Lean product development systems

How internal lean production principles and work organization integrate with product development systems

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ABSTRACT

Purpose – The purpose of this paper is to investigate how internal lean production principles and work organization can integrate with organizational systems for product development.

Research design – The study applies a qualitative approach with an explorative design. The method employed for data collection is five in-depth interviews based on a semi-structured interview guide. The respondents include practitioners working with product development in the Scandinavian region in the IT and automotive industry respectively. Interviews were recorded and transcribed, thereafter organized using topic codes. The research applies a hermeneutic ontology where the analytical outcome is a co-creation of understandings and presumptions between the researchers and the informants.

Findings – Lean principles are primarily integrated with product development systems by redefining value and waste. Product development generates value through variation while in production value lies in consistency. Hence practitioners translate the original forms of waste in order to fit a specific context, which establishes a foundation for the removal of non value-adding activities and efficient use of resources.

Originality/value – According to the author’s best knowledge, this is the first known study that investigates how lean principles and work organization can integrate with organizational product development systems, more specifically the StageGate and Agile product development processes. The study seeks to evaluate how pure lean methodology functions outside its original context of production, excluding obscured versions of the concept and thereby finding it’s true applicability in product development.

Keywords – Lean production, Lean principles, Lean work organization, StageGate new product development process, Agile new product development processes

Paper type – Master’s thesis
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2. INTRODUCTION

Since the publication of the Machine that Changed the World in 1990, based on an extensive study on the Toyota Motor Corporation and their production system, the concept of lean has received major attention from practitioners and scholars around the globe (Hoppmann et al., 2011). According to Womack et al. (1990), a significant feature of lean is its applicability to any industry, service and context. Although criticized, the universality of lean is based on the rationale that the principles behind the Toyota Production System (TPS) are comprehensive, very simple and even common sense (Ohno, 1988). Lean is generally considered a suitable management method for improving organizations competitiveness, and has therefore been recognized as beneficial outside its natural context of manufacturing (Mayano-Fuentes & Sacristán-Díaz, 2012). Over twenty-three years after its inception, a quick search for ‘lean’ on Libsearch (http://libsearch.cbs.dk) reveals 103,299 results. Among these result there are identified terms such as; lean accounting, lean marketing, lean logistics, lean service operations, lean library management, lean supply chain management, lean planning, lean software development, lean retailing, lean construction, lean product development, and the list goes on. This illustrates how lean production is applied in a number of different areas and industries, including both tangible and intangible offerings. According to Hoppmann et al. (2011), the field of product development (PD) is an area with a particularly high potential for realizing the benefits of lean principles. This is because PD by definition plays a key part in defining customer value, it determines the physical appearance of the product and defines the materials to be used. With other words PD largely constrains the set of production processes that can be employed to manufacture the product (Hoppmann et al. 2011). Subsequently, the impact on cost, quality, and manufacturing lead-times is usually much bigger in the phase of PD than during production (Kennedy, 2003; Morgan & Liker, 2006). What is found interesting, then, is that there are no results concerning Robert G. Cooper & Scott J. Edgett’s famous Stage-Gate system related to lean. According to Cooper & Edgett’s official website, between 70 to 85 percent of leading U.S. companies use StageGate to drive new products to market (http://www.prod-dev.com/stage-gate.php, 27.05.13). Assuming validity in that statement as it supposedly results from several independent studies (Product Development & Management Association, AMR Research, & Booz-Allen Hamilton), StageGate new product development process could arguably be the most dominant approach to PD efforts within the present corporate environment. Despite this Agile PD processes has experienced a colossal popularity momentum in correlation to the blossoming IT technology. This exciting shift has made the researchers curious if there is a PD transformation happening from the more traditional
industries versus the modern service delivery industry such as IT. Consequently, the nexus between lean and these two dominant product development systems represent an interesting gap in current research.

2.1 Problem field

As indicated above, the conceptual point of departure for this paper is embedded in the idea that lean methodology might be applicable to StageGate and Agile PD systems in the pursuit of improving organizational competitiveness and performance. PD is also an area traditionally characterized as fuzzy and prone to failures (Cooper & Edgett, 2005). Despite being the dominant PD process StageGate is not the de-facto standard for innovation systems. A contender is found in Agile PD systems. However it isn’t until recently with the offspring of advanced technology Agile PD techniques has been fully utilized by corporations. This paper will therefore position itself between two main streams of research; lean and structured PD-systems hereunder StageGate and Agile.

As illustrated above, the concept of lean is by no means novel and has been subject to growing attention from the scientific community since the 1990s (Mayano-Fuentes & Sacristán-Díaz, 2012). Voss (1995) established that the level of research into lean production (LP) and just-in-time (JIT) was high and increasing during the mid 90s, based on the number of articles published in the International Journal of Operations & Production Management. Subsequently in 2003, Shah & Ward (2003) also highlighted the attention lean was receiving from researchers, while a more recent debate was initiated by Radnor & Boaden (2008) on the repercussions that lean has in public services. This demonstrates how the benefits of lean are recognized outside the manufacturing sector, including the service sector, and more specifically, a number of sectors with particular features, such as public services. The literature provides numerous articles reviewing LP, but with different purposes. Hines et al. (2004), for example, analyzed the evolution of research on LP coupled with the lean concept itself. The authors identified 4 key stages in its development focusing on various competitive priorities, hereunder awareness in the 80s, quality in the early 90s, quality, cost and delivery in the late 90s, and the value system from 2000 onwards (Hines et al. 2004). Holweg (2007) pursued another approach, and investigated the reasons explaining the origin and rise of lean production at the MIT International Motor Vehicle Program. He states that; ‘the lean concept itself was not a single point invention, but the outcome of a dynamic learning process that adapted practices emanating from the automotive and textile sectors in response to environmental contingencies at the time’ (p. 432). More recently, Mayano-Fuentes & Sacristán-Díaz (2012) presented an
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The analysis of research on LP since the concept was developed at the end of the 1980s with the aim of developing a model that permits an extended and comprehensive understanding of LP. The study identified four bundles of research within LP (Mayano-Fuentes & Sacristán-Diaz, 2012):

- Internal LP aspects
- LP’s impact on the value chain
- Work organization in LP
- Impact of geographical context on LP.

Moreover, three areas of research are identified within the bundle of internal lean aspects (Mayano-Fuentes & Sacristán-Diaz, 2012):

- Principles
- The implementation process
- Results of implementation

The primary focus of this paper will be on internal LP principles and work organization (WO) in LP. There exist a vast number of literature on the subject, this paper will be limited to the investigation of principles connected with the lean concept, excluding research on lean implementation and results. Because lean is at the core of this paper, implicit aspects related to the management system such as those linked to Total Quality Management (TQM), Total Productive Maintenance (TPM), single minute die exchange, or other technical traits, are rejected.

The other research stream entails PD processes, chiefly how to structure organizational systems for innovation. As several authors has stated, this process may seem difficult to master, because the process is not as visible as other processes in an organization (Cooper & Edgett, 2005; Thomke & Reinertsen, 2012). From a historical perspective innovation has been around since the existence of mankind, however structured processes for achieving innovation is of newer date. NASA developed a sequential model for innovation in the 50’s (Takeuschi & Nonaka, 1986). Although NASA has been successful, they don’t compete in a similar environment as companies most, and weaknesses specifically in terms of cycle-time, inflexibility and costs have been addressed with this approach (Takeuschi & Nonaka, 1986). StageGate was first presented in 1988 as a respond to the amount of failures observed in the field of PD. The
founders had realized that companies fell into the same pitfall over and over again (Cooper & Edgett, 2005). StageGate was the solution, it has been refined through the years, enhancing the flexibility and introducing new aspects, which in turn has made the process closer to an encompassing system for PD (Cooper, 2008). Despite this, introduction of modern technology has shifted the necessity of heavy front-end analysis to a more practical approach utilizing IT-technology to test out novel ideas virtually (Larson & Gray, 2011). Because of the vast amount of systems for innovation we have limited this thesis to the two PD processes StageGate and Agile. StageGate is the established and the most utilized PD system worldwide, while Agile is an increasingly popular method embraced especially by the IT-industry. The research will then divide between StageGate and Agile to find if there is differences that is fundamentally opposing and how these systems unit with the origin of lean.

2.2 Research question

Based on the above described problem fields and defined limitations, a research question can now be established. In recapitulation: this paper seeks to investigate the application of internal LP principles and WO in structured new product development efforts (NPD), more specifically StageGate- and Agile NPD. Accordingly, this paper warrants the following articulation:

RQ: How can internal lean production principles and work organization integrate with product development systems?

In order to answer the proposed research question in a sufficient manner, both the concept of lean and the organized PD systems StageGate and Agile PD would have to be addressed. These represent three theoretical areas and therefore require an establishment of sub-questions addressing these main components of the primary articulation. Consequently, the following sub-questions have been established in order to answer the research question adequately:

SQ1: What is lean?
SQ2: What is StageGate?
SQ3: What is Agile product development?

Founded on empirical studies and theoretic examinations this paper will seek to understand how corporations might approach the nexus between lean thinking and the NPD systems StageGate and Agile, and how a integrated methodology could reveal the true compatibility of those conceptualizations.
2.3 Theoretical framework methodology

The research methodology employed for the theoretical framework encompassing respectively chapter three and four of this paper was a literature survey. According to Mayano-Fuentes & Sacristán-Diaz 2012), methodology of this kind has been successfully used in evaluating research on other management systems, hereunder TQM (Sila & Ebrahimpour, 2002), supply chain management (SCM) (Gunasekaran & Ngai, 2005), and NPD (Krishnan & Lock, 2005). The revised bibliography includes peer reviewed journal articles and managerial books with impact on the topic. Literature was primarily abstracted from journals within the following areas: production management, operations management, logistics management, engineering management, business process management, product innovation, product management, and technology management. Articles where identified in the main management databases using libsearch (http://libsearch.cbs.dk), hereunder Business Source Complete, Elsevier ScienceDirect, Taylor & Francis Online, and Emerald Database. Key words was used to locate the relevant research, and included terms such as lean management, lean thinking, lean production, JIT, TPS, product innovation, NPD processes, PD processes, StageGate, and Agile. The research was conducted during the autumn/summer of 2013. The following two chapters make up the theoretical framework of this paper, starting with lean.
**3. LEAN**

The concept of lean is used in almost every aspect of business, ranging from marketing and sales to product development. This has resulted in a plethora of different understandings and definitions of the concept, and it can seem that lean has lost its true meaning and become just another attractive word. Within the defined limits, the purpose of this section is to investigate the origin of lean and how it has developed based on TPS. Emphasis is put on literature that has made the greatest contributions to developing and spreading the lean concept. More specifically, the origin of lean is examined based on Womack et al. (1990) extensive study on Toyota during the late 1980s. Following the history of TPS, more influential literature is reviewed to demonstrate the lean discourse development from 1990 until present time. Special focus is put on the various definitions that researchers use to characterize the lean concept. Finally, lean methodology is investigated through the principles most commonly associated with the concept. This will establish the foundation towards understanding integration of lean to other fields than manufacturing, and thereby contributes to the investigation of lean in systemized PD. Accordingly, this section shall answer the following sub question:

**SQ1: What is Lean?**

### 3.1 The origin of lean

In the end of the 1980s, there grew a major interest in the TPS among Western researchers. They assigned the label *lean* to their observations, and a new concept emerged. John Krafcik (1988) was the first to use the term *lean production* in his article *Triumph of the Lean Production system*, published in the *Sloan Management Review*. The article compared productivity levels among various automotive companies, and Krafcik found two types of productions systems; a robust and a fragile. Because he thought the word *fragile* had negative associations, he used the word *lean* to represent the efficient production system (Modig & Åhlström, 2012).

*The Machine that Changed the World* published in 1990 made the concept of lean widely known, whereas Womack et al. (1990) provided comprehensive insight in what lean production was all about. The book shows how Toyota successfully achieved productivity and quality levels that no other automaker could. By taking the perspective of Taiichi Ohno, which was an executive within Toyota Motor Company and considered to be the founding father of TPS, they elaborate the origin of lean production.
3.1.1 Muda

Womack et al. (1990) claim that Ohno established a new approach to human resource management through his empowerment of assembly line workers, and that this paid enormous dividends for Toyota. Ford is exemplified as an opposing approach, ‘…Ford’s system assumed that assembly-line workers would perform one or two simple tasks, repetitively and, Ford hoped, without complaint’ (Womack et al, 1990, p. 55). The authors mention a range of specialized positions in Ford:

The foreman did not perform assembly tasks himself but instead ensured that the line workers followed orders. These orders or instructions were devised by the industrial engineer, who was responsible for coming up with ways to improve the process. Special repairmen repaired tools. Housekeepers periodically cleaned the work area. Special inspectors checked quality, and defective work, once discovered, was rectified in a rework area after the end of the line. A final category of worker, the utility man, completed the division of labor (Womack et al, 1990, p. 55).

