view', 'Eliminate waste', 'Continuous improvement', 'Customer focus' and 'Supportive leadership'. The value 'Continuous Improvement' was added and the value ´Lean leadership´ in the first questionnaire was enhanced to incorporate more than in the earlier questionnaire because of the fact that the value 'Leadership commitment' no longer was covered in the questionnaire.

In order to not only measure to what extent the respondent agrees that the values presence in everyday work but also if they find them important, the questionnaire was divided into two parts, presence and importance. The questionnaire was constructed in such a way that the respondents were asked to rank each statement from 1 to 7 using a Likert scale. First they rated the statement according to their perceived agreement with the statements corresponding with their working conditions (1 equalled totally disagree, 7 equalled totally agree). Then if the respondents considered the statements to be important (1 equalled not at all important, 7 equalled very important).

The questionnaire was handed out to six different clinics in one organisation, where two were so called pilot clinics and had been working with Lean for 18 months (Group 1, Pilot) , two had worked with it for 9 months (Group 2, started) and two had not yet started their Lean work (Group 3, not started).

Main findings

The results show that the only significant statistical differences were regarding the presence of the values ´Continuous improvement´ and ´Supportive leadership´. A rank test was also done using Wilocoxon Signed-Rank Test which gave the same result. Post hoc analyses using the Scheffé post hoc criterion for significance (sign. level 0.05) indicated that the average was significantly higher regarding the presence of ´Continuous improvement´ in group 1 ($M = 5.78$, $SD = 0.82$) than in the group 3 ($M = 4.77$, $SD = 0.94$), $p = 0.000$. The same was valid for presence of ´Supportive leadership´; group 1 ($M = 5.74$, $SD = 0.85$), group 3 ($M = 4.82$, $SD = 0.95$), $p = 0.001$. A report was compiled and communicated to the organisation where the results and the analysis were presented.

The study showed no difference between the three groups in relation to the stated importance of the values, something that could indicate that there is a commonly shared value base in the organisation. The only difference that was statistically significant was with regard to the presence of the values ´Continuous improvement´ and ´Supportive leadership´ between Groups 1 (pilot, 18 month since starting to apply Lean) and 3 (not yet started to apply Lean). This could show that the organisation has what is required by Emiliani (2010) to reach ´Real Lean´ since ´Continuous improvement´ and ´Respect for people´ can be said to be represented by the two values. The fact that a difference can be detected even after a relatively short period could be explained by the similarity in results from importance of the values and that Lean gave them methods and tools to work with these values.

When using this questionnaire for measuring the starting point it could help management to prioritize which areas to focus on at the beginning of applying Lean. This could be both regarding the methods or tools that might be needed to start practicing Lean as well as the methods and tools needed to affect the values within the organisation. When used as a recurrent measure for monitoring progress it can be a complement to hard measures like reduction of cost and lead-time.

4.2 Paper B

Mårtensson, A., and Ingelsson, P., (2013) *Managers basic assumptions when applying Lean*. Published in the proceedings of 16th Qmod-ICQSS Conference, September 2013, Portoroz, Slovenia.

Introduction

It appears that organisations apply a Quality Management (QM) initiative, e.g. Lean or Total Quality Management (TQM) to arrive at a structured and supporting system for quality development. According to Emiliani (2010) the reason why organisations apply Lean has a profound effect on what will be focused on within an organisation. The reason for applying Lean has to be for the benefit of the customer, not for internal company reasons (ibid). In organisations that choose to work with a QM initiative as a strategy for development the leaders need to participate in the work of educating the co-workers and to be role models. In order to do that they need to be skilful in the values and principles which are represented and have the ability to adopt a system view (Liker, 2004; Liker & Hoseus, 2008).

According to Douglas & Judge Jr (2001) is it most important to focus on the depth of the implementation of a TQM program, not only on the presence of the program. Since the values in Lean, in much the same way as TQM, rest on a number of principles (which in this paper are seen as synonyms to values) these values are said to be needed in the organisation for the successful application of Lean (Achanga et al., 2006, Bhasin & Burcher, 2006, and Henderson & Larco, 1999).

Purpose

The purpose of this paper was to present the result from a case study were managers where interviewed in order to find out their basic assumptions (i.e. purpose and underlying values) for applying Lean. The purpose was also to investigate if these basic assumptions were in line with what the literature describes as important for succeeding when applying Lean.

