

Challenges of ICT Companies in Lean Transformation

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Abstract

Current business environment is very turbulent requiring companies to adapt to changes. Many enterprises consider a fundamental change – transformation – in order to benefit from the opportunities and to respond to the challenges of the ever-changing business environment. At the same time, interest in lean thinking has grown in industries and research communities. Lean paradigm is assessed as a potential means to help companies pursue efficiency and increased customer value. This paper discusses lean transformation experiences of software intensive enterprises. Based on interviews in five ICT companies several challenges are identified in their journey towards a lean enterprise. This paper highlights challenges against the different levels of lean transformation framework and literature findings.

Keywords: *Software development, agile, lean, transformation.*

1. Introduction

In software domain, agile methods have benefited companies since the mid-1990s. It has been claimed that they increase software organisations' ability to respond to dynamic market changes [1] and turbulent business environment. However, despite of the agile methods in use, companies are still struggling with inefficiency, at the same time when the business environment brings along new challenges. Additionally today, customer value has grown a topical concept, which has led companies to find new means to develop products and services that fulfil or exceed customers' expectations.

Consequently, companies are seeking for new means to overcome the challenges and benefit the opportunities. Lean thinking [2], which has been introduced in several

industries, and today also in software development [3-5], is anticipated to help companies in pursuing efficiency and increased customer value. Lean thinking represents more as a philosophy than practical guidelines and applying it in an organisation most evidently needs a big change. Thus, if a company has decided to apply lean thinking in its operations, the transformation towards lean needs a comprehensive approach, and the result will be a lean enterprise.

In this research, lean transformation was seen as the main approach in order to prepare the companies to respond to the challenges and opportunities brought. Hence, the purpose of this paper is to examine lean transformation of software intensive companies and especially addressing the challenges in lean transformation. The challenges are analysed against the lean transformation framework for software intensive companies [6]. The research questions of this paper are defined as follows:

- What kinds of challenges software companies face in the lean transformation?
- How these challenges relate to the different levels of lean transformation framework?

The research questions are answered based on a multiple case study from five ICT (Information and Communications Technology) companies, in which all together six semi-structured interviews were held. The paper is structured as follows: section 2 presents the theoretical background for this study, section 3 introduces the research method and the case companies, section 4 describes the lean transformation in the case companies,

and finally, section 5 discusses and concludes the research results.

2. Theoretical basis

In this section, we will briefly outline the current knowledge on lean thinking in software development and describe approaches to lean software enterprise transformation. Thereafter, we will also name challenges related to lean transformation based on the literature.

2.1 Lean thinking in software development

Lean thinking traces back as far as to the beginning of 1900s and it strengthened in the 1950s [2]. At the end of 1990s, Womack and Jones [2] widened the scope of lean thinking from lean manufacturing to lean enterprise. Later, lean thinking is applied also in software development [3, 4, 7]. Clearly similarities between these three unrelated tracks can be seen even though the writers have a different approach to lean software development. Charette [7] approaches lean software development from the organisation’s change-tolerance perspective. He explains that the objective is to create an organisation that succeeds in times of uncertainty, change, and complexity, as well as creates software intensive systems of size in one-third the time, at one-third the cost, and with one-third the defect rate. On the contrary, Middleton and Sutton [3] see lean software development as a management system dedicated to eliminate waste. According to Poppendiecks [4] lean software development is an option based approach, in which options are kept open until the final decisions are made.

Lean software development is a set of principles derived from lean manufacturing and thinking. The presented three tracks to lean software development have different amounts of principles, but they all cover the same basic ideas, namely, eliminating waste, continuous improvement, encouraging change, just-in-time production, and creating customer value. The incremental and iterative software development perspective is also one of the similarities between the tracks. According to [7] a lean development project is formed with an iterative process, and according to [3] lean product development is incremental. Instead, [4] defines lean development as consisting of series of end-to-end learning cycles.