Womack et al. (1990) further observed that the headquarter managers generally graded factory management on yield and quality, 'Yield was the number of cars actually produced in relation to the scheduled number, and quality was out-the-door- quality, after vehicles had defective parts repaired' (Womack et al, 1990, p. 55). Historically factory managers knew that falling beneath the assigned production target entailed big trouble. Defects could be fixed in the rework area at the end of the line thus ignoring cars with misaligned parts was perfectly accepted. Minutes and cars lost to a line stoppage, however, could only be compensated for with expensive overtime. This conduct is referred to as the move the metal mentality in the mass-production auto industry (Womack et al, 1990). The authors state that Ohno thought ‘this whole system was rife with Muda, the Japanese term for waste that encompasses wasted effort, materials, and time’ (Womack et al, 1990, p. 56). Womack et al. (1990) continue with describing Ohno’s rationale:

He reasoned that none of the specialists beyond the assembly worker was actually adding any value to the car… Ohno thought that assembly workers could probably do most of the functions of the specialists and do them much better because of their direct acquaintance with conditions on the line (p. 56).

After having observed the Western practices in Detroit, Ohno went back to Toyota City and started to experiment. Womack et al. (1990) describes his approach in the following way:
The first step was to group workers in teams with a team leader rather than a foreman. The teams were given a set of assembly steps, their piece of the line, and told to work together on how best to perform the necessary operations. The team leader would do assembly tasks as well as coordinate the team, and, in particular, would fill in for any absent worker. Ohno next gave the team the job of housekeeping, minor tool repair and quality checking. Finally, as the last step, after the teams were running smoothly, he set time aside periodically for the team to suggest ways collectively to improve the process…This continuous, incremental improvement process, kaizen in Japanese, took place in collaboration with industrial engineers, who still existed but in much smaller numbers. (p. 56).

3.1.2 Kaizen

Womack et al. (1990) explain Ohno’s thinking related to continuous improvement, or kaizen:

Once a defective part had become embedded in a complex vehicle, an enormous amount of rectification work might be needed to fix it. And because the problem would not be discovered until the very end of the line, a large number of similarly defective vehicles would have been built before the problem was found (p. 57).

The authors describe Ohno’s solution, which was in striking contrast to mass-production plants, ‘Ohno placed a cord above every workstation and instructed workers to stop the whole assembly line immediately if a problem emerged that they couldn’t fix. Then the whole team would come over to work on the problem’ (p. 57).

In mass production plants, Womack et al. (1990) describe how the idea was to simply repair each error and hope it did not occur again. Errors were more or less treated like random events. Ohno, on the contrary; ‘instituted a system of problem solving labeled the five why’s’ (Womack et al, 1990, p. 57). Production workers were ordered to systematically trace any error back to its ultimate cause, then devise a fix so it would never happen again (Womack et al, 1990).

3.1.3 Just-in-time

Toyotas famous JIT system is a way of coordinating the flow of parts on a day-to-day basis (Womack et al., 1990). The authors describe were the concept originates based on Ohno’s rationale:

Ohno’s idea was simply to convert a vast group of suppliers and parts plant into one large machine… by dictating that parts would only be produced at each previous step to supply the
immediate demand of the next step. The mechanism was the containers carrying parts to the next step. As each container was used up, it was sent back to the previous step, and this became the automatic signal to make more parts (p. 62).

This seemingly simple strategy was tremendously difficult in practice because it eliminated practically all buffers, meaning that a breakdown in one step would halt the entire system (Womack et al., 1990). ‘In Ohno’s view, this was precisely the power of his idea – it removed all safety nets and focused every member of the vast production process on anticipating problems before they became serious enough to stop everything’ (Womack et al., 1990, p. 62).

3.1.4 From push to pull

Another major element of TPS is the renowned pull-system. Toyota Motor Sales Company built up a network of distributors that Toyota owned or held a small equity stake (Womack et al. (1990). In this way the distributors would have a shared destiny with Toyota, which led to the development of a set of techniques termed aggressive selling.

The basic idea was to develop a long-term, indeed a life-long, relation between the assembler, the dealer, and the buyer by building the dealer into the production system and the buyer into the product development process (Womack et al., 1990, p. 67).

Womack et al. (1990) further explain how Toyota went from a push- to a pull-system:

The dealer became part of the production system as Toyota gradually stopped building cars in advance for unknown buyers and converted to a build-to-order system in which the dealer was the first in the kanban system, sending orders for presold cars to the factory for delivery to specific customers in two to three weeks (p. 67).

At this point the origin of lean and its most renowned concepts has been reviewed based on Womack et al.’s comprehensive study on TPS. When discussing the truly important organizational features of a lean plant, the authors state the following

The truly lean plant has two key organizational features: It transfers the maximum number of tasks and responsibilities to those workers actually adding value to the car on the line, and it has in place a system for detecting defects that quickly traces every problem, once discovered, to its ultimate cause (Womack et al., 1990, p. 99)
3.2 Defining lean

After the major success of *The Machine that Changed to world*, great amounts of authors have written about TPS and tried to develop the concept of lean even further. This section will therefore investigate more influential research conducted on the topic in order to clarify how the concept of lean has developed over time.

In 1996 Womack & Jones published a follow-up book labeled *Lean Thinking: banish waste and create wealth in your corporation*, where they elaborate on how companies can become lean. The authors argue that a lean way of thinking allows companies to ‘*specify value, line up value-creating action in the best sequence, conduct these activities without interruption whenever someone requests them, and perform them more and more effectively*’ (Womack & Jones, 1996, p. 15). The book defines lean as a five-step process with a clear focus on implementation (Womack & Jones, 1996):

1. Value can only be defined by the ultimate customer
2. Map the value stream and eliminate all non-value-adding steps
3. Ensure that the remaining value-adding steps generate a smooth flow of units towards the customer
4. When flow is established, enable the customer to pull value upstream from the next upstream activity
5. When steps 1 – 4 are completed, the process restarts continuously until a state of perfection is reached, hereunder perfect value creation with zero waste

The authors state that by following these steps, a company could become *leaner* in their operations and increase the flow efficiency of their processes. The same year as *Lean Thinking* was released, Christer Karlsson and Pär Åhlström (1996) published an article in the International Journal of Operations & Production Management, which develops an; ‘*operationalized model which can be used to assess the changes taking place in an effort to introduce lean production*’, and the authors state that ‘*lean can be seen as an intended direction, not as a state or as an answer to a question*’ (p. 24).

In assessing the changes towards lean production, Karlsson & Ålström (1996) highlight the importance of making a distinction between the determinants and the performance of a lean production system:
The ultimate goal of implementing lean production in an operation is to increase productivity, enhance quality, shorten lead times reduce costs etc. These are factors indicating the performance of a lean production system. The determinants of a lean production system are the actions taken, the principles implemented, and the changes made to the organization to achieve the desired performance (p. 24).

In 1999 researchers Steven Spear and H. Kent Bowen published an article in the Harvard Business Review. This article once again brought TPS to the attention of the Western civilization and has become one of the most frequently quoted articles on the topic (Modig & Åhlström, 2012). The researchers wondered why no one that tried to observe and copy TPS was successful, especially when Toyota was so open about their practices.

…few manufacturers have managed to imitate Toyota successfully – even though the company has been extraordinary open about its practices…The answer, we believe, is that observers confuse the tools and practices they see on their plant visits with the system itself. That makes it impossible for them to resolve an apparent paradox with the system – namely, that activities, connections, and production flow in a Toyota factory are rigidly scripted, yet at the same time Toyota’s operations are enormously flexible and adaptable (Spear & Bowen, 1999, p. 97).

Spear & Bowen (1999) claim that you have to unravel this paradox in order to understand Toyota’s success; ‘you have to see that the rigid specification is the very thing that makes the flexibility and creativity possible’ (p. 97). As a result, they performed a 4-year study in order to decode the tacit knowledge absorbed within TPS. The authors explain an important finding:

We found that, for outsiders, the key is to understand that the Toyota Production System creates a community of scientists. Whenever Toyota defines a specification, it is establishing sets of hypotheses that can be tested. In other words, it is following the scientific method (Spear & Bowen, 1999, p. 98).

The authors describe how Toyota work with a scientific rigor, ‘To make any changes, Toyota uses a rigorous problem-solving process that requires a detailed assessment of the current state of affairs and a plan for improvement that is, in effect, an experimental test of the proposed changes’ (Spear & Bowen, 1999, p. 98). They further explain how Toyota manages to keep so flexible and standardized at the same time:
The fact that the scientific method is so ingrained at Toyota explains why the high degree of specification and structure at the company does not promote the command and control environment one might expect. Indeed, in watching people doing their jobs and in helping to design production processes, we learned that the system actually stimulates workers and managers to engage in the kind of experimentation that is widely recognized as the cornerstone of a learning organization (Spear & Bowen, 1999, p. 98).

Spear & Bowen (1999) puts forward four rules that underlie TPS. These rules guide the design, operation, and improvement of every activity and connection, as well as pathways for every product and service (Spear & Bowen, 1999):

1. All work shall be highly specified as to content, sequence, timing and outcome.
2. Every customer-supplier connections must be direct, and there must be an unambiguous yes-or-no way to send requests and receive responses.
3. The pathway for every product and service must be simple and direct.
4. Any improvement must be made in accordance with the scientific method, under the guidance of a teacher, at the lowest possible level in the organization.

Spear & Bowen (1999) explain that all the rules require that activities, connections, and flow paths have built-in tests to signal problems automatically; ‘It is the continual response to problems that makes this seemingly rigid system to be so flexible and adaptable to changing circumstances’ (p. 98). The authors claim that by following these rules an organization can achieve a nested modular structure. An elaboration on the benefits of such a structure are provided, ‘The great benefit of a nested, modular organizations is that people can implement design changes in one part without unduly affecting other parts. That’s why managers at Toyota can delegate so much responsibility without creating chaos’ (Spear & Bowen, 1999, p. 106).

Toyota became the world’s largest automaker around 2004, right at the time when Jeffrey K. Liker published his book entitled The Toyota Way: 14 management principles from the worlds greatest manufacturer. This yet again sparked interest in TPS. Liker (2004) also offers a description of TPS and LP, and put forward a definition of the lean enterprise; ‘you could say that it’s the end result of applying the Toyota Production System to all areas of your business’ (p. 7). The author explains how most attempts to implement lean have been fairly superficial, because the majority of companies focus too much on tools such as 5S and JIT, ’without understanding lean as an entire system that must permeate an organization’s culture’ (Liker,
He then goes on and adopts Womack & Jones’ (1996) definition of lean manufacturing, but make his own description of what it entails to be lean:

To be a lean manufacturer requires a way of thinking that focuses on making the product flow through value-adding processes without interruption (one-piece flow), a ‘pull’ system that cascades back from customer demand by replenishing only what the next operation takes away at short intervals, and a culture in which everyone is striving continuously to improve (Liker, 2004, p. 7).

In similar vein as Womack et al. (1990), Liker (2004) takes the perspective of Taiichi Ohno in order to support his claim:

All we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value-added wastes (p. 7).

Moreover, Liker (2004) provide a description of how Toyota was forced to pursue another strategy than mass-production and economies of scale, because of their small market in Japan during the turmoil of World War II. He states that the key to their operations was flexibility, which helped them make a critical discovery: ‘when you make lead times short and focus on keeping production lines flexible, you actually get higher quality, better customer responsiveness, better productivity, and better utilization of equipment and space’ (Liker, 2004, p. 8).

Hofer et al. (2012) describe lean as a philosophy with strong focus on the use of certain activities, and defines it as; ‘a strategy or philosophy that promotes the use of practices, such as kanban, total quality management (TQM) and just-in-time, to minimize waste and enhance firm performance’ (p. 243). Cottyn et al. (2010) likewise define lean as a philosophy, but points out that it should not be viewed as a tool in itself. Slack et al. (2010) elaborate on what they term ‘lean synchronization’, based on the origin of lean in Japan. Not unlike Hofer et al. (2012) and Cottyn et al. (2010), Slack et al. (2010) claim that lean synchronization, or lean is; ‘both a philosophy and a method of operations planning and control’ (p. 429). Slack et al. (2010) develop their own definition of lean synchronization; ‘lean synchronization aims to meet demand instantaneously, with perfect quality and no waste (p. 433), and further state that this entails ‘supplying products and services in perfect synchronization with the demand for them’ (p. 429). When using the word ‘synchronization’, the authors mean that:
The flow of products and services always delivers exactly what customers want (perfect quality), in exact quantities (neither too much nor too little), exactly when needed (not too early or too late), and exactly where required (not the wrong location). Lean synchronization is to do all this at the lowest possible cost (p. 431).

Slack et al. (2010) explain that the best way to understand lean synchronization is to compare it with what they call ‘the traditional approach’. The traditional approach simulates each stage in the process to place its output in an inventory that buffers that respective stage from the next one downstream in the process. The following stage will then (eventually) take outputs from the inventory, process them, and pass them through to the next buffer inventory. These buffers are created in order to isolate each stage from its up- and downstream neighbors so that each stage is relatively independent. In this way the next stage in the process can continue operating even though the previous stage is experiencing a breakdown, at least for a while (Slack et al., 2010). The authors explain how the increase in buffer inventory will lead to greater insulation between stages, and that ‘this insulation has to be paid for in terms of inventory and slow throughput times because items will spend time waiting in the buffer inventories’ (Slack et al., 2010, p. 431). The authors claim that the main argument against the traditional approach, however, ‘lies in the very conditions it seeks to promote, namely the insulation of stages from one another’ (Slack et al., p. 431).