Methodology

Values within Lean and TQM, with more focus on Lean, were studied. An organisation was chosen on the basis of being in the beginning of their 'Lean journey' and used the strategy to roll out the change process through the start of pilot groups. The assumption being that there is a similar culture within the organisation to begin with, so the starting points are reasonably similar.

An interview guide was created and it contained open-ended questions. Follow-up questions were then asked to capture as much as possible of the leaders´ personal attitudes about the basic assumptions of Lean. Interviews with two managers, a manager from one pilot clinic and a manager from one clinic which had not started to work with Lean, were carried out during the fall of 2011. The pilot clinic had worked with Lean for over one and a half years and the clinic that had not started was set up to start according to the organisations rolling out plan. The aim of the interviews was to identify what the managers perceived as the purpose for applying Lean, what they hoped to achieve when using Lean and their view on the basic elements in Lean.

Main findings

The result indicates that the managers had different purposes for applying Lean. The manager in the pilot clinic says that customer focus and co-worker

involvement are the purpose for applying Lean, while the manager for the clinic that had not started to apply Lean says that structure for problem solving and committed co-workers is the purpose. Both managers have purposes that can be identified in the literature as values or parts of values within Lean initiative, (see e.g. Berglund, 2010; Emiliani, 2010).

It seems as if the manager from the pilot clinic has enlarged the organisations opportunity areas and is also incorporating other Lean values. The manager has e.g. integrated the value customer focus which is seen as the starting point within Lean according to both Emiliani (2010), and Womack and Jones (2003). Identified values and fragments of values are presented in Table 4.

Table 4 (in paper numbered as Table 1) Summary of detected Lean values. A black dot indicates a clear detected value and an unfilled dot indicates a partial detected value.

Value	Manager from pilot clinic	Manager from clinic not started
Supportive leadership	●	
Customer focus	●	
System view	●	
Continuous improvement	●	o*
Long term-thinking		
Respect for people	●	

*In the appended paper this symbol is missing.

It is our opinion that the manager for the clinic that has not started to apply Lean has put more focus on problem solving than on being a learning organisation and adopting a way to think which Liker and Franz (2011) state are major parts in continuous improvement. The lack of the value supportive leadership is also shown by the manager (at the clinic not started) when stepping aside to let the co-workers take responsibility for individual economy and how they act. It seems like the manager has focus on the outcome. On the other hand the manager from the pilot clinic exhibit sides that suggest a supportive leadership. The manager involves co-workers to set up goals for the clinic and works closely with them, which also is supported by Liker (2004) description of Lean leadership as being involved with the actual work.

It is our belief that the differences between the managers' purposes when applying Lean and how they commented on the values depends on their knowledge about and ability to practice Lean, and also on their individual leadership. Clearly it is important to educate managers and perhaps also to evaluate the manager's ability when starting to apply Lean. The manager who has started to apply Lean mentions more values supported in the literature than the manager who has not started applying yet. The reason for this can be that the managers from the pilot clinic had the value base from the beginning or that time and practice of Lean has led to the development of said value base.

4.3 Paper C

Mårtensson, A., Ingelsson, P. and Öberg, L-M., (2014*). Can Lean values contribute to Sustainable Development?* Published in the proceedings of 17th Qmod-ICQSS Conference, September 2014, Prauge, Czech Republic

Introduction

There are many reasons to work with Quality Management (QM) initiatives; one is that it can support sustainable development (SD). Deming (1986) who is well known as the founder of the fourteen points of Quality Management, argues for the importance of the system, because it has the biggest influence on the outcome. Consequently, a system view is necessary. According to Sapru and Schuchard (2011), the lack of quality in organisations has shown itself to be harmful to environmental and social performance. More recent studies have shown the effect on an organisation´s outcome of applying a QM initiative and how, when it is combined with environmental initiatives, see e.g. Wiengarten et al. (2013), there are higher performance benefits in terms of cost, flexibility and delivery performance and according to Lindsey (2011), also reduced waste and thereby reduced costs. United Nations (2012), acknowledges that SD and all its aspects need to be more integrated at all levels and that interlinkages between different aspects are believed to achieve SD in all dimensions.

The quality management initiative, Lean, has played an important role as a way to develop organisations and improve organisational performance see e.g. Salah et al. (2010). Lean can be defined as a management system designed to be responsive to the needs of individuals in business and deliver better outcomes for stakeholders (Emiliani, 2003). One area that is in need of quality development and that constitutes an important part of many systems is the

production of Technical Communication (TC). TC is an important function which makes it possible to introduce, use, maintain and phase out technical artifacts in a safe, beneficial and sustainable way (Asproth, 2011).