2.2 Lean software enterprise transformation

Smeds [8] and Johnson [9] propose both top-down and bottom-up approaches in change management towards lean enterprises and according to Rouse [10] a transformation needs both strategy-oriented and operations-oriented approaches. Lean transformation is a long-term activity which requires even years to be completed. Hines, et al. [11] proposes up to five years’ timeframe to complete lean transformation. Bhasin and Burcher [12] claim that lean paradigm needs to be seen as a journey and as a mind-set that governs how one looks at the business and processes. A lean transformation framework for software industry was created by Kuusela and Koivuluoma [6], which follows the “Transition-to-Lean Roadmap” presented by MIT researchers [13]. The framework includes three cycles i.e. strategic alignment cycle, organisational and business alignment cycle, and lean implementation cycle. The three cycles represent different time frames of transformation. The lean transformation framework for software industry is presented in Fig. 1.

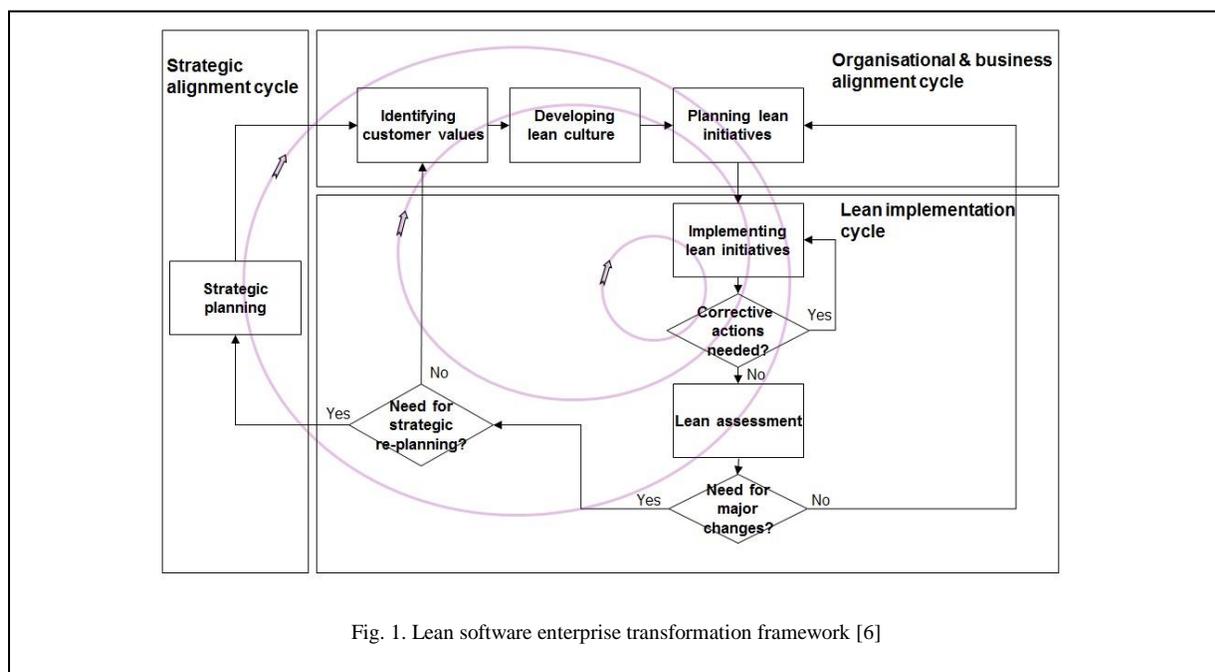


Fig. 1. Lean software enterprise transformation framework [6]

The transformation cycle requiring the longest running time is called **Strategic alignment cycle**. This cycle concerns the highest organisational level of the enterprise, where strategic planning takes place. The strategic planning process is continuous and issue driven process even though it may vary across the companies [14]. Continuous planning, which refers to a planning process that is dynamic and that links strategy with execution under continual change, is part of this cycle, since strategic planning occurs through continuous iterative cycles. As lean paradigm focuses on the whole enterprise, lean thinking shall be intertwined to the strategic planning. As well, lean thinking highlights the importance of customer values. Stakeholders' and especially customers' values shall be contextualised in an early phase of transformation and the values shall yield through the whole transformation.