In contrast to the traditional approach, Slack et al. (2010) explain how a pure lean synchronized process makes sure that items are processed and then passed directly to the next stage just-in-time for them to be processed further. The authors describe how problems have a very different effect in such a system:

If stage A stops processing, stage B will notice immediately and stage C very soon after. Stage A’s problem is now quickly exposed to the whole process… This means that the responsibility for solving the problem is no longer confined to the staff at stage A. It is now shared by everyone, considerably improving the chances of the problem being solved, if only because it is now too important to be ignored (Slack et al., 2010, p. 432).

By exposing the system to problems in this way, Slack et al. (2010) claim that problems can both be more evident and change the ‘motivation structure’ of the whole system towards solving problems. This corresponds with Womack et al. (1990) and their reference to Taiichi Ohno argumentation that the removal of safety nets (buffers) would focus every member of the production process to anticipate problems before they became serious enough to stop
everything. The authors claim that lean synchronization has many benefits, but that these come at the cost of capacity utilization (Slack et al., 2010). This is because buffers allow each stage to continue working in the event of a stoppage, hence allowing high capacity utilization. According to Slack et al. (2010), however, there is no point in producing output just for its own sake, unless output is useful and causes the operation as a whole to produce saleable products. Hence, the authors state that ‘producing just to keep utilization high is not only pointless, it is counter-productive, because the extra inventory produced merely serves to make improvements less likely’ (Slack et al., 2010, p. 433).

In 2012, Swedish researchers Niklas Modig and Pär Åhlström released the book; *This is lean: resolving the efficiency paradox*, which seek to develop a definition of lean on a high level of abstraction so that it can be applied regardless of organizational contexts. The authors label their definition Lean 2.0 and describe it as ‘*an operations strategy that prioritizes flow efficiency over resource efficiency*’ (Modig & Åhlström, 2012, p. 117). They claim that the most important lesson from the Toyota story is that the company was forced to focus on flow efficiency:

…the lack of resources forced the company to develop a production system that focused on flow efficiency. The resource scarcity forced Toyota to focus on customer needs. Toyota saw all the steps in the production process as internal customers and suppliers, which created an understanding of the big picture.’ (Modig & Åhlström, 2012, p.74).

The authors further claim that Toyota’s goal was to *maximize flow efficiency so that value was added to the product one hundred per cent of the throughput time, from order through to deliver and payment* (Modig & Åhlström, 2012, p. 74).

Unlike the traditional form of efficiency that focuses on maximum utilization of resources, Modig & Åhlström (2012) explain that flow efficiency ‘*focuses on ’the unit’ processed in an organization*’ (Modig & Åhlström, 2012, p. 13). The unit is described as ‘*a product comprised of different types of components that are processed in various stages to make the product. In services, the unit is often a customer whose needs are met through different activities*’ (Modig & Åhlström, 2012, p. 13). The authors refer to this form of efficiency as flow efficiency because the focus is on the unit that ‘*flow’s*’ through the organization; hence they use the word *flow unit* (Modig & Åhlström, 2012). Moreover, flow efficiency is defined as ‘*the sum of value-adding activities in relation to the throughput time*’ (Modig & Åhlström, 2012, p. 26).
Throughput time is described as 'the time it takes for the flow unit to move through the whole process, as defined, from start to finish' (Modig & Åhlström, 2012, p. 22). The authors highlight the importance of defining flow efficiency from the perspective of the flow unit, and that the important factor is 'the time during which the flow unit receives value' (Modig & Åhlström, 2012, p. 14).

Similar to Slack et al. (2010), Modig & Åhlström (2012) refer to an efficiency paradox. ‘The paradox is that a greater focus on utilizing resources efficiently tends to increase the amount of work there is to do’ (Modig & Åhlström, 2012, p. 47). The authors state that long throughput time, many flow units in process, and restarts characterize the resource efficient system, which mainly focus on maximum capacity utilization (Modig & Åhlström, 2012). The authors claim that these characteristics generate what they term ‘superfluous work’, which is defined as activities that address ‘a need that has arisen due to failure to satisfy the primary need’ (Modig & Åhlström, 2012, p. 61). According to Modig & Åhlström (2012), the main point is that too much focus on resource efficiency have negative effects such as the need for additional resources, work, and efforts that would not be necessary in a flow-efficient organization. The authors claim that focusing on flow efficiency is at the core of resolving the efficiency paradox, and that this enables an organization to eliminate many of the secondary needs that arise as a consequence of low flow efficiency (Modig & Åhlström, 2012). More specifically, they state that

… any decision that decreases throughput time, the amount of flow units in process, and/or the amount of restarts will eliminate superfluous work. Paradoxically, not focusing on utilizing resources makes it possible to free up resources (Modig & Åhlström, 2012, p. 64).

Browning & Sanders (2012) confront the notion of using lean as a means of eliminating waste in novel and complex operations, and state that ‘cutting out the fat’ is much more challenging in product innovation, research, and new process development. The authors define lean as a ‘system of waste reduction and cost control’, and argue that ‘Lean practices were pioneered in repetitive production systems characterized by relative stability and certainty’ (Browning & Sanders, 2012, p. 5). The authors explain how traditional lean practices is built on stability, where ‘lean practices assume stable and routine processes, high-volume production, a stable learning curve (costs decrease with repetition of jobs), a stable workforce, and the elimination of buffers such as waiting time and inventory’ (Browning & Sanders, 2012, p. 8).
In their view, however, a large number of today’s development and production systems is pushed by the need for mass customization and innovation, and are characterized by novelty and complexity (Browning & Sanders, 2012). Based on this argument, the authors claim that a traditional application of lean practices can lead to the opposite of cost savings, and that the timing, scale and extent of lean implementation become much more critical (Browning & Sanders, 2012). Mayano-Fuentes & Sacristán-Díaz (2012) seem to support this claim, stating that there is an opportunity to pursue a lean strategy when demand is predictable.

**3.3 Lean methodology**

Most research on lean characterizes the concept through various principles and methods. The following sub-section will therefore investigate various aspects associated with lean methodology.

**3.3.1 Teamwork**

Teamwork is one of Womack, et al., (1990) fundamental principles of lean, and claim that one feature of a truly lean organization is the allocation of a maximum number of tasks and responsibilities to the people actually adding value to the product or service (Womack et al., 1990). This corresponds with Karlsson & Åhlström (1996) which states that the most salient feature of WO in LP is the extensive use of multifunctional teams and task rotation, and it’s claimed that; ‘the percentage of employees working in multifunctional teams is much higher than in traditional work organizations’ (Karlsson & Åhlström, 1996, p. 34). One important benefit with multifunctional teams and task rotation is considered to be that ‘increased flexibility reduces the vulnerability of the production system’, because ‘there is not so much dependence on single persons’ (Karlsson & Åhlström, 1996, p. 34). Karlsson & Åhlström (1996) regard decentralized responsibilities as another important characteristic of a lean work organization, where ‘responsibilities are decentralized onto the multifunctional teams’ and that ‘the multifunctional team is expected to perform supervisory tasks’ (Karlsson & Åhlström, 1996, p. 36). The authors state that this is achieved through ‘rotating team leadership among employees especially trained for the task’ (Karlsson & Åhlström, 1996, p. 36). Integrated functions is further argued to be a second important principle related to multifunctional teams, whereas:

…the number of tasks performed by the team increases, and consequently the number of indirect employees can be reduced. Support functions are no longer necessary to the same extent as in traditional production systems’ (Karlsson & Åhlström, 1996, p. 37).
Liker (2004) also highlight the importance of teamwork among his 14 management principles, and state that one should develop exceptional people and teams who follow your company’s philosophy. However, Liker (2004) goes further and explains the importance of building a culture of stopping to fix problems, so that the right quality can be achieved the first time. He also emphasizes the weight of growing leaders who understand the work and live the philosophy, as well as teach it to others. Slack et al. (2010) likewise define ‘the involvement of staff in the operation’ (p. 433) as a key issue of the lean philosophy.

According to Womack et al. (1990), Toyota enables teamwork through simple but comprehensive information displays which allows everyone to respond quickly to errors, and perhaps most importantly, it allows everyone to understand the plant’s overall situation. With reference to a Toyota executive, Modig & Åhlström (2012) term this kind of overview or visual planning as Jidoka, and states that ‘the intention of jidoka is to create a transparent organization so that everyone can see everything all the time. That is made possible through visualizing and continually updating all the relevant information concerning the business on our walls’ (Modig & Åhlström, 2012, p. 136). Karlsson & Åhlström (1996) strengthen this with their principle of vertical information systems. They argue that ‘Information is important in order for the multifunctional teams to be able to perform according to the goals of the company’, where the objective is to ‘provide timely information continuously, directly in the production flow’ (Karlsson & Åhlström, 1996, p. 36).

Sim & Chiang (2012), questions the social organization in lean, and states that lean is often viewed as pro-company and not pro-employee. Studies have shown that lean is associated by working conditions related to high stress, that employees often feel a sense of insecurity and that they perceive lean as a ‘redundancy threat’ with adverse effect on moral, leading to worker unhappiness and withdrawal that ultimately may cause company failure (Sim & Chiang, 2012). Mehri (2006) supplements this view, and believes that international enthusiasm for TPS results from western observers failure to understand fundamental factors of Japanese culture and business, hereunder to discern the honne (what you actually feel or do) within the tatemae (what you are supposed to feel or do). According to Mehri (2006), there is a curtain of formality and messages from management at Toyota (tatemae) that obscures the realities (honne) of the Toyota way. In reality, Mehri (2006) claims that TPS is characterized by limited potential for creativity and innovation, narrow professional skills, worker isolation and
harassment, dangerous conditions on the production line, accident cover-ups, excessive overtime, and poor quality of life for workers.

3.3.2 Efficient use of resources and elimination of waste

Another salient feature of lean, as originally put forward by Womack et al. (1990) is the efficient use of resources and elimination of waste. Womack & Jones (1996) later described this principle more specifically as mapping the value stream and eliminating all non-value adding steps, and argue that waste is especially concerned with any human activity that absorbs resources but creates no value. They identify seven forms of waste:

1. Defective products
2. Inventory
3. Processing
4. Movement
5. Transportation
6. Waiting time
7. Overproduction.

Chen, Li, & Shady (2010) explain that any task in a manufacturing facility can be classified into one of three categories, incidental work, value-added work, and muda (waste).

Incidental processes are processes such as inspection that do not add value to the product, but are required in the current production system. Value added processes add value to the product, such as the final assembly of a product. Finally, non-value added processes, or muda, are defined as any process that does not add value to the product and is not required by the current production system (Chen, Li, & Shady, 2010, p. 1070).

Karlsson & Åhlström (1996) explain waste as something that 'the customer is not willing to pay for and it should therefore be eliminated' (Karlsson & Åhlström, 1996, p. 27), and claim that the most important source of waste is inventory.

Keeping parts and products in stock does not add value to them, and should be eliminated. In manufacturing, inventory in the form of work in progress is especially wasteful, and should therefore be reduced. Apart from being wasteful in itself, inventory also hides other problems, preventing their solution (Karlsson & Åhlström, 1996, p. 27)
In relation to the elimination of waste, Slack et al. (2010) describe a simple methodology for organization work areas that focus on visual order, organization, cleanliness and standardization. It’s called the 5-S terminology and helps to keep track on all types of waste relating to uncertainty such as, idle time, searching for relevant information, variations, etc. (Slack et al. 2010):

1. Sort (eliminate what is not needed and keep what is needed).
2. Straighten (position things in such a way that they can be easily reached when needed).
3. Shine (keep things clean and tidy).
4. Standardize (maintain cleanliness and order).
5. Sustain (develop a commitment and pride in keeping to standards).

The 5S terminology is also something that Liker (2004) describes as part of his elaboration on the principle ‘use visual control so no problems are hidden’ (Liker, 2004, p. 149), but claim that companies tend to confuse 5-S with LP, and offer an explanation on how the terminology should be understood:

The Toyota Way is not about using 5S to neatly organize and label materials, tools, and waste to maintain a clean and shiny environment. Visual control of a well-planned lean system is different from making a mass-production operation neat and shiny. Lean systems use 5S to support smooth flow to takt time. 5S is also a tool to help make problems visible and, if used in a sophisticated way, can be part of the process of visual control of a well-planned lean system (Liker, 2004, p. 152).

Similar to Modig & Åhlström (2012), Liker (2004) also highlights that long lead times, or throughput time, can act as an important source of waste. Liker (2004) explains:

If any large batches of material are produced and then sit and wait to be processed, if service calls are backed up, if R&D is receiving prototype parts they don’t have time to test, then this sitting and waiting to move to the next operation becomes waste (Liker, 2004, p. 9).

In Liker’s (2004) view, this is why TPS has an intense focus on the value added from the customer’s perspective. ‘Because the only thing that adds value in any type of process – be it in manufacturing, marketing, or a development process – is the physical or information transformation of that product, service, or activity into something the customer wants’ (Liker, 2004, p. 10). Modig & Åhlström (2012) builds their research on the same rationale, and argue
that value is only added ‘when something happens to the flow unit, or when it is moved forward (being processed)’ (Modig & Åhlström, 2012, p. 24).