Purpose

The aim of this paper was to study interactions between sustainable development and Lean values by comparing two organisations, one with Technical Communication in-house and one with Technical Communication partly outsourced.

Methodology

A literature review has been carried out focusing on values within SD and Lean, and interactions between them. Identified SD values were then compared to categories representing Lean values designed by the research group. The categories agreed upon were: 'Customer perspective', 'Long-term thinking', 'System view', 'Value flows', 'Standardization', and 'Continuous improvement'. In order to identify best practices and areas of improvements in TC based on Lean, interviews in two companies working with TC in different ways were conducted. The interviews were semi-structured and based on an interview guide, which was sent out to the companies in advance. All transcribed interviews were read through by all of the members of the research team and each identified best practice and areas of improvement. Each interview was compiled by the research team in workshops, where the identified best practice and improvements were discussed and then categorized into the six categories.

Main findings

The results from studying interactions between sustainable development values and identified Lean categories shows that there are several interactions, see Figure 3.

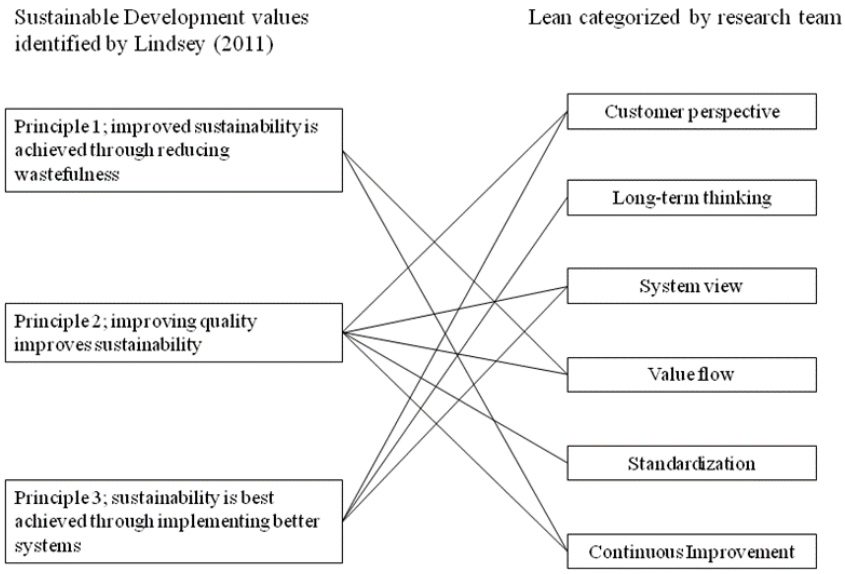

Figure 3 (In paper numbered as Figure 1). Interaction between sustainable development values and Lean

Company A (presented as Case 2 in the thesis) has fragments in both identified best practice and areas of improvement from all categories. ´Value flow´ and ´Customer focus´, were seen as more visible in identified best practice. On the other hand, ´Customer focus´ along with ´Long-term thinking´, were the two areas that were most identified in areas of improvement. In Company B (presented as Case 3 in the thesis) five of six Lean categorizes identified in best practice. As well as in Company A, the presence of ´Customer focus´ was also more visible in the results. Even if Company B focused on processes, a focus on ´Value flow´ was missing. It seems like Company B has processes for gathering customer needs, but there are difficulties in feeding back the customer needs to production. TC has a low status within the company but the customers think it is an important area.

The literature study and our results indicate that the presence of Lean values helps to create the conditions for SD, but organisations need to focus on their culture and values see e.g. (Yukl & Kaulio, 2011). Identified best practice in the companies indicates that the conditions for SD are weak. Studying separate parts like TC does not give the whole picture about the system,

however it may help those who are active in sub-systems to understand their contribution to the system. On the other hand TC has connection to the product throughout the life cycle and can be a support when developing new more sustainable systems.

4.4 Paper D

Mårtensson, A., Ingelsson, P. and Snyder, K., (2017*). Linking Lean and Sustainability: How ready are leaders?* Submitted

Introduction

The connections between Lean, a philosophically based management practice for organisational development, and sustainable development (sustainability), a philosophy clarified by principles, have been studied in different ways. Organisations practising Lean have a positive impact that is in line with a sustainable impact; see, for instance, Piercy and Rich (2015), Vincent (2009), and Rusinko (2005). In the UN Resolution, The Future We Want, adopted by the general assembly of the United Nations on 27 July 2012, it was stated that more must be done from an organisational point of view to speed up the development of sustainability on our planet.