In **Organisational and business alignment cycle**, both business and organisational development related things shall be planned and deployed. This cycle highlights the importance of value stream by proposing value stream mapping, creating a vision of how customers pull value from the value stream, and by involving stakeholders in the transformation. Also organisational structure shall support the business plan deployment. And still, in order to properly implement the lean transformation the enterprise shall consider cultural aspects.

Lean implementation cycle represents shorter term activities and focuses on continuous improvement at team or unit level. At intervals, it might be useful to conduct lean assessments to get a picture how transformation towards lean is progressing and where to focus improvement actions. Even though strategic planning aims at longer term plans, it is useful to check if the enterprise's strategic plans should be revisited and updated to respond to so far unforeseeable changes. The strategic plans are living documents and should be adjusted according to internal and external changes [15].

Transparency is seen as a fundamental way to make alignment within and between these cycles since it makes the progress of the work visible. At simplest transparency is about process and information visibility [16]. Also, human factors related to transparency are seen vital, since they facilitate the coordination and control in lean enterprise information sharing [17].

2.3 Challenges in lean transformation

Today, many companies in many industries are applying lean principles in their operations. However, only little has

been written about lean transformation challenges in the current literature. Crute et al. [18] write about implementing lean thinking in aerospace industry. They claim that applying lean in other than automotive industries may be difficult and they end up listing factors influencing rate of lean improvements: change strategies, effects of company culture, product focus, senior management commitment and consistency of focus, and finally time and space for performance improvement. Crute et al. [18] argue that challenges in implementing lean in aerospace industry compared to high volume sectors like automotive are not more difficult but different. On one hand, Emiliani and Stec [19] studied lean transformation experiences from management perspective without sticking to any particular industry. They list eleven common errors that senior managers make when implementing lean. On the other hand, Kindler et al. [20] write about applying lean to application development and maintenance, and resulted in listing three challenges of lean transformation. All these challenges are defined in more detail in Table 3, in which the challenges from the literature are compared with challenges found out in this study.

3. Research design

In this section, the research design of this article is described. It includes the purpose, methods and process of the research as well as the case company descriptions.

3.1 Research purpose and methods

The purpose of this research is to shed light on how contemporary ICT companies are progressing in their lean transformation; what kind of challenges software companies face in their lean transformation, and how these challenges relate to the different levels of lean transformation framework. This study follows the principles of a case study [21]. The case study method is a suitable research approach for the overall study in which the researchers act as investigators rather than participants [22] and where the goal is to investigate a contemporary phenomenon in a real-life context. Additionally, the case study is a suitable research methodology for software engineering research and it is descriptive and interpretive in nature, i.e. it aims at portraying a situation through the interviewees' interpretation of their context [23].

3.2 Research process

The research included five global ICT companies. The main data collection method in this research was semi-structured individual interviews. Altogether, six persons from the five case companies were interviewed in spring 2012. The interviewees of the case companies were chosen

based on their possibility to see the progress of the transformation in the whole organisation under study. The interviewees are the leaders or persons very deeply involved in the execution of the transformation. On one hand, this is an advantage as they have visibility over the organisation-wide transformation, they are able to go and see the effects of the transformation throughout the organisation. On the other hand, this is a disadvantage as they cannot go deeper to details of the organisation's all units, departments, teams etc. All data of about one hour interviews were recorded and transcribed. Also, one internal Cloud Software Program seminar was organised, in which the initial findings of the research were presented and discussed as well as feedback was collected to enrich the study.

The analysis of the interview data and feedback from the seminar was conducted by the researchers and the research results were validated by the interviewees. During analysis, all transcribed interviews were carefully read with the intention to identify recurring elements or concepts, namely in this research challenges in lean transformation, which is typical to open coding techniques [24]. All the interviews were read several times by the involved researchers and compared to the emerging concepts. Finally, after applying the constant comparison, we came to a state where no new significant concepts emerge.