Browning & Sanders (2012) provide a different perspective, stating that value and waste cannot always be attributed to individual activities in the process. ‘Rather, value stems from how activities work together, and waste from how they fail to do so’ (Browning & Sanders, 2012, p. 6). They also claim that lean practices in itself can be wasteful if implemented at a poor time, or taken too far (Browning & Sanders, 2012). According to Browning & Sanders (2012), the lack of value often stems less from doing unnecessary activities and more from doing necessary activities with the wrong inputs and then having to redo them (the ‘garbage in, garbage out’ problem). In Browning & Sanders’ (2012) view, truly removing waste, or ‘anti-value’, requires a holistic system perspective which they call ‘diet and exercise’. This focuses on becoming competitive and healthy rather than on short-term surface appearances (Browning & Sanders, 2012). ‘It focuses on maximizing value and recognizes that a truly Lean and agile athlete may actually weigh more than their emaciated counterpart’ (Browning & Sanders, 2012, p. 7).

### 3.3.3 Continuous improvement

A third fundamental lean principle, as initially stated by Womack et al. (1990), concerns continuous improvement. Cottyn et al. (2010) claim that the ultimate goal in lean is a process without any of the seven deadly wastes put forward by Womack & Jones (1996). The author’s state that; 'however, as that situation is impossible to reach, Lean manufacturing is a continuous process towards perfection' (Cottyn, Landeghem, Stockman, & Derammelaere, 2010, p. 4389). Karlsson & Åhlström (1996) define continuous improvement as ‘ongoing improvement involving everyone’ (Karlsson & Åhlström, 1996, p. 29), and provide examples on how this is can be done in practice:

Involving everyone in the work of improvement is often accomplished through quality circles. These are activities where operators gather in groups to come up with suggestions on possible improvements. This is tied to an elaborate scheme for implementing suggestions, rewarding employees, and feeding back information on the status of suggestions (Karlsson & Åhlström, 1996, p. 29).

According to Liker (2004), the standardization of tasks is the foundation for continuous improvement and employee empowerment. Modig & Åhlström’s (2012) supplements this, and state that standardization concerns crating and maintaining an efficient flow, because the flow must be standardized at some point so that everyone can have the same understanding of how
tasks should be carried out (Modig & Åhlström, 2012). As part of their four principles that underlies TPS, Spear & Bowen (1999) also underline the importance of standardization, and states that ‘all work should be highly specified as to content, sequence and outcome’ (Spear & Bowen, 1999, p. 98). Karlsson & Åhlström (1996) argue that the goal with continuous improvement of the process is to achieve products that are fault free, and claim that zero defects denote how a lean company works in order to attain quality (Karlsson & Åhlström (1996). According to Karlsson & Åhlström (1996), the principle of JIT is closely associated with zero defects since flawless parts are a prerequisite for achieving JIT deliveries.

3.3.4 Just-in-time (JIT)

JIT has in some cases been defined as a managerial or manufacturing philosophy, while others indicate that JIT is simply a set of practices (Mackelprang & Nair, 2010). Claycomb et al. (1999) claim that ‘in its ideal form, JIT integrates the entire supply chain’s marketing, distribution, customer service, purchasing, and production functions into one controlled process’ (Claycomb et al., 1999, p. 614). Operationally, JIT production necessitates the identification and removal of waste from overproduction, waiting (idle time), motion, transportation, inventory, processing, and product defects (Brox & Fader, 2002). According to Mackelprang & Nair (2010), JIT manufacturing is in particular associated with cost, delivery and cycle time performance, but not with quality performance. Since JIT is regarded as a subset of lean, Inamn et al. (2011) narrow their definition to the following: ‘JIT is a subset of lean associated primarily with the elimination of waste through planning, scheduling and sequencing operations’ (Inamn et al., 2011, p. 344) According to Claycomb et al. (1999), the purpose of JIT is to improve coordination between a manufacturer and its supply and distribution networks, and describe it as a total pull system with demand originating from the final customer and rippling upstream through all processes. This fundamental objective of pull requires production and delivery of a specific product in the exact quantity needed at the precise time required, conforming to quality specification every time, all in parallel to minimizing total supply chain cost by eliminating waste (Claycomb et al., 1999). Advantages of JIT include reduced inventories, reduced lead times, higher quality, reduced scrap and rework rates, ability to keep schedules, increased flexibility, easier automation, and better utilization of workers and equipment (Akturk & Erhun, 1999). According to Brox & Fader (2002), the implementation of JIT has at least two key factors critical to its success: complete commitment and reliable delivery.
Pull control is the term used by Slack et al., (2010), which explain that ‘the essence of pull control is to let the downstream stage in a process, operation, or supply network, pull items through the system rather than have them ‘pushed’ to them by the supplying stage’ (p. 441). According to Slack et al., (2010), one method of operationalizing pull control is the use of Kanban. Matzka et al., (2012) claim that Kanban is a core element of the TPS system, and describe it as an; 'information system which controls the production quantities in every process' (p. 49). The aim of the system is to pull parts when necessary, to visualize in-process inventories and to control the in-process inventories, where Kanban refers to a 'card' or 'tag' and carries information about the withdrawal, the transport and the product (Matzka et al., 2012). Akturk & Erhun (1999) describes two types of Kanban systems, hereunder dual-card and single card. The dual-card Kanban system distinguishes between production Kanban and withdrawal (transportation) Kanban. 'A withdrawal kanban defines the quantity that the following stage withdraws from the previous stage. A production kanban defines the quantity of a certain product which the stage should produce in order to compensate the removed parts' (Matzka et al., 2012, p. 49). In a single-card kanban system the transportation of parts is also controlled by transportation kanbans, but production is controlled by central production planning instead of production kanbans (Akturk & Erhun, 1999).

Another sequencing procedure promoted by TPS, which is strongly related to JIT, is labeled level scheduling (Boysen & Bock, 2011). Level scheduling aims at spreading supply evenly over the planning horizon, which reduces demand peaks so that material supply is alleviated (Boysen & Bock, 2011). In this way, a sequence is sought where the actual consumption rates of materials are as close as possible to the target rates. Kubiak (1993) term this material-oriented level scheduling as the Output Rate Variation problem, because materials constitute the outputs of the preceding production levels, the actual demand rates of which are to be leveled (Boysen et al., 2009). Lawson (2001) challenges the principle of JIT, and argues that slack is necessary for organizations to have room to adapt, change, and protect critical processes from environmental turbulence. The author state that key characteristics of slack include available time (or money to buy that time) that is not fully engaged in the current delivery of the organization’s primary product or service (Lawson, 2001). When perceiving slack as waste, Lawson (2001) claim that; 'resources vital to renewal, innovation, organizational learning, and adaption to change...become candidates for elimination, since the net effect of these activities is difficult to see on the bottom line in a short period of time’ (p. 127).
3.4 Concluding lean

Womack & Jones (1996) defined lean as ‘A way of thinking that allows companies to specify value, line up value-creating action in the best sequence, conduct these activities without interruption whenever someone requests them, and perform them more and more effectively’ (p. 15). Subsequently, there has been a vast number of authors developing the concept of lean further, and includes the following definitions at a high level of abstraction: a way of thinking, an intended direction, a nested modular structure, the end result of applying TPS to all areas of the business, a philosophy, a strategy, an operations strategy, a system, and a management method. Moreover, through the investigation of lean methodology it becomes clear that all principles are interrelated, both overlapping and complementing one another. JIT is a principle that enables the efficient utilization of resources and waste elimination; teamwork is a principle which enable continuous improvement, while continuous improvement is a way of eliminating waste, eliminating waste establishes a flow, while process flow enables efficient use of resources, and so on and so forth. The initial principles by Womack et al. (1990) have been developed in greater depth by numerous authors, and new principles have been developed both through supplementary studies on Toyota and the Japanese working organization (JWO), as well as literature reviews on previous research.

3.5 Literature review

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<th>Author(s)</th>
<th>Empirical methodology</th>
<th>Lean Principles</th>
<th>Definition of lean</th>
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| Womack, Jones, & Ross (1990) | Toyota case study | • Teamwork  
• Communication  
• Efficient use of resources and elimination of waste  
• Continuous improvement | It transfers the maximum number of tasks and responsibilities to those workers actually adding value to the car on the line, and it has in place a system for detecting defects that quickly traces every problem, once discovered, to its ultimate cause. |
| Womack & Jones (1996) | Toyota case study | • Value can only be defined by the ultimate customer  
• Map the value stream and eliminate all non value-adding steps  
• Ensure that the remaining value-adding steps generate a smooth flow of units towards the customer  
• When flow is established, enable the customer to pull value upstream from the next upstream activity  
• When steps 1-4 are completed, the process restarts continuously until a state of perfection is reached, hereunder perfect value creation with zero waste | A way of thinking that allows companies to specify value, line up value-creating action in the best sequence, conduct these activities without interruption whenever someone requests them, and perform the more and more effectively. |
| Karlsson & Åhlström (1996) | Clinical research project | • Elimination of waste  
• Continuous improvement  
• Multifunctional teams  
• Vertical information systems  
• Decentralized responsibilities/integrated functions  
• Pull instead of push | An intended direction, not as a state or as an answer to a question |
| Spear & Bowen (1999) | Toyota case study | • All work shall be highly specified a to content, sequence, timing and outcome  
• Every customer-supplier connection must be direct, and there must be an unambiguous yes-or-no way to send requests and receive responses  
• The pathway for every product and service must be simple and direct  
• Any improvement must be made in accordance with the scientific method, under the guidance of a teacher, at the lowest possible level in the organization | A nested modular structure, where people can implement design changes in one part of the organization without unduly affecting other parts |
### Lean product development systems

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<td>• Use pull systems to avoid over-production</td>
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<td>• Respect your extended network of partners and suppliers by challenging them and helping them improve</td>
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<td>• Go and see for yourself to thoroughly understand the situation</td>
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<td>• Become a learning organization through relentless reflection and continuous improvement</td>
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<td>• Specify value</td>
<td>A philosophy and not a tool in itself</td>
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<td>• Identify value streams</td>
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<td>• Let the customer pull value</td>
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<td>• Pursue perfection (Womack &amp; Jones 1996)</td>
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<td>• Involvement of staff in the organization</td>
<td>Both a philosophy and a method of operations planning and control: aims to meet demand instantaneously, with perfect quality and no waste</td>
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<td>• Drive for continuous improvement</td>
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<td>• Elimination of waste</td>
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<td>• Inventory leanness</td>
<td>A strategy or philosophy that promotes the use of practices, such as kanban, total quality management (TQM) and just-in-time, to minimize waste and enhance firm performance</td>
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<td>• Holistic system</td>
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<td>• Just-in-Time</td>
<td>An operations strategy prioritizing flow efficiency</td>
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<td>• Jidoka (transparency)</td>
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<td>• Implement lean at a time of least disruption</td>
<td>A system of waste reduction and cost control</td>
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<td>• Understand the complexity of a system before attempting to improve it</td>
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<td>• Do not remove a process or activity in isolation</td>
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<td>• Reconceptualize value and waste</td>
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<td>• Do not push lean to the point of negative returns</td>
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<td>A management method for improving companies’ competitiveness</td>
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<td>• Avoid interruptions in value flow</td>
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<td>• Let customers pull value</td>
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<td>• Start pursuing perfection again</td>
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<td>• Committed management</td>
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<td>• Respect for people</td>
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<td>• Involve supply chain management</td>
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<td>• Value proposition</td>
<td>A philosophy that seeks to reduce waste anywhere in the company, optimize core resources and establish a corporate culture dedicated to identifying and continuously fostering customer satisfaction</td>
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<td>• Perfection (Womack &amp; Jones, 1996)</td>
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4. Product development systems

In the field of innovation a popular distinction is made between *incremental innovation* and *radical innovation*. Incremental innovation concern refinements of existing ideas. Radical innovation stands for completely new ways to approach a problem (Tidd & Bessant, 2009). There are evidence that radical innovation are becoming more frequent and more severe according to Birkinshaw et al. (2007):

The implication for many firms—and particularly those in fast-moving, high-technology industries—is that they need to increase their capacity for discontinuous innovation (p.67).

According to Cooper & Edgett (2005); ‘*only one out of seven becomes a new product winner; and 44% of businesses’ product development projects fail to achieve their profit targets*’ (p.3).

Most product development managers are always struggling to bring in projects on time and on budget. They never have enough resources to get the job done, and their bosses demand predictable schedules and deliverables (Thomke & Reinertsen, 2012, p.85).

This is how Thomke and Reinertsen introduce their article concerning myths about product development. They emphasize on the constant pressure managers work under, as a result it can lead managers to push human resources as if they were machines.

Although many companies treat product development as if it were similar to manufacturing, the two are profoundly different. In the world of manufacturing physical objects, tasks are repetitive, activities are reasonably predictable, and the items being created, can be in only one place at a time. In product development tasks are unique, project requirements constantly change, and the output… is information, which can reside in multiple places at the same time (Thomke & Reinertsen, 2012, p. 85).