It is essential for managers, who are involved in an organisational development such as Lean to be committed and have deep knowledge about the organisation and the development practice (Emiliani, 2007). In addition to knowledge, they need a deep understanding of the core values and principles that form Lean (Saratun, 2016), and also are interlinked with sustainable theory and practice. Managers also have a crucial role during implementation to build and spread the organisational culture, and cope with the challenges of implementation (Hines et al., 2008; Joosten et al., 2009).

Purpose: The purpose of this paper was to explore evidence of interlinkages between Lean and Sustainability among organisational leaders in the early stages of Lean implementation.

Methodology

In this study, a multiple-site case study approach was used to gain insight into the connections between Lean and sustainable development during the implementation stages of a Lean practice. In-depth interviews were

conducted with managers from four different units in one organisation regarding their perceptions about Lean in order to find out if they have knowledge and understanding about the interlinked areas between Lean and sustainable development. A literature study was conducted to identify those dimensions with interlinkages between Lean and sustainability. Eigth dimensions was chosen, which then were used as an analytic frame determine whether these interlinkages were present in the organisation. Each indication was also categorised in one of the two organisational levels: strategic and operational.

Main findings

The results indicate that none of the clinics had interlinkages in all eight dimensions. Clinic A and Clinic B revealed presence of interlinkages in seven out of eight dimensions. At Clinic C and Clinic D, there were fewer indications of presence of interlinkages in the dimensions. It varied between the clinics which dimensions had indicators of interlinkages.

In the case presented in this study, it seems that the managers have some knowledge of the Lean values and principles (Liker, 2004), some of which are represented in those dimensions with interlinkages between Lean and sustainable development. However, when looking at the results as a whole, it appears that the managers´ knowledge contains large gaps: the identified indications of the dimensions are fragmented and some are completely missing. This is visible on both the strategic and operational levels. Since the managers have an important role for the implementation and application of Lean, their knowledge and understanding of it will be essential for the rest of the organisation (Joosten et al., 2009; Piercy & Rich, 2015). The visualisation of the knowledge gap can help the organisation to identify and recruit the "right" managers for the task. The result also reinforces how important it is that the dimensions be actualised at both the strategic and operational levels in an organisation to achieve the desired effect.

5 Main findings

In this chapter, a reconnection to the purpose is done by answering the research questions.

5.1 Reconnection to purpose and research questions

The purpose of this thesis is to contribute a deeper understanding of the application of Lean values when implementing Lean, and the potential to interlink to sustainability theory. The purpose is further elaborated in two research questions, answered by the theoretical and empirical studies that were presented in four independent papers (Papers A-D). In Paper D, the findings were explored by examining both the operational and strategic levels.

RQ1. What Lean values can be identified in a lean implementation? How are those values visible?

In the three case studies, a number of different Lean values were identified, albeit fragments of Lean values; no one Lean value was identified in it is entirety. As well, the Lean values were identified to differing degrees in the three cases. A fragmented Lean value was identified for example when respondents only can mentioned a Lean value by its name and did not give a deeper explanation. Another example was when describing the Lean value 'Continuous improvement' as problem solving, and missing the learning part. This example, and others are found in Paper B-D.

The presence of Lean values was found to differ based on the role of the person: i.e., manager or employee, and the level at which the values were identifiable: i.e., strategic or operational. Four of the indicated values that were affected by these factors included were identified in all three cases: 'Continuous improvement', 'Customer focus', 'Long-term thinking and 'System view'. Below all identified Lean values and dimensions with interlinkages between Lean and sustainability are presented in alphabetical order.

'Continuous improvement', was identified in Paper A, as one of two values with higher presence among the employees in the Pilot group. In Paper B this value was identified with the manager of the Pilot group, and partly with the manager from the group Not started. Learning was missing in the identified

value in all cases. 'Continuous improvement' was indicated at both the operational level and the strategic level, see Paper D.

'Customer focus', also named customer perspective and stakeholder requirement, was another Lean value identified as indicated in Papers A-D. The value was identified with the manager from the Pilot group in Paper B, and the value was indicated at both the strategic level and the operational level in Paper D. 'Elimination of waste', or 'Reduce waste', was identified among both employees and managers, see Paper A, B, and D. However, the value was only indicated at the operational level as demonstrated in Paper D. The dimension 'Ethics', was only identified among managers, and was indicated at both the strategic level and the operational level, as presented in Paper D. 'Long-term thinking', presented in Paper C, was also identified by managers in Paper D, yet to a lesser degree and only at the strategic level. The value, 'Quality', was identified among managers, albeit weakly, and was found to be represented at both the strategic level and the operational level (see Paper D).