3.3 Case companies

Five case companies were chosen to represent large global ICT companies. One of the main reasons for selecting these case companies was that they all had transformed their organisational practices starting with agile methods, more precisely with Scrum method [25], and later on complemented it with lean approach. A common characteristic for all the five companies was that significant changes in organisational structures had been done since agile methods were introduced. The case companies (from A to E) are briefly introduced in Table 1.

Table 1. Case companies

Characteristic	A	B	C	D	E
Number of employees	1000	1700	18000	10400 0	70000
Transformation	Lean	Lean and agile	Lean	Lean and agile	Agile
Beginning of transformation	2005	2007	2006	2008	2005

4. Research results

In this chapter, the research results are discussed. First, we identify the lean transformation challenges based on this research and map them to the cycles of lean software enterprise transformation framework [6]. Then, the identified challenges are reflected to the challenges reported in the current literature and discussed thereafter.

4.1 Identified challenges in lean transformation

The lean transformation challenges based on this research are related to communication, strategy, customer value, organizational structure, organisational culture, leadership, continuous learning, and transparency. Table 2 presents the challenges identified in the case companies as well as maps the challenges to the cycles of lean software enterprise transformation framework (Fig.1). It is notable that all the challenges – at least to some extent – were identified in all the case companies, but the table lists the challenges that appeared pronouncedly during the interviews.

Table 2. Challenges in lean transformation mapped to lean transformation framework (Fig.1)

#	Challenge	A	B	C	D	E	Transformation cycle
1	Communication	X		X	X		Overall
2	Strategy		X	X			Origin in strategic alignment, effect overall
3	Customer value	X	X	X	X	X	Origin in business alignment
4	Organizational structure	X	X	X	X	X	Origin in organisational alignment
5	Culture			X	X	X	Origin in organisational alignment, effect overall
6	Leadership			X	X		Origin in organisational alignment, effect in implementation
7	Learning				X		Implementation
8	Transparency	X	X	X	X	X	Overall

Communication was a topical issue during the interviews. All the case companies consider proper, continuous

communication at all organisational levels as a success factor in the transformation. Proper communication leads to openness, trust and transparency in an organisation, which all are seen also as attributes of organisational culture. Communication covers the whole organisational levels and all transformation cycles shown in Fig. 1.

Strategy was topical issue in this research, which on one hand results from the fact that the interviewees possess managerial roles, but on the other hand, strategy is the general plan to achieve the organisation's goals. At the same time when the interviewees as managers/leaders communicate strategic decisions and managerial messages further in the organisation, they also expect management commitment and support from their superiors. Big changes, such as lean transformation, are part of the organisation's strategy. When executing a company's strategy and plans, management commitment and support to employees are crucial things. Then also collaboration with all organisational levels is vital in order to pursue goals consistently. Strategy as a challenge originates from the strategic alignment cycle (Fig.1) and affects overall in the organisation.

Customer value seems to be an emerging topic today and appeared as an important concept in the interviews. Lean thinking highlights the importance of customer value in parallel with removing waste. Additionally, there is a growing need amongst the companies to better understand how to increase customer value in their products and services. However, the interviews revealed that the definition of customer value was not very clear yet in their companies. Customer value was seen as one of the most important focus areas in the future. Customer value is defined in the business alignment cycle of the lean transformation framework (Fig. 1).

Organisational structure seems to be one of the enablers of successful transformation. All the case companies had changed their organisational structures at least to some extent. Lean transformation was not the only reason for the changes, though, but also other reasons to achieve better efficiency and effectiveness existed. One of the case companies had removed several levels in their organisational structure aiming at more efficient working ways. This challenge was not articulated clearly by the interviewees. However, they implicitly brought out that right organisational structure assists the transformation. Moreover, all the case companies had recently conducted changes in their organisational structures. Setting the organisational structure takes its place in organisational alignment cycle of the lean transformation framework (Fig. 1).

Organisational culture and more precisely changing the culture, in accordance with the lean transformation was seen as a very important and even mandatory thing in the success of the change. Employees' attitude, mind-set, willingness to change and contribute to the change, and thus changing the organisational culture was seen as the biggest challenge in this research. Changing organisational culture is a long-lasting activity, which was well recognised by the interviewees. Changing the culture originates from the organisational alignment cycle (Fig. 1), but the effect permeates through the whole framework and the whole company.