Thomke & Reinertsen (2012) claim that these misconceptions have lead to several fallacies, undermining the planning, execution and evaluation of NPD efforts. Fall pits are according to Cooper and Edgett (2005) mostly the same, being aware of these is the first step towards more successful PD. Cooper and Edgett (2005) also states that; ‘*Productivity in product innovation in the top performing businesses is five times what it is in the average business… and top performers get 12 times the productivity as poor performers*’ (p.1). Moving beyond incremental
and radical innovation, Utterback & Abernathy (1975) defined a model taking into account the types of innovations taking place during the life of a product.

![Figure 4.1: Process & product innovation (Utterback & Abernathy, 1975)](image)

As the model illustrate product innovation tends to be high in the products early life. When a product is established, innovation related to the product tends to decline, what becomes important is refining and developing solutions to maximize profit out of each unit sold. This is called process innovation (Tidd & Bessant, 2009). The figure can be seen in the light of both the adoption process and the product life cycle (Kotler & Keller, 2012). It makes sense to spend money early in a process to gain market share. Later, developing efficient ways to deliver the product or enhance the *augmented product* will be most important for gaining higher profit, quicker deliveries and fewer faults (Kotler & Keller, 2012). In the following sections the two main strands within NPD will be presented; StageGate and Agile. First out is one of the best known and perhaps most successful innovation processes of them all, and the researchers aim to answer the following sub-question:

*SQ2: What is StageGate?*

### 4.1. StageGate

StageGate is a trademarked and patent protected process founded by PD gurus Robert Cooper and Scott Edgett. ‘*A StageGate process is a conceptual and operational map for moving new product projects from idea to launch and beyond – a blueprint for managing NPD-process to improve effectiveness and efficiency*’ (Cooper, 2008, p.214). The process is based on the premise that some firms really understand how to innovate. As Cooper (2008) explains; “*Indeed StageGate was originally developed from research that modeled what these winners do*” (p.214). Through their consulting jobs they realized that too many projects and teams miss the mark and fail to perform. Through a closer inspection Cooper & Edgett (2005) revealed that
companies failed and omitted important activities and time-consuming processes. They had poor organizational design and were lacking necessary leadership. In addition, execution of tasks was done in an unsystematic manner often as a result of unreliable data (Cooper & Edgett, 2005). As a corresponding need for guidance they developed StageGate. Research on dozens of U.S and Canadian companies shows improved performance hereunder higher product success rates when launched, better performing teams, and shorter cycles times (Cooper, 1995).

StageGate consists of stages and gates, where the stages consist of activities tied up to a set of goals. For each stage there is a gate functioning as sieves, gate reviews are performed by resource personell often senior executives (Cooper & Edgett, 2005).

**Source:** Cooper (2008)

*Figure 4.2: Overview of StageGate (Cooper, 2008)*

StageGate has received critique for being a rigid process (Thomke 2003). Cooper (2008) responded to the critics by debunking what he call a myth about StageGate; “due to the visual
graphics associated with StageGate some people see it as a linear model...They miss the point that although the stages are laid out in a sequential stepwise fashion, within each stage activities and tasks are anything but linear...inside stages, there is much looping, iterations, and back and forth play...some activities are undertaken sequentially, others in parallel, and other overlapping. Even the stages are allowed to overlap...” (p.216). Thus StageGate is like a map with directions from A to B, but flexible enough to include alternative routes, indeed this is approved by Cooper (2008); “…as opposed to a rigid book of rules and procedures to be religiously followed. No activity or deliverable is mandatory: StageGate is a guide that suggest best practices, recommended activities and likely deliverables” (p.224). The purpose with StageGate is lean, rapid and profitable PD, this is achieved by the following six principles.

4.1.1 Customer focused

Cooper and Edgett (2005) highlight that customers include anyone involved in the products value chain:

The number one key to success in product innovation is developing and delivering differentiated products that offer the customer unique benefits, solve major customer problems, and feature a compelling value proposition for the customer or user (p.39).

This view is also supported by Thomke and Reinertsen (2012) stating that a common fallacy is the belief that more features equals higher customer satisfaction:

The quality of a problem statement makes all the differences in a team’s ability to focus on the few features that really matters…Determining which features to omit is just as important and perhaps more important than figuring out which ones to include (p.91).

Thomke and Reinertsen (2012) imply that; ‘products get closer to perfection when no more features can be eliminated’ (p.90). Perhaps Leonard Da Vinci was right when he said; ‘Simplicity is the ultimate sophistication’.

The challenge, however, is to uncover unique customer values when customers often can have a hard time articulating or to even be aware of their own wants (Cooper & Edgett, 2005). According to Cooper and Edgett (2005) best practice firms use the following five checkpoints for creating superior customer value:

• Build in key market-focused actions
4.1.2 Front-end loaded

Front-end work comprises the first two stages in the StageGate model. The purpose is to acquire crucial information. Cooper & Edgett (2005) elaborates; “Both of these front-end or homework stages are vital. It’s false economy to cut corners here! They are key to both timeliness and profitability” (p.49). Hurried front-end processes will not result in reduced cycle time as Cooper & Edgett (2005 explain:

More and better front-end work results in better and sharper product and project definition, which then speeds up the development and testing stages, with less recycling and wasted time…Front-end homework done well anticipates product problems and design changes. The product design changes are made early in the game…( p.53).

The number one cause of delays in PD projects is vague objectives and nitpicking front-end work is important to eliminate this (Cooper & Edgett, 2005). What differs outstanding performers is that the project team along with management already before the development has established the target market, product concept, value proposition, product requirements and positioning strategy (Cooper & Edgett, 2005). Establishing these decision variables mitigate and can eliminate the problems related to project scope creeps and altering product specifications (Cooper & Edgett, 2005). The challenge is to balance between attaining information and dealing with time. Accordingly: ‘Undertake only enough homework to yield data that is essential for the key decisions you must make’ (Cooper and Edgett, 2005, p.56). The matrix below clarifies types of information and how to enact on it, in terms of decision-making.

Figure 4.4: Information stability/information reliability Cooper & Edgett (2005)
4.1.3 **Spiral development**

Fluid information is always present, because of this companies have to operate flexible to make sure not to be overwhelmed by uncertainty. Cooper and Edgett (2005) explains; “Spiral development help the team get the product and the product definition right, in spite of the fact that some information is fluid and some may even be unreliable when the team moves into the development stage” (p.59). Hence black boxing the project after a thorough front-end process can have implications.

… the team set themselves up for failure. Maybe they did not get the initial product requirements 100% right – maybe they missed some key points when they did their initial customer visitation work, or maybe they misinterpreted some customer requirements. Or perhaps things really change in the 10 to 15 months that ensued… The point is that a rigid and linear process does not work because it is not adaptive and does not respond to changing and fluid information. (Cooper & Edgett, 2005, p.61)

This requires the PD process to be more flexible than the sequential product development process developed by NASA in the 50’s; as such a linear process makes little room for alterations (Takeuchi & Nonaka, 1986). Flexible PD processes contains spirals or iterative steps as Cooper and Edgett (2005) points out; ‘These loops are a series of “build-test-feedback-and-revise” iterations’ (p.61). By exhibiting prototypes to customers the reference group can provide early feedback and with ease revise the products more thoroughly. Cooper and Edgett (2005) explain the rationale behind these iterations; ‘…customers do not really know what they are looking for until they see it or experience it. So get something in front of the customer…and start early…The iterations with users separate facts from speculation, and they establish interest, liking and purchase intent’ (p.67). However spirals need to be quick, frequent and inexpensive to be efficient and reduce cycle time (Cooper & Edgett, 2005). As the model illustrate loops are outlined already from the front-end phase.
4.1.4 Holistic approach driven by effective cross-functional teams

A well-run new product project is much like a small business start-up. The project team is the start-up group...The team requires the talents of many different types of people to be successful...So the project or “start up business” is very much a holistic enterprise, involving all departments (Cooper & Edgett, 2005, p. 70).

Constitution of cross-functional project teams tends to be the most effective tool to reduce cycle time (Cooper & Edgett, 2005). Isolating each activity and then spreading the responsibility among many different departments have in most cases been disastrous in PD-processes as Cooper & Edgett (2005) illustrate below:

The team lacks members from all the key functions, the team leader is the wrong person...the team lacks cohesiveness and does not share a common vision of their project... What we really witness are dysfunctional teams rather than cross-functional teams! (p.9).

Even more important is a clearly defined interpretation of the core team-members. As Cooper and Edgett (2005) elaborates; ‘On exiting each Go/Kill gate, it is clear who is on the core team and, therefore, who is accountable for the end result, versus who is just a resource person to the team’ (p.73). Team responsibility is an important element for teams to transcend from the established and create novel outcomes, Cooper and Edgett (2005) proceeds; ‘In best practice companies, product innovation teams are increasingly teams of responsible experts who focus on the result rather than on the procedure...teams think for themselves. They map out their path forward, and propose the plans and solutions, rather than being ordered or led by their bosses’(p.73). Keeping the same team enhance the consistency and keeps momentum and motivation. This is underlined by Cooper and Edgett (2005); ‘In effective product innovation teams, every team member is responsible for the entire project...This end to end team is an important facet of the way best performers play the game’(p.74). Cooper and Edgett (2005) highlight four important assets a core project team possesses;

- Momentum
- Passion
- Knowledge
- Accountability (p. 74).
Team-members should be chosen by their expertise in important fields, the leader however should be picked by other criteria’s than outstanding knowledge in a special field. Team leaders should be assigned by excelling leadership qualities including people skills, communication skills and being able to articulate passion for the project through visions, goals and motivate the team (Sarin, Hills, & Baron, 2001). Cooper and Edgett (2005) convey that empowered teams are more likely to achieve success; ‘In high-productivity businesses, senior management provides strong support for and empowerment of project teams’ (p.79). Thus selection of team members will be a crucial activity for the senior management.

4.1.5 Metrics, accountability and continuous improvement

Best performers are better to learn from past experience and have established a culture for continuous improvement. Cooper and Edgett (2005) mention three components necessary for achieving continuous improvement.

**Choose metrics and measure performance** - To improve you need to track how well you fared. Cooper and Edgett (2005) refer to how top performers measure critical aspects concerning product innovation. First, individual success of products, usually measured by revenue, profitability, market share or customer satisfaction. Second, how well the processes are working with regards to hitting objectives, budget and time. Third, overall business performance in PD, for example the percentage of business revenue stemming from products launched (Cooper & Edgett, 2005).

**Set success criteria’s and hold the core team accountable and responsible for results** - When the team is held accountable for the result this boost the incentives and relevance of getting tasks done correctly and on time. As Cooper and Edgett (2005) highlight; ‘Gone are the days when project leaders would simply pull a number out of thin air and present it as a first year sales estimate...With success criteria and accountability now in place, project leaders must present much more sober and realistic projections, because all eyes are on those estimates until Post Launch Review – there is accountability’ (p.87). Bonuses for reaching objectives may serve motivational as well as the consequences of not reaching them get more relevant as the results now are traced directly back to the team. Cooper and Edgett (2005) emphasize on establishing success criteria’s before each gate and for the project as a whole. At each gate, due diligence and review session should take place to frequently get a heads-up on what direction the project is heading. Cooper and Edgett (2005) explains; ‘These success criteria become valuable tools for making better Go/Kill decisions’ (p.87).
Learn from experience - Well after a year post launch the StageGate system incorporates a final review. Team and project performance is gauged against original success criteria, gaps identified and corrective actions taken to fix problems (Cooper and Edgett, 2005).

4.1.6 Maximizing productivity in your portfolio

There are two ways of improving productivity in NPD. The first is by emphasizing doing projects right… The other way to improve productivity is to do the right projects. (Cooper & Edgett, 2005, 95).

The first way includes all former elements for improving the success rate of PD projects. The latter consists of having the right NPD portfolio. Way too often these portfolios are ineffectively managed, Cooper and Edgett (2005) illuminate; ‘There are far too many projects for the limited resources available in the great majority of firms, and most businesses confess to doing a poor job of ranking and prioritizing product innovation projects’ (p.99). Cooper and Edgett (2005) pronounce; ‘High-productivity businesses… install a systematic portfolio management system which ensures the right balance and mix of projects in the portfolio and helps to select the right projects to invest in’ (p.96). Cooper and Edgett (2005) compares portfolio balance to the logic behind stock market and present the following formula:

\[ \text{Productivity} = \frac{\text{Output}}{\text{Input}} \]

This simple formula displays everything important to keep in mind when selecting projects. Thorough front-end work and established metrics is important to get this correct. Scorecard that ranks the project in terms of net present value from the income divided on development cost are most commonly used (Cooper & Edgett, 2005).

High resource utilization is by many PD and lean scientists regarded as wasteful and creates longer cycle times (Reinertsen, 2009; Howell et al, Slack et al., 2010; Modig & Åhlström, 2012; Kingman, 1961). High resource utlization has serious negative implication for the organization, according to Cooper and Edgett (2005); ‘One result is that projects take far to longer than they should…Another is that project quality starts to decline; for example, corners are cut, a needed market study gets skipped, the field trials are abbreviated...’ (p.10).