'Standardisation', was indicated as present in both organisations in Paper C. 'Supportive leadership', was the other value with higher presence among the employees in the Pilot group, when comparing to the two other groups, see Paper A. Among the managers the value was only indicated by the manager representing the Pilot group. 'System view', was the value with lowest mean, when it comes to importance in all three groups presented in Paper A. Among managers 'System view' had low indication and was only represented at the strategic level, see Paper D. 'Value flow', only represented in Paper C, was indicated in one of the studied organisations.

There were a number of different factors that were found to contribute to the visibility of the Lean values: Length of time, articulation in the vision, organisational level, and employment type. Length of time working with implementation affected the presence of two values in particular: ´Continuous improvement´ and 'Supportive leadership'. This was visualised when comparing different clinics that had been implementing Lean for different time, this is presented in Paper A. In Paper B, the interviews with the two managers, showed that time regarding how long the implementation had been going on influenced the presence of Lean values. The manager at the clinic Not started, only showed one visible value: 'Continuous improvement'. While the manager in the Pilot had indication of six visible values.

The inclusion of Lean values articulated in the vision and strategy of an organisation appeared to have importance for the degree to which they were present and visible among employees. For example, the Lean values, 'Continuous improvement' and 'Engaged employees', were found to be more visible in the companies in which the values were included in the vision. In Paper A, 'Continuous improvement' was more important among the respondents than the other Lean values. In Papers B and D, these two values were frequently reiterated by participants during the interviews. In Paper C, one of the organisations had the value 'Customer focus' as a lead value in their vision and it was articulated by participants as one of their strength for the organisation.

In Paper D, the findings indicates that there are differences between the organisational levels: strategic and operational regarding presence of Lean values. The most significant differences were found among the Lean values: 'Reduce waste' and 'Long-term thinking'. 'Reduce waste', which was indicated in all four of the clinics examined, was found only at the operational level in the organisation, whereas 'Long term-thinking' was found at the strategic level in two clinics and at the operational level in one clinic. The Lean value 'Continuous improvement', was indicated at the operational level in all four clinics, but only at the strategic level in two of the clinics. 'Waste reduction' and 'Continuous improvement' found at the operational level were visible as structures for how to work and included specific methods, such as 5S. In the clinics in which the Lean values were found at the strategic level, they were identified by the managers' way of describing their thinking with reference to organisational strategies.

RQ 2. How can we theoretically and empirically understand the potential interlinkages between Lean values and sustainability?

On a theoretical level it is easy to see and understand the interlinkages between Lean and sustainable development. In Paper C, the theoretical connection is exemplified in a model, see Figure 3 on page 51, that show which sustainable development principle interacts to which Lean values. Interaction occurred among all three sustainability principles and the Lean values. The second sustainability principle, improving quality improves sustainability, had the most interactions to the Lean values, four out of six possible. In Paper D, dimensions with interlinkages are put in a framework, see Table 1 on page

17, which also visualise in which literature the dimension is found. The interlinkages described in theory are for instance: having a system view and continuously evolve the systems, reduce waste at its source, continuously improve in order to increase quality, and always treat human beings in an ethical way, which includes customers, employees, third part stakeholders etc.

When studying the empirical material, interlinkages between Lean and sustainability were not as obvious. For example, none of the respondents participating in the interviews mentioned anything about Lean interlinking to sustainable development, see Paper B-D. Moreover, the Lean values identified were not as fully developed in practice as described in theory. This appeared to influence the interlinkages to sustainable development, as identified in the behaviours in the organisation and the organisational outcome.

The empirical studies indicated that some Lean values, which in theory interlink to sustainability, were not perceived to be important by employees. In some of the cases, the values were not perceived to be important, nor did the employees perceive that they had the possibility to influence the values. One example relates to the value 'System view'. In Paper A, employees identified this value as least important for their organisation. At the same time the organisation focused on a structured way of working with continuous, when implementing Lean, which indicates a desire to improve the system. This discrepancy suggests that participants didn't recognize the connection between viewing the organisation as a system and continuous improvement. In Paper D, only one manager identified 'System view' as a value that was present in its clinic; a finding that was contrary to the articulated purpose in the organisation. In Paper C, the respondents indicated that 'System view' was important from their point of view, but they did not have the ability to affect the organisation as a whole.