Leadership plays an important role in a change, which was evident also in this study. Good leadership leads to empowerment and involvement of people in the transformation; it helps employees to find new ways of doing things and to take responsibility of their doings. Leadership is also called as coaching, which characterises the leader's role well; today, people talk about a servant leader. Objectives of leadership are set in organisational alignment cycle (Fig. 1), but the results are visible overall in the organisation.

Continuous learning is one of the corner stones of lean thinking and it was very strongly visible also in this research. The interviews told that making mistakes and learning from them is important. Learning from workmates and learning from other companies was highlighted as well. Continuous learning is a company-wide challenge.

Transparency is seen as an important antecedent for successful operations in ICT companies. It is linked to most of the issues listed in this chapter. Good transparency in an organisation supports the alignment of different activities at various levels and directions of the organisation. In the context of lean transformation, transparency through the organisation helps to see the progress of the change, which on the contrary motivates employees. In lean transformation, an important success factor is keeping people involved and committed to the change. By keeping people continuously updated of the overall situation of the transformation and giving them feedback is a way how to commit people to the change. The case companies discussed transparency as an important topic and also as an improvement area for the future. In lean transformation an important success factor is keeping people involved and committed to the change. By keeping people continuously updated of the overall situation of the transformation and giving them feedback is also the way to commit people to the change.

4.2 Comparison and discussion of the identified challenges

The identified challenges of this research are reflected to the challenges reported in the current literature (ref. Section 2.4) in the Table 3.

Table 3. Challenges from literature compared with challenges of this study

<i>Challenge from literature</i>	<i>Challenge identified by this study</i>
<i>Implementing lean in aerospace industry [18]</i>	
Lean capabilities are not firm-specific but plant/site specific	Not applicable
Characteristics of one ‘best performing’ site cannot be transferred to other sites	Not applicable
Strategy shall be comprehensive and holistic with internal targets	Strategy
Operations managers shall have strategic role in lean implementation, senior management’s role in communicating the business strategy is important	Communication, Strategy, Leadership
Culture to support autonomy and learning through experimentation is needed	Culture, Learning
Changing factory layout require time and physical space	Not applicable
<i>Senior managers’ errors when implementing lean [19]</i>	
Senior managers do not understand lean as a comprehensive management system	Strategy
Leadership behaviors conflict with efforts to implement lean	Leadership
Leadership participation in lean implementation is not sufficient	Leadership
Management turnover makes lean implementation more difficult	Not applicable
Business metrics do not support lean implementation	Strategy
The result of productivity improvement is often unemployment	Not applicable
Lean activities are not linked to company strategy	Strategy
Total cost is not understood correctly	Not applicable
Lean transformation is not considered as a long term activity	Strategy
Focus is not on end-use customers	Customer value
The whole supply chain is not involved	Not applicable
<i>Lean transformation in application development and maintenance [20]</i>	
Changing the behavior and convincing the staff and managers of the value of lean approaches	Culture

Broadening the focus from specifics to general principles	Strategy
Setting up proper metrics and right incentives	Strategy, Transparency

Strategy related challenges are the most common challenges in lean transformation presented in the literature. These challenges pertain from the need of management support and commitment in all the levels and functions of the organisation. Drive from the management is needed to get employees to adapt the new thinking and mind-set. However, as pointed by the company C, management commitment and support are vital, but if the whole organisation is not ready for the change, the transformation will be troublesome. Even more complicated situation was found at company E, where transformation is not included to the company’s strategy very clearly. The literature [18] also highlights the need for comprehensive and holistic strategy for lean transformation to succeed. As the origin of the strategic alignment is at the first transformation cycle (see Fig.1), and if it is not properly taken into account then, the whole lean transformation process pops out of its track, especially, because the strategic alignment cycle has its effects to the other cycles. It was also revealed by the literature [11] that challenges occur when lean transformation is not linked to the company’s strategy or seen as a long-term activity. Furthermore, in company D transformation has been conducted by doing, discussing and involving, rather than documenting.