If a company embarks on a project before it has the resources to move ahead it will stumble slowly through the development process. That is problematic because product development work is highly perishable. Assumptions about technologies and the market can quickly become obsolete. The slower a project progresses the greater the likelihood it will have to be redirected (Thomke & Reinertsen, 2012, p. 90).
Thomke and Reinertsen (2012) refers to Little’s Law; “...cycle time is proportional to the size of the queue divided by the processing rate” (p. 90). Reducing cycle time is then down to reducing the number of jobs or decrease process time. As Thomke and Reinertsen (2012) say; ‘reducing the number of jobs is in most settings the only practical choice’ (p. 90). Logically if machines are set to work 100% percentage of their time then the outcome should be increased, however in PD Thomke and Reinertsen (2012) have found something dissimilar; “…in practice that logic doesn’t hold up. We have seen that projects speed, efficiency and output quality inevitably decrease when managers completely fill the plates of their product development employees... High utilization has serious negative side effects…” (p. 86)

In PD queues are not visible as they are in factories, few companies include the cost of queues in their accounts and the intrinsic variability of PD work derives unpredictability that in turn causes uncertainty on how much time that is necessary to complete each task (Thomke & Reinertsen, 2012).

The reduction of batch sizes is a critical principle of lean manufacturing… Small batches have even greater utility in product development… One reason is the nature of their workflow. Again, because the information they’re producing is mostly invisible to them, the batch sizes are too. Second, developer seems to have an inherent bias to use large batches – possibly because they incorrectly believe that large batches produce economies of scale (Thomke & Reinertsen, 2012, p.88).

The effect of optimizing the batch size is not just economical, as Thomke and Reinertsen (2012) explain:

A manufacturer of computer peripherals that used a similar approach with its software group reduced cycle time in software testing by 95%, improved efficiency by 220%, and decreased
defects by 33%... Although those results were exceptional, we have found that reducing batch size improves most development projects significantly (p. 89).

This view on small batches is also supported by Larson & Gray (2011); ‘Iterative and incremental delivery create a flow of value to customers by ‘chunking’ project delivery into small, functioning increments’ (p. 587).

4.2 Critique against StageGate

StageGate has by no means been accepted as the blueprint for how an innovation process should look like. Particular the author’s boldness to claim the process is adaptable to everyone as not gone unnoticed. Much of the critic is also directed towards what is called the fuzzy front-end and how StageGate is designed to incentivized early kills. This can result in radical ideas being shut down.

4.2.1 Buggie

Buggie (2002) describes StageGate with the following words:

A StageGate process is not actually a new product development process at all; rather, it is a conventional project-management process incorporating milestones as it proceeds. It can be useful in managing and controlling the efforts and investment in any project where the starting point is vague and ill-defined, the activities altogether require significant time, inputs from various sources are contributed along the, and the outcome is in doubt (Buggie, 2002, p. 11).

Buggie believe StageGate is an overall project management system for controlling and guarding milestones. However when it comes to judging novel ideas, Buggie (2002) vividly explains; ‘Any fuzzy new product concept is a lamb led to slaughter by the StageGate review committee’ (p. 11). According to Buggie (2002) this is because value in StageGate is measured on how early it can kill a new product candidate.

The very first thing to do is to step back a pace and establish a set of specific success criteria which define, in advance, all of the essential attributes and desired characteristics of the ideal, next-generation new product line. That can be accomplished by the company’s top executive team in two sittings…first to draft, then to refine and confirm (Buggie, 2002, p. 11)

This will help to correct what Buggie (2002) relate to as a crucial fault in StageGate, subjective criteria’s in gate reviews:
Rather than each reviewer searching for a fatal flaw in the new product candidate and criticizing it...everyone on the review committee keeps everyone else objective by citing the previously agreed, exclusive basis for evaluation; consequently, the joint effort is directed toward positive efforts to force-fit the concept to meet success criteria, or to modifying it so that it will then pass muster (p.12).

Cooper (2008) responds to this critic in a later article, stating that a highly defined system will lead to inefficiencies:

Having a well-defined and efficient system that speeds new products to market is the goal. Instead, what some companies have done is to design a cumbersome, bureaucratic process with a lot of make-work and non-value-added activities (p.221).

4.2.2 Jespersen, Sethi & Iqbal,

Based on the idea that the outcome is formed by the stages, and an assumption that learning takes place along the way of the stage-to-stage process, Jespersen (2012) directed a problematic conception towards information dependency:

A concern raised is that development activities for each NPD stage are rigorously followed by NPD managers. In other words, stage-to-stage information dependency may potentially trap NPD managers rather than create effective learning from end to end of the development (p.257).

Jespersen claim information dependency is rather rare in PD processes:

End-to-end information paths are rare in NPD. Further, market condition changes increase information dependencies. From the analyses it seems likely that information dependencies trap managers at NPD gates more than they create effective learning (p.271).

This is in accordance with Benner’s (2009) study of the implication an ISO 9000 certification system had on innovation. Benner’s analysis found that codification in NPD were a constraint for flexibility, learning and innovative success (Benner, 2009). Yet others criticize StageGate for being a process, which can lure businesses into inflexibility (Sethi & Iqbal, 2008).

StageGate controls have the potential to compromise some important aspects of the new product development process and to adversely affect novel new products. Our results suggest that when gate review criteria are more strict, objective and frequently applied, they increase the
inflexibility of the new project. The attempt to mitigate the adverse effect of rigorous criteria on project inflexibility through the adoption of conditional gates does not work. In turn, project inflexibility increases learning failure in the product development team. This adverse effect of project inflexibility on learning is worsened when there is turbulence in the technological sector of the environment. Learning failure due to Stage-Gate evaluation adversely affects the market performance of novel new products (Sethi & Iqbal, 2008, p.129).

4.2.3 Thomke & Reinertsen

Perfection from the beginning is characterized as a NPD pitfall by Thomke and Reinertsen (2012). Having this mindset can cause the PD-team to get a heavy bias towards minor changes, Thomke and Reinertsen (2012) elaborate; ‘Requiring success on the first pass biases teams toward the least-risky solutions, even if the customers didn’t consider them much of an improvement over what’s already available. Worse yet, teams have little incentive to pursue innovative solutions to customers problems’ (p. 92). Delivering imperfection is also supported by Jeppesen & Molin (2003); ‘Firms that know how to lay out an appropriate solution space for their consumers may be able to launch ‘half-finished’ products which consumers work to finalize’ (p.380). Later also Eric Rice (2011) has supported that claim, although taking it to more extreme levels.

To avoid making mistakes, teams follow a linear process in which each stage (specify, design, build, test, scale, launch) is carefully monitored at review ‘gates’. Work on the next stage cannot begin until the project passes through the gate. As the project moves down the line…the cost of responding to new insights increases by orders of magnitude (Thomke and Reinertsen, 2012, p.92).

Thomke, an old adversary of StageGate yet again forays back with what can be seen as critic of Cooper & Edgett’s system, while supporting iterative processes:

Consider what we found in a study of 391 teams…teams that followed an iterative approach and conducted early and frequent tests made more errors along the way. But because they used low-cost prototyping technologies, they outperformed teams that tried to get their design right the first time… Experimenting with many diverse ideas is crucial to innovation projects…many novel concepts will fail…But such early failures can be desirable because they allow teams to eliminate poor options. …provided that they occur early in a process, when few resources have been committed… (Thomke & Reinertsen, 2012, p. 92).
Once again critic is directed against StageGate being a too rigid process, not facilitating truly novel and high risk concepts. Despite this Cooper is strong in his faith that StageGate is a process that put novelty in focus (Cooper, 2008). In fact Cooper & Edgett (2005) highlight products lacking novelty as a PD pitfall:

The bar is never set high enough, and the project team develops yet one more me-too, ho-hum, tired and vanilla product… There is no compelling value proposition for the users or customers and, given no reason to switch, they don’t (p. 6).

Thomke & Reinertsen (2012) direct yet another critic against StageGate this time regarding front end loading and painstaking analyses; ‘we’ve never come across a single product-development project whose requirements remained stable throughout the design process’ (p. 89). This is also supported by Jespersen (2012).

They attribute any deviations to poor management and execution and to minimize them, carefully track every step against intermediate targets and milestones. Such thinking is fine for highly repetitive activities… but it can lead to poor results in product innovation, where new insights are generated daily and conditions are constantly changing (Thomke & Reinertsen, 2012, p.89).

External factors as well causes challenges to stick to the plan, when customers preferences suddenly change new requirements emerge, Thomke and Reinertsen (2012) explains; ‘Customer preferences can also shift abruptly during the course of a development project, as competitors introduce new offerings and new trends emerge… For all those reasons sticking to the original plan… can be a recipe for disaster... However, the plan should be treated as an initial hypothesis that is constantly revised as the evidence unfolds, economic assumptions change, and the opportunity is reassessed’ (p.89).

4.2.4 MacCormack, Crandall, Henderson, & Toft and MacCormack & Verganti

StageGate is designed as a macro process, overarching every other PD process in the firm (Cooper, 2008). This is a fairly drastic claim to make, and indeed one that has not gone unheeded.

One size does not fit all; there is no single, universal product development style that is right for all businesses at all times. Instead, different business contexts demand different product development styles. Learning from HP's experiences, R&D managers can become more adept at understanding what their business context requires from product development and assessing
how their practices must change in order to deliver these objectives. By driving these changes explicitly and proactively, managers can systematically improve the responsiveness of their innovation processes and outperform competitors still caught in the best practices trap (MacCormack, Crandall, Henderson, & Toft, 2012, p.43).

Once again Cooper (2008) respond to the problem by introducing more flexibility into StageGate:

Perhaps the greatest change in Stage-Gate over the last few years is that it has become a scalable process, scaled to suit very different types and risk levels of projects—from very risky and complex platform developments through to lower-risk extensions and modifications and even to rather simple sales force requests (p.223).

Cooper introduced two new StageGate processes less time consuming than the initial, designed to take on smaller NPD projects as the model demonstrates.

**Figure 4.8: StageGate, StageGate Xpress & StageGate Lite** (Cooper, 2008)

However these StageGate models contribute less to the conceptualization of uncertainty. (MacCormack, et al., 2012)

Our findings lend support to a contingent view of the new product development process, suggesting that managers must avoid the potential pitfalls of best practice thinking and instead must evaluate a wide range of contextual factors before deciding upon the most appropriate process to adopt in any given project. Such a view implies that the first stage of any project should not, in fact, be concerned with the product design, but rather should focus on the design of the development process itself (MacCormack & Verganti, 2003, p.230).

This can also been seen in light of Buggie’s (2002) critic of StageGate missing objective
criteria’s in the gates as a cause of subjective gate reviewers. From a process being accused of being rigid with mechanisms reducing novel outcomes we shift focus to a process that are designed to be open and to produce originality. Next is Agile NPD and the following question to answer.

**SQ: What is Agile NPD?**

### 4.3 Agile NPD

Agile as a professional process in NPD is fairly new, it is designed to overcome the barriers of uncertainty, as Larson & Gray points out; ‘*Agile lives in the unpredictable zone*’ (p.585). Agile methods have to a large degree been made possible by evolving IT-technology. Today designers can use advanced software to test out for an example the drag coefficients of virtually drawn cars and immediately see crucial elements in the design that needs to be changed (Thomke, 2001). The key in terms of PD-processes is as Larson & Gray (2011) explains; ‘*Agile project management represents a fundamental shift away from the traditional plan-driven project management approach by adopting a more experimental and adaptive approach...Projects evolve rather than are executed*’ (p585). Agile processes come in many different forms, nevertheless the rationale behind agile methodology is based on the same principles; focus on customer value, iterative and incremental delivery, experimentation and adaption, self-organized teams and continuous improvement (Larson & Gray 2011). Agile has also been called the artful process of product development, by the resemblance to how artist iterate and refine their work until a satisfactory outcome has been reached (Austin & Devin, 2004). The model below illustrates the process in agile value creation.

![Figure 4.9: Agile NPD - Iterative product development cycles (Austin & Devin, 2004)](image)

As indicated IT companies have incorporated this method in their businesses, however one of the best-known advocates for Agile methodology is the consultant company IDEO. IDEO has taken Agile further and developed their own framework for PD. The whole rationale behind
their process is to develop new ideas fast, cheap and be able to make late alterations (Nussbaum, 2004). Nussbaum describe the following five steps;

1. **Observation** – Agile projects tend to focus on customers, IDEO demonstrate this by actively observing the target audience. This gives them valuable insight in what the customers actually feel, say and do. Insights from this point are brought further and create a starting point for the brainstorm.

2. **Brainstorming** – These sessions are fast and contain rules the group must comply. Those are; one speaks at the time, no negativity is allowed, no ideas are discarded, quantity over quality, keep within the target and wild ideas are good.

3. **Rapid prototyping** – From the brainstorming session many new ideas has been developed, promising ideas will then needed to be built. The idea is to make the ideas alive and visualized. What might work or what will not is now fairly visible.

4. **Refining** – At this stage it is important to select the most promising candidates. Brainstorming sessions in collaboration with the client and approval from stakeholder is important to develop a solution that will put all the features together. The promising features are then prototyped and tested.

5. **Implementation** – Here the prototypes from the refinement stage has been approved and is ready for production. IDEO will now use their diversified skills to develop the finished solution.