6 Analysis and discussion

This chapter, gives an overall discussion of the subjects that are included in this thesis, a reconnection of the main findings to theory is made, and analysis of the findings are also done.

This thesis integrates three areas of study to address the research purpose of the study: Lean values, organisational culture and sustainable development. These areas are used to analyse the findings and discuss implications for leaders to implement Lean to support sustainability. Based on the main findings, four themes will be discussed as they relate to the purpose of this study: 1) values that are visible, 2) the role of time, 3) the role of culture and organisational levels, and 4) the connection to sustainability values.

Values that are visible

Findings from these studies revealed that four Lean values were visible in the three studied cases: 'Customer focus/perspective', 'Continuous improvement', 'Long-term thinking', and 'System view'. Earlier research also shows that these four values are prerequisites for Lean (Emiliani, 2010; Liker, 2004; Womack & Jones, 2003). In theory the values: 'Employee engagement' (Emiliani, 2010; Liker, 2004), which is a part of the dimension Ethics', 'Waste reduction' (Liker 2004; Womack & Jones, 2003), and 'Supportive leadership' (Convis, 2001; Emiliani, 2010), are also of importance. These values were only visible in one case, which is Case 1.

When implementing Lean, it was found advantageous for organisations when the Lean value 'Customer focus' was present and visible. The customers have an important role in the definition of quality (Bergman & Klefsjö, 2010). When it comes to Lean, the value 'Customer focus' is important, because the reason for implementing Lean has to be for the benefit of the customer (Emiliani, 2010; Liker, 2004; Womack & Jones, 2003). Even when an organisation claims not to work with Lean in a formal sense, a presences of a value of the value 'Customer focus' can lead to the same end result, see Case 3.

The main findings indicated that the studied cases have managed to make some values more visible then other. This is as an indication that also is verified in theory, and which demonstrate that the whole set of values that constitute the Lean philosophy need to be implemented in the organisation if

Lean is to be successfully applied (Bhasin & Burcher, 2006; Henderson & Larco, 1999).

The inclusion of values in the vision and strategic planning was also found to support earlier studies. This is shown in Case 1, in which the two values 'Continuous improvement' and 'Engaged employees' were visualized through behaviours and structures, as well as reflected their vision. This finding is in agreement with Mirvis et al (2010) who claims that values, together with vision and mission, are needed in an organisation to be successful with their sustainability work, and how Yukl and Kaulio (2011) describes that values can unconsciously affect attitudes and behaviour.

The presence and visibility of Lean values raises interesting questions about whether an organisation is really implementing Lean, or if it should be considered as implementing quality management at a more general level (i.e. not specifically Lean). It is difficult to distinguish different quality initiatives from each other, as several of the initiatives share the underlying principles, methods and tools (Dahlgaard-Park, 2011). Perhaps organisations should strive to implement Lean or perhaps develop practice inspired by Lean rather than aiming to implement Lean. The organisations will not be successful in their application of Lean if they do not have the intention to practice the whole value base of the Lean philosophy as required (Achanga et al., 2006; Bhasin & Burcher, 2006; Henderson & Larco, 1999).

The role of time

It takes time to change an organisational culture (Kotter, 1996). More values were visible in the clinics that had been implementing Lean for a longer time. According to Emiliani (1998), implementing Lean takes five to ten years and the application never ends. The time horizon, has connection to 'Long-term thinking' in the organisation, and in these cases this value was not one of the most visible values. If the organisations are missing the ability to consider 'Long-term thinking', it can be assumed they will have problems to maintain focus during the cultural change; a focus that is required to achieve application of Lean (Emiliani, 1998; Liker, 2004). None of the studied organisation has reached Emilianis´ (2010) time limits. They were all under two years. However, based on the number of values identified in the organisations, it appeared that the greater number of values present could be seen as an indication that the organisations were more advanced towards a

Lean application. Though, they have to take into account that successful implementation is connected to their ability to change the organisational culture (Bhasin & Burcher, 2006; Yamamoto & Bellgran, 2010), and they have to be assiduous in their work.

The role of culture and organisational levels

When it comes to Case 1, it seems that the way in how they have started the Lean implementation they have managed to reach out with their values at some degree to all employees. However, there are differences in the presence of the values among the employees when it comes to the strategic and operational levels. This is shown in Case 1 were identified values are categorised into one of the two levels. It can be assumed that the managers have the ability to influence in the strategic level to a greater extent than employees. This is important since the organisational culture begins with managers, if they practice leadership (Schein, 2004; Senge, 2006).