Communication and getting people involved are good ways to motivate people to transformation, but if there isn’t any documents communication and transparency across the organisation becomes difficult. That stands also for strategic planning, if plans are not documented, they cannot be displayed throughout the organisation and revised by right people.

Challenges related to organisational structure didn’t rise up from the literature; but even so, it is obvious according to our case studies that the changes in the organisational structure are crucial in order to achieve success in the transformation. When organisational structure is simple and low, there are less management levels, and thus even continuous planning becomes easier. This also shows in the tools that are used in the organisation e.g. for planning and showing the current status of the implementation. Tools that enable transparency make continuous planning much easier and worthwhile since then the strategic decisions and their associated changes are for everyone to see and reachable. That said, challenges concerning communication and transparency are closely related to strategy, and can be considered as the enablers of continuous strategic planning. For example, without open communication companies claimed trusts can hardly be

achieved. Furthermore, visibility, proudness and understanding (named by company A) are difficult to increase and even achieve without transparency in all the levels of the organisation.

In the interviews transparency was often combined heavily with company culture – the way how ready people were for sharing information. This was mentioned as a challenge in many interviews, as the openness for information sharing was often negatively impacted by poor atmosphere. The atmosphere for openness is strongly a culture and human related topic, which also has links to leadership styles and management support. The human factor in transparency is highlighted e.g. by [17]. It was also mentioned the various legal and local regulations and NDA's which limit the information sharing between teams and units.

Continuous learning is an important corner stone of lean thinking. Koenigsaecker [26] argues that the ultimate goal of a lean transformation is to build a learning culture. Organizational learning is an essential element in transformation of an enterprise and it has to be integrated into existing business processes [27]. That said, it is confirmed by the challenge identified in this study i.e. the challenge of conducting continuous learning in parallel with lean transformation.

5. Discussion and conclusions

Many software intensive companies consider applying lean principles in their businesses. As a big change, lean transformation may cause challenges. This research lists eight major challenges that are related to communication, strategy, customer value, organisational structure, culture, leadership, learning, and transparency. These challenges are mapped to lean transformation framework's cycles (Fig. 1): strategic alignment, organisational and business alignment, and implementation. On one hand, mapping the challenges to the framework helps to visualise, where to focus improvement actions. On the other hand, the mapping validates the framework as a useful tool in lean transformation and in lean operations of a company.

The results are significant as they point out the most probable areas, where transforming companies should focus most efforts in order to achieve successful results. Strategy and organizational structure are more concrete and more easily defined and implemented than the other ones, which are intangible, human related and not that easily defined. Despite challenges that are proposed by this study, there are also treatable things like tools, methods and systems, which the case companies see are easily decided, combined with others and tailored when needed.

The primary goal of this study was to investigate what kinds of challenges the case companies have faced when transforming to lean enterprises. Case specific validity is achieved through the detailed description of the case companies' lean transformation journey and by grounding the previous researches to this study. Internal validity has been achieved with different types of triangulation [23]. First, data triangulation was used in the data collection, as six people from five companies with different roles and sites were interviewed. Second, methodological triangulation was used by combining different types of data collection methods, i.e. semi-structured interviews and one seminar. Third, theory triangulation was used when utilizing different theories in the research. The number of interviews of this study is very small in order to be able to provide firm conclusions. Additionally, the roles of the interviewees covered only upper levels of the organisations. However, this research suggests the initiative ideas for more thorough studies in this field. There is still room for further research particularly related to strategic planning and especially continuous planning through the organisation as well as enterprise transparency. All of them are important elements of successful way of working in contemporary companies.

The proposition that this research suggests when running lean transformation is to consider using the lean transformation framework as a guideline through the whole long-lasting change in the company. Additionally, companies should consider investing energy in the human related, "soft" things like communication, changing the people's mind-set, continuous learning and leadership. The "hard" elements like strategy, organisational structure and systems, tools and methods are ultimately easier to change.

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