This seemingly playful approach coupled with modern technology has become quite popular among entrepreneurs, however more somber actors are now seeing the benefits of Agile. In the subsequent section we will introduce Hirotaka Takeuchi and Ikujiro Nonaka, who already in 1986 wrote an article about this phenomena and by many is regarded as the grandfathers to modern agile methodology.

### 4.3.1 Takeuchi & Nonaka

Takeuchi and Nonaka (1986) had seen a change in the way of developing new products:

> The rules of the game in new product development are changing. Many companies have discovered that it takes more than the accepted basics of high quality, low cost, and differentiation to excel in today's competitive market. It also takes speed and flexibility... (p.2).

The traditional PD-processes had until then looked similar to an assembly line, each department did their job and passed it on to the next. Thus sub-optimization and alienation could be likely results (Takeuchi & Nonaka, 1986).
Rather than moving in defined, highly structured stages, the process is born out of the team members' interplay... It stimulates new kinds of learning and thinking within the organization at different levels and functions. Just as important, this strategy for product development can act as an agent of change for the larger organization. The energy and motivation the effort produces can spread throughout the big company and begin to break down some of the rigidities that have set in over time (Takeuchi & Nonaka, 1986, p.3).

Companies had for a while worked with lean principles in other more mechanical fields of their businesses. When these principles were transferred to PD especially the principle of waste resulted in few incentives for playing jeopardy and producing high-risk novel products (Liker & Morgan, 2006). The goal of Takeuchi & Nonaka’s (1986) PD-process were to overcome this; ‘This approach is essential for companies seeking to develop new products quickly and flexibly. The shift from a linear to an integrated approach encourages trial and error and challenges the status quo’ (p.3). Like StageGate, Takeuschi and Nonaka established a set of principles for a successful, rapid and flexible PD-process.

**Built in instability** - Takeuschi and Nonaka had observed how management could impose urgency in a team by setting a goal, but rarely give instructions on how to get there. As a Honda executive had remarked creativity was born when people were pushed almost to the extreme (Takeuschi & Nonaka, 1986).

**Self-organizing teams** - Similar to Cooper and Edgett (2005), Takeuschi and Nonaka (1986) empathize strongly the importance of making the team responsible, and for being in charge of the process; ‘Left to stew, the process begins to create its own dynamic order. The project team begins to operate like a start-up company - it takes initiatives and risks, and develops and independent agenda at some point, the team begins to create its own concept’ (p.4). According to Takeuschi and Nonaka (1986), in order to be self-organized a team need to possess three characteristics; autonomy, self-transcendence and cross-fertilization. Also Cooper & Edgett (2005) highlighted cross-functional teams, however, Takeuschi and Nonaka (1986) take this a step further and highlight that picking a diversified team is not enough; ‘While selecting a diverse team is crucial, it isn't until the members start to interact the cross-fertilization actually takes place’ (p.5). As a project team member in Fuji-Xerox explained; ‘If everyone understands the other person's position then each of us is more willing to give in, or at least to try to talk to each other. Initiatives emerge as a result’ (Takeuschi & Nonaka, 1986, p.5).
Overlapping development phases – Given the different tasks a PD process contains, people will be in and out of the project as it progress. Because of this flexibility is necessary, and the former mentioned capability of a self-organized team plays a big part in this dynamic. Takeuschi and Nonaka (1986) describe it like this:

The self-organizing character of the team produces a unique dynamic or rhythm. Although the team members start the project with different time horizons...they all must work towards synchronizing their pace to meet deadlines...each member soon begins to share knowledge about the marketplace and the technical community. As a result, the team begins to work as a unit. At some point, the individual's rhythm and the group's rhythm begin to overlap, creating a whole new pulse. This pulse serves as the driving force and moves the team forward (p.5).

This dynamic also plays an important part in dealing with flexibility and to reduce the negative effect bottlenecks can have in the PD-process.

Under the sequential or relay race approach, a project goes through several phases in a step-by-step fashion, moving from one phase to the next only after all the requirements of the preceding phase are satisfied. These checkpoints control risk. But at the same time, this approach leaves little room for integration. A bottleneck in one phase can slow or even halt the entire development process. Under the holistic or rugby approach, the phases overlap considerably, which enables the group to absorb the vibration or "noise" generated throughout the development process (Takeuschi & Nonaka, 1986, p.5).

However, Takeuschi and Nonaka (1986) also focus on the challenges related to overlapping phases, they elaborate; ‘The more obvious demerits result from having to manage an intensive process. Problems include communicating close contact with suppliers, preparing several contingency plans, and handling surprises. This approach also creates more tension and conflict in the group’ (p.6). This indicates that the process perhaps is the more demanding, but can eventually be the superior.

Multilearning - As Takeuschi and Nonaka (1986) explains learning is almost inherent in modern PD-structures; ‘Because members of the project team stay in close touch with outside sources of information, they can respond quickly to changing market conditions. Team members engage in a continual process of trial and error to narrow down the number of alternatives that they must consider’ (p.7). Takeuschi and Nonaka (1986) divide learning in two dimensions; multilevel learning and multifunctional learning. Multilevel learning takes place across multiple levels such as individual, groups and corporations, at a corporate level.
Takeuschi and Nonaka (1986) recommend the following; ‘Learning at the corporate level is best achieved by establishing a company-wide movement or program’ (p.7). Takeuschi and Nonaka (1986) encourage that experts accumulate experience in areas other than their own. Takeuschi and Nonaka (1986) call these two dimensions of learning multi-learning and they describe; ‘It fosters initiative and learning by doing on the part of the employees and helps keep them up to date with the latest developments. It also serves as a basis for creating a climate that can bring about organizational transition’ (p.7).

**Subtle control** - Management set the direction and goals, which we recall resulted in tension and instability for the core team, however as Takeuschi and Nonaka (1986) points out; ‘...management avoids the kind of rigid control that impairs creativity and spontaneity. Instead, the emphasis is on ‘self-control’ ‘control through peer pressure’ and ‘control by love’ (p.8). This is called subtle control (Takeuchi and Nonaka, 1986)

**Organizational transfer of learning** - Takeuschi and Nonaka (1986) also put the spotlight on transfer of learning to others outside the project group; ‘Transfer of learning to subsequent new product development projects or to other divisions in the organization takes place regularly’(p.8). This is an important factor to how these NPD-projects can transfer and improve the overall company, as Takeuschi and Nonaka (1986) explains; ‘Knowledge is also transmitted in the organization by converting project activities to standard practice’ (p.9). Therefore successful NPD-projects can seem to be a source to overall corporate improvement. Despite this Takeuschi and Nonaka (1986) direct a warning; ‘Institutionalization, when carried too far, can create its own danger. Passing down words of wisdom from the past or establishing standard practices based on success stories work well when the external environment is stable. Changes in the environment, however, can quickly make such lessons impractical’ (p.9). Accordingly in the nexus between implementing NPD activities and achieving new product performance, focus on previous plans can trap managers especially in the case of changing market conditions (Hauser et al.,2006; Barczak et al.,2009; Jespersen, 2012). This can also be occurring in networks, where strong ties make it hard for the organization to shift direction (Harryson S. J., 2008; Harryson S. J., 2006). Or as Birkinshaw et al. (2007) put it: ‘the ties that bind may become the ties that blind’ (p.68; Cohen & Prusak, 2001). However this can be overcome, Takeuschi and Nonaka (1986) describe it as the concept of unlearning; ‘Several companies have tried to unlearn old lessons. Unlearning helps keep the development team in tune with the realities of the outside environment. It also acts as a springboard for making more incremental improvements. Much of the unlearning is triggered
by changes in the environment’ (p.9). Hence Takeuchi and Nonaka (1986) as well as Cooper and Edgett (2005) strongly empathize to get the project team out of the office.

4.3.2 Scrum

Stemming from the work of Takeuschi and Nonaka (1986), Scrum has become a popular Agile method for NPD-processes. As Larson & Gray (2011) points out; ‘The Scrum metaphor has been expanded and refined into a fairly prescriptive framework that has enjoyed success on high-tech and software development projects’ (p.588). In Scrum features are used as deliverables and prioritized by which one that gives the highest customer value, Larson & Gray (2011) explains; ‘A feature is defined as a piece of a product that delivers some useful functionality to a customer’ (p.588). Features are created in iterations, which in Scrum-terminology are called sprints as Larson & Gray highlight; ‘The goal of each sprint is to produce fully functional features’ (p.588). In Scrum three different roles are present; product owner, development team and scrum master (Larson & Gray, 2011). The product owner is the spoke person of the customers interest, Larson and Gray (2011) elaborate; ‘The product owner established the initial list of product features and prioritizes them... The product owner ultimately decides whether the project is completed. Product owner are the keeper of the product vision and watch dog on the return on investment’ (p.589). As in other agile methods the PD-team is self-organized, however as Larson & Gray (2011) describe; ‘There are no designated roles or titles; people take on different responsibilities depending on the nature of the work’ (p.589). Larson and Gray depict the Scrum master responsibilities as follows; ‘The Scrum master facilitates the scrum process and resolves impediments at the team and organization level. The Scrum master is not the leader of the team but acts as a buffer between the team and outside interference...The Scrum master serves more as a coach than a manager’ (p.590).

Figure 4.10: Scrum (Larson & Gray, 2011)
The product backlog consists of a hierarchical list of features the customer wish for when the project is completed. Simultaneously with the backlog the project team develop a sprint backlog (Larson & Gray, 2011). Together they make up the only solid documents existing for the project. Consisting of estimates concerning time, cost and time remaining (Larson & Gray, 2011). This can seem treacherous in a professional NPD-process, however as Larson & Gray (2011) points out; ‘Risk is mitigated by short developmental cycles and rigorous testing’ (p.592). With the backlog and sprint log in place, the iterations begin. As the model implies a sprint takes between 2-4 weeks. When the sprint is running, alterations are not possible. The sprints consists of analyzing requirements related to the features, developing the requirements needed to make the feature, building the feature and last test the feature (Larson & Gray, 2011). During the sprint the project team communicate through the Scrum (Larson and Gray, 2011).

Each work day at the same time and place, team members stand in a circle and take turn answering the following key questions: 1) What have you done since the last Scrum 2) What will you do between now and the next Scrum 3) What is getting in the way you from performing your work as effectively as possible? (Larson & Gray, 2011, 591).

This will create a sense of urgency and a group-wide understanding of the progress in the project, as Larson & Gray (2011) indicates; ‘Having everyone report what they plan to do for that day generates a social promise to the group, thereby building accountability’ (p.591). After each sprint the client, the project team and the product owner meet for sprint reviews. As Larson & Gray (2011) indicate these sprint reviews can act like counseling sessions:

The team can take this opportunity to suggest improvements and new features for the product owner to accept or reject. The sprint review is an opportunity to examine and adapt the product as it emerges and iteratively refine key requirements (p.591).

In addition the project team will have a sprint retrospective as Larson & Gray (2011) points out; ‘The purpose of the retrospective meeting is to reflect on how well the previous sprint went and identify specific actions that can improve future sprints ’ (p.591). The Scrum method is as other agile projects to a large degree dependent on the customer. The hands-on approach, daily meetings and close collaboration with the customers makes it possible to accomplish these projects without any additional planning and implantation of traditional project management tools, however it requires a lot from both team-members and customers in terms of interaction, collaboration and communication (Larson & Gray, 2011).
4.4 Concluding product development systems

PD comprises several branches and schools. In this thesis the focus has been directed towards StageGate and Agile. StageGate works to reduce the uncertainty in PD processes, it is about demystifying this field that by many has be labeled fuzzy (Cooper & Edgett, 2005). This is done by the following six principles: constant customer focus, front-end loading, spiral development, holistic cross-functional teams, accountable teams and the establishment of metrics in order to continuously improve, and maximize portfolio management. StageGate has been refined throughout the years in response to a changing business climate. The result is that StageGate as Cooper and Edgett (2005) proclaims is an encompassing business system that fit all. The question is whether StageGate possess enough flexibility to embrace every business, something that MacCormack et al. (2012), Buggie (2012), Sethi & Iqbal (2008) and Jespersen (2012) believe is not the case. This subject will be brought up later in the discussion.

Agile has developed in another direction and comprises several branches to cope with changes in the business environment. Agile is a more intense process heavily involving customers and designed to produce the best outcome for the specific project and not necessarily work as a overarching model for corporate innovation strategy (Larson & Grey, 2011). Despite this the principles Agile follow is remarkably similar to those of StageGate: focus on customer value, iterative and incremental delivery, experimentation and adaption, self-organized teams, and continuous improvement. Agile has also been criticized, where Summers & Scherpereel (2008) point out that Agile along with lean constrain decision-making and that the objective is to reduce the cost of errors.