Implementation of Lean values at both strategic and operational level is important to create the opportunities for an organisation to become sustainable. The findings indicate that Lean contribute to a structure at the operational level, for example teams for problem solving, and waste reduction according to 5S. At the strategic level the Lean values are indicated to be presence to some degree in managers´ strategies. From a sustainability view these examples are not enough, sustainability values must still exist in the organisation (Lazlo et al, 2005). However, if focus is put on all Lean values organisations will have a greater degree of support for values in line with principles for sustainability.

In addition, to the multilevel culture of an organisation, explained in Schein (2004), there are also levels in the organisational structure, the strategic and the operational level (Hines et al., 2008; Joosten et al, 2009). Both levels are needed to succeed with a Lean implementation (Liker, 2004). When considering these two levels, the findings indicate some values appear easier to handle in one of the levels. 'Waste reduction', 'Ethics' and 'Continuous improvement' are more natural at the operational level, while 'Long-term thinking' and 'Quality' are more in line with the strategic level. This can be a consequence of chosen methods and tools in the organisation. It is known that values can unconsciously affect behaviours (Yukl & Kaulio, 2011), but at the same time it can be difficult to get a value into being an action unless knowledge of and the ability to use the right structures and tools is available.

The connection to sustainability values

According to Laszlo and Zhexembayeva (2011), an organisational outcome in line with sustainability is reached if both the individual mind-set and the organisation has sustainability integrated deep into the inside, in other words embedded in the values. The findings in this thesis, indicate that in a beginning of a Lean implementation neither the organisations nor the people working in the organisations has come that far in their development towards sustainability. The first step might be to understand the interlinkages between Lean and sustainable development.

It is interesting what appears in Case 1, they see Lean, as a way of developing their structure for continuous improvement i.e. developing their system, but they think 'System view' is the least important and less present value. According to Bisheno and Holweg (2009) 'System view' is an essence in Lean, and from a sustainability point of view, the system must consider all three aspects: the economy, the environment and society (Winter, 2008).

The KATI project, that involved studying Case 2 and 3, was initiated from an understanding that the value 'System view' was missing from production of Technical Communication in the production chain in some companies. The respondents were aware of this shortcoming and the need for 'System view'. Yet they found it difficult to achieve. It was not enough to review separate parts in an organisation for the successful result in line with sustainable development (Adetunji et al., 2003). This is one example of the need to develop a culture to reflect both the values and the practice to influence behaviours and thought (Schein, 2004), which are necessary to interlink sustainability and Lean values.

In Case 1, connection is identified between the vision and the values that are visible in the organisation. For organisations to achieve sustainable practice it is important for the employees to understand the connection between values and practice so that the culture is in line with the vision and strategy. Previous studies on Lean application have shown positive results, such as increased profits (Rusinko, 2005), lower environmental impact (Kleindorfer et al., 2005), better conditions for work environment (Piercy & Rich, 2015), and higher involvement or stakeholders (Wu et al., 2015). Since this study focused on the interlinkages between Lean values and principles for sustainable development no measurements of possible improvements in these areas were

done. However, the findings show that the organisations by themselves had not identified these interlinkages. If the interlinkages is not identified, it can be assumed that the underlying values are not practiced among the people in the organisations, and the possible results in line with sustainability will not be reached.

6.1 Method discussion

The research methodology selected affects the results that are obtained (Morgan, 2014). In this case, the presence of Lean values may not be the biggest question. Instead, what is important can be how and with whom in the organisation values can be identified. The difference between methods will still be lifted, which in turn gives rise to increased learning. According to Creswell (2014), in quantitative studies the variable is given in advance for the respondent, and here is the variable of the requested values. This is also consistent with quantitative studies aimed at finding relationships and making comparisons (ibid.). The respondents were limited to answering the questions in the questionnaire; it was not possible to add more information.

At the times when a value is not mentioned in advance, i.e., no variable was given without the respondent to express himself, as was the case in the interviews —the same values were not the values present, and the clarity of the values varied. The interviews reflect a snapshot of reality at one particular moment. Qualitative studies will examine the only reality that the persons involved experience in the given situation (Creswell, 1994). This difference between different research methods' goal is visible in Case 1, which involved two different empirical studies. According to the survey, the requested values are found in all the clinics included in the study. However, in the interviews with the managers represented among these clinics, the presence of the values varies. The chosen method for data collection may be the reason for this difference, since the managers were included in the questionnaire.

The use of a mixed-method design has made it possible to move between different research methods, leading to the identification of aspects in the collected data that should not have been found if the methods were used separately, which according to Leech (2010), is allowed in a mixed-method design. A mixed-method design, which, according to Creswell (2014), can be appropriate when a complex reality is studied, appropriate since the study of values and organisations is complex. Values can be both spoken and

unspoken, and they are connected at several levels within an organisation (Schein, 2004). The mixed-method design has made it possible to identify patterns, to make assumptions involving the identification of differences within a single organisation and to make assumptions about the interlinkages between Lean and sustainable development.

There is a risk that respondents will say what they think you want to hear, not what they really think. To counteract this, the results have been predominantly based on the respondents' own examples of their activities, and they have more descriptive words to communicate their meaning.

My profound knowledge have been developed throughout this research journey, which has contributed a deeper understanding of Lean values and the interlinkages between Lean and sustainable development. One proof of this is that more Lean values have been added when knowledge has increased. One contribution that enables the addition of Lean values is the chosen research method. It can be assumed that the chosen method took this research in the right direction for its context. Another example is in the choice of terms and words that have changed over time. Initially the phrase 'only apply Lean' was used. Later this was changed to both 'implement and apply Lean'. This development reflects my opinion that they have different meanings. The categorisation of Case 1 has also changed, from one case to multi-site case, because my knowledge in research method has developed.

7 Conclusions

In this chapter, the conclusions based on the main findings, analysis, and discussion are presented.

From this study, four main conclusions can be drawn, which are identified below. First, this thesis confirms what is found in earlier research, that implementing Lean takes time. The organisations that were studied were in the early stages of a Lean implementation and none of the identified Lean values for found to be fully implemented. Even more, some of the Lean values indicated by the theory of Lean were not evident at all. This would suggest that, at a minimum, the organisations need more time to implement Lean.

Secondly, the strategic choices and decisions made by the business leaders have an impact on the visibility of Lean values. Among the Lean values that were identified in the organisations, some were easier to implement than others. There are two potential explanations for this. First, the organisations, before starting the implementation, were clear about their vision and strategy for implementing Lean, which is important to affect and change organisational culture necessary to support Lean. In these organisations the values that were integrated in the vision and strategy were more visible than the other Lean values. The second reason why some values were found easier to implement could be due to the choice of Lean tools and methods, which have connections to specific values.

Thirdly, the presence of the Lean value 'Customer focus' is a prerequisite to enhance an organisations work with quality improvement. Implementing Lean has to, according to theory, be for the benefit of the customer. All three organisations had the Lean value 'Customer focus' indicated within their organisation. The customer has an important role in the definition for quality, and improving quality is of significance when it comes to striving for sustainability.

Fourthly, knowledge about interlinkages between Lean and sustainability is important for both the leaders and employees for them to be able to consciously work with integrating sustainability values when implementing Lean. Sustainability needs to be incorporated in the vision and strategies of the Lean implementation in order to be practiced in the organisation. The interviewed respondents did not by themselves express an understanding

about the interlinkages between Lean values and sustainable development. Moreover, there was no evidence of understanding about the important interlinkage with the value ´System view´, which is a central component of sustainable development.

At this stages of the Lean implementation there are gaps when it comes to identified interlinkages between Lean and sustainable development in both the strategic and operational level. It can be compared to: if an organisation should be seen as sustainable, it is not enough to have a sustainable product. To summarise: if an organisation will consider themselves as sustainable, they have to integrate sustainability into the individuals and organisational values, and be able to make the values concrete in the business.

7.1 Future research

This research has an internal organisation perspective. It would be interesting to find out how the organisation is experienced from other perspectives, for instance, by customers and stakeholders. It would also be interesting to find out more about perceived levels within an organisation at different internal levels of management and employees.

The study of behaviours among employees could provide more information about an organisation, because determining one thing does not automatically make it happen. The findings in this thesis show that there are differences between the Lean values that are identified at the strategic and operational levels.

Longitudinal studies could be a help for organisations since changing organisational culture, which Lean implementation requires, is a long-term commitment that require years of development. Knowledge evolves over time and new knowledge is continuously developed.

More must be done from an organisational perspective to meet the global challenge of sustainable development. Lean is seen as a QM initiative, and it shares values with other initiatives within the QM field. It is those same values that are identified with interlinkages to sustainable development. Therefore, it would be interesting to do more studies of these values, especially in a manner that supports organisations' ability to take system view into account.

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