4.5 Literature review

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<th>Key findings</th>
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<td>Utterback &amp; Abernathy</td>
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<td>Product innovation - Process innovation</td>
<td>Innovations related to the product tend to be high in the early stages of the product life, later innovations related to the processes around the product is enhanced.</td>
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<td>(1975)</td>
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<tr>
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<td>(1986)</td>
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<td>Buggie (2002)</td>
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<td>The Fuzzy front-end</td>
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<td>StageGate conventional project management process, novel ideas will be turned down as a result of subjective gate reviewers. Hence objective success criteria's should be set by senior management.</td>
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<tr>
<td>MacCormack &amp; Verganti</td>
<td>Empirical analysis based on a study of product development practices in the Internet software industry from 1996 - 1998</td>
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<td>Managers must avoid pitfalls of choosing best practices. The first stage of NPD projects should not be product design but design of the development process.</td>
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<td>Author(s)</td>
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<td>Firms that have an appropriate solution space may launch products not completely finished, but being ended up by the customers</td>
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<td>Austin &amp; Devin (2004)</td>
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<td>Nussbaum (2004)</td>
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<td>The IDEO way</td>
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<td>Core team must do the in-the-field work. Initiate customer interaction early and frequent. Use time &amp; resources pre-development to analyze real customer needs. Iterations tackle situations with fluid information. Clear definition on who is one the core team. Each team-member equally accountable for the result, hence metrics is important to secure team accountability and as a source for analysis to improve</td>
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<tr>
<td>Cooper &amp; Edgett (2005); Cooper (2008)</td>
<td>Book</td>
<td>Lean, rapid &amp; profitable NPD</td>
<td>Why NPD processes fail - Lacking novelty - No front-end homework - Lack of customer input - Project scope creeps - Silo-structured development teams - Excessive project portfolios - Lacking skills, knowledge &amp; competencies</td>
<td>Overabundance of incremental innovations. Cutting corners to save time and money results in product design freeze as a consequence of assumptions, but few facts. Failing to interact with customers create assumptions not necessarily right. Changing objectives because of sudden new information is usually down to inaccurate front-end homework. Effective cross-functional team is number one key to driving cycle-time down. Silos result in lack of responsibility, suboptimization and lack of urgency. Idle projects are not good times to initiate a new project. Too many under-resourced projects. Lacking skills, knowledge, and competencies as a result of lack of necessary analysis to point out what is necessary to undertake the project</td>
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<td>Thomke &amp; Reinertsen (2012)</td>
<td>Literature review based on former quantitative studies done by Thomke &amp; Reinertsen</td>
<td>Why NPD processes fail - High utilization - Processing in large batches - Overconfidence to the plan - Early project initiation - Overkill products - Perfection from beginning</td>
<td>Project speed, efficiency and output quality decrease when utilization increases. A workload increase by 5% can result in up to 100% longer completion time. Reduction of batch sizes increase efficiency, reduce defects, cycle time and costs. Plans should be hypothesis being constantly revised. Initiating too many projects increase utilization, but reduce speed, the slower the progress the greater likelihood of redirections. Features to omit is just as important as features to include in a product. Success from the beginning creates a bias towards least risky option</td>
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<td>Sethi &amp; Iqbal (2008)</td>
<td>20 interviews with product development executives across 12 industries</td>
<td>StageGate, learning failure and adverse affect on novel new products</td>
<td>StageGate controls have potential to compromise important aspects of NPD. Strict gate reviews increase inflexibility. Which in turn increases learning failure in situations of uncertainty NPD have adversely affects on market performance of new products</td>
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<td>Summers &amp; Scherreperel (2008)</td>
<td>Conceptual paper</td>
<td>Decision making in PD</td>
<td>Inside-out approach - Outside-in approach</td>
<td>Lean, agile and StageGate constrain decision making to reduce the cost of errors. Lean focusing on eliminating errors. Agile focusing on reducing the size and severity of errors arising from unpredictability. Most PD projects will benefit from combining these techniques</td>
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<tr>
<td>Larson &amp; Gray (2011)</td>
<td>Book</td>
<td>Agile PD</td>
<td>Focus on customer value - Iterative and incremental delivery - Experimentation and adaption - Self-organized team - Continuous improvement</td>
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5. Research design

To collect empirical data on how lean principles and WO can integrate with PD systems, the research is based on a qualitative approach with an explorative design. An explorative design is used when a problem’s characteristic is unclear and when the researcher has little knowledge about what is to be examined (Selnes, 1999). Through an explorative design the goal is to understand and interpret the phenomenon, rather than explaining underlying problem areas. The following subsection describes the interview setting of this study.

5.1 Study objects

In order to establish a better understanding of who and how data has been generated, a brief presentation of the respondents and the context of the interviews will be provided. The author’s deliberately contacted people they knew had experience with systemized innovation processes and lean. The sampling falls into what Joseph A. Maxwell (2005) terms purposeful selection, which is appropriate as it allows to get hold of those in the field of research that are better suited to provide useful insights to the proposed research question. The study further employs a combination of practitioner and expert interviews, as one of the informants moved on to become a researcher after his carrier in the automaker industry. Even though focus was put on his experience from the industry, this might provide valuable insight into areas where practice and theory differs. Nevertheless, due to the sample size it will not be possible to generalize and transfer key findings to areas outside the respondent’s contexts.

All interviews were initiated with a short presentation of the paper and the authors, nevertheless in a generic way to ensure that the respondents were not tempted to answer in a ‘correct’ manner. The interviewees were encouraged to speak as freely as they could and draw on their experience, keeping the interview narrative.

5.1.1 Pilot: Thomas Hoholm

To test the interview guide and structure it was decided to do a pilot in order to ensure a sound conduct of the interviews. Being former students at BI Norwegian School of Management the authors decided to contact their old school and initiate an interview with a product development and innovation researcher. Thomas Hoholm is a post professor at the institute of innovation and economic organization. His field of research is innovation, entrepreneurship and innovation and learning. Hoholm was not an expert in lean PD but is an experienced researcher and could give useful feedback for the interview guide and could help us get in touch with suitable companies.
The interview was conducted at BI Oslo and was a valuable contribution for the final interview structure.

5.1.2 Finn (Lean expert & HoI)

Finn is an online Norwegian marketplace for buying and selling commodities. Finn was established in 2000 and have experienced an expansive growth, now with a turnover of approximately 700 million NOK and employs nearly 300 people. They are head quartered in Oslo. The primary reason for contacting Finn was their reputation as a very innovative organization having solid traditions for implementing lean in their PD system.

The interview was done physically in the company’s HQ in Oslo. The first interview was with one of Finn’s lean experts, while the latter was with the Head of innovation (HoI). Both interviewees were very talkative and spoke freely around the subject. However, as the HoI was relatively new in the company he was naturally limited when it came to aspects of integrating lean principles and WO with their PD system. Hence his statements were partly an accumulation of the other employee’s perceptions. The setting was relatively formal, yet relaxed, both candidates were open minded and talked willingly from their personal experiences, still the conversation was held in a professional manner. Both respondents strongly empathized the importance of focusing on customer- and user needs.

5.1.3 Lean Communication (Consultant)

Lean Communication is a Norwegian consultant firm specializing in lean. The company was established in 2009 and consists of 13 employees. The company was perceived as an ideal candidate because of their expertise with lean in PD. The interview object (Consultant) had experience with StageGate, Agile and lean PD from the automotive industry. Currently he is a consultant and could draw on the experiences and practices he had witnessed in numerous companies. The respondent was very talkative and drew on his experience stemming all the way from the 80’s. This provided insights from many different industries and how lean principles and WO can integrate with PD systems. The interview was done in the company’s office in Oslo. The setting was relatively formal and the interview was conducted in a professional tone.

5.1.4 Torgeir Welo (Prof.)

Torgeir Welo is a professor at the Norwegian University of Science and Technology (NTNU) and holds a professorship at the institute for Product development and materials. His work experience stems from Sintef (sintef.no) and Hydro Automotive (hydro.no) in both Europe and
USA. He has also held different functions within board, committees and groups of interest in the car, metal bending and aluminum industry. Today his field of research includes lean product development. Welo emerged on the radar when searching for competent people within lean PD. His broad and long involvement with lean PD and experience from both industry as well as academia made him an ideal person to interview. The interview was done through Skype. The interview setting was formal, but Welo was very talkative, relaxed and talked in a jovial manner, yet within a professional context. His role as a lecturer shined through. The informant was very open about his thoughts, and based his answers on experience from both research and practice.

5.1.5 Kongsberg Automotive (PD expert)

Kongsberg Automotive is a global supplier of parts to the automotive industry. They have 11,000 employees located in 20 countries and revenues close to €1 billion. The other candidates have praised Kongsberg Automotive as one of the guiding stars in lean PD. After some e-mail correspondence the author’s got an interview with Sven Elfverson, senior expert in PD systems and processes. He had introduced the lean based grind system in Kongsberg. The interview was conducted by telephone and the respondent talked freely. He especially highlighted the importance of understanding customer needs and interests and allocated substantial attention towards knowledge gaps and working continuously to cover these.

5.2 The hermeneutic ontology

Because the authors entail an understanding of how lean principles and WO can integrate with PD systems, the authors entail an understanding of how our informants make sense of their businesses and how they interpret the world. At the same time it seems obvious that the authors as researchers cannot move outside of their own world. It is then the meeting between the informants and their understandings and the author’s understandings as researchers that constitute the foundation for this paper, the authors are applying a hermeneutic ontology to their research. Hans-Georg Gadamer emphasized on the essence of understanding as a basic fundament for human life (Gadamer, 1999). Gadamer’s claim is essential because it explicates the idea that the world is constituted on our efforts to make sense of the world, and that all phenomena and practices are originated in an understanding of purpose (Gilje & Grimen, 2007). The authors are not focused on understanding as a basic human assumption on life, but rather on the notion that understanding is always a product of interpretation. Understanding is always connected with the subject that understands and the presumptions that the subject already holds (Schwandt, 2003). For the authors it becomes vital to stress this as a basis for the
analysis. The analytic outcome is therefore a co-creation of understandings and presumptions (both authors and informants). The outcome and the knowledge generated are therefore also socially and historically situated (Gilje & Grimen, 2007). This becomes relevant as a qualitative matter because this hermeneutic ontology is manifested in the clarification of presumptions in order to create an inter-subjective understanding of the findings and avoid biases.

Because the hermeneutic ontology is based on the meeting of understandings and presumptions, knowledge is produced in a dialogical form (Kvale, 2008). This has consequently made the authors use the interview as a primary source of data generation.

5.3 The method of interviewing

Steiner Kvale (2008) recognizes the qualitative research interview as an interview which purpose is to collect descriptions of the informant’s picture of the world with the intention of interpreting those descriptions that have been made. It therefore constitutes an opportunity to directly engage in the life worlds of the informants in regards to their understandings of how lean principles and WO can integrate with their PD systems. It further proposes an opportunity in which the authors can bring their own assumptions and understandings into play with the informants and thereby in line with the hermeneutic ontology generating meaning and understanding. This can be exemplified in the way the authors sometimes have used their own understandings to confirm or negotiate meaning in different understandings in the interviews. Because such a procedure is based on an open understanding of what knowledge and information is, the authors will concentrate the experiences deriving from the interviews into categories related to the research questions, but based on the vocabulary used by the informants. In such a way the authors are again combining the understandings that they embody as researchers and the sense making of the informants. The interview comes to practice through a semi-structured interview guide.

5.4 Semi-structured interview guide

Because the authors take an epistemological standpoint based on a hermeneutic ontology, the knowledge production is constituted in the negotiation of meaning, the negotiation between the informants and the authors as researchers. As of this the authors needed to enable a flexible and open interview setting, hence a semi-structured interview guide. The semi-structured interview form is less rigid than the structured interview form which more or less function as a questionnaire. The semi-structured interview allows a more dynamic tension to the interview,
but at the same time this dimension might lead the interviewer out of his plans. This puts the interviewer in a central position, allowing the dynamic of the telling of the respondent and at the same time being attentive to the goals and aims of the interview (Karpaschof, 1984). This was handled by having a thematic categorization of questions in regards to the research question, focusing on general practices, lean and PD systems. This thematic categorization was made based on the author’s presumptions of the research field, and the premise of lean and PD core principles. This is the reason there is a differentiation in the relevant findings and the interview guide. By only working with two themes the author’s ensured a more fluent and open interaction with the informants, which Kvale accentuates in his regards on a semi-structured interview (Kvale, 2008). Furthermore, the researchers finished each interview by asking whether they had failed to address any subjects of importance through the interview, thereby opening up and challenging their own presumptions on the research field. Because the authors apply an ontological and epistemological standpoint wherein they acknowledge their own positions as co-creators of the knowledge produced through the data generation, the authors find it essential to ascertain the quality of data generated. Joseph Maxwell proposes different strategic moves to ascertain a high degree of validity, where it will be argued for the use of what he considers the three most important notions: a descriptive-, an interpretative- and a theoretical validity (Maxwell, 2002).

5.5 Descriptive validity

The descriptive validity relates to the concern of factual accuracy. The question then is how do the authors make sure that those descriptions, statements and accounts that is presented are true? Maxwell refers this to actions and behavior rather than meanings, it is then about what the authors as researchers report to have seen and experienced. The terms of this validity is therefore based on a high degree of inter-subjectivity and contextualized on singularized cases and claims rather than generalized (Maxwell, 2002). The descriptive validity then relates to a way of assuring that the description of a happening is true to both the researcher and participant. We did this by sending our transcriptions to the participants for them to confirm any inaccuracies.

5.6 Interpretive validity

The descriptive validity is fundamental and enables the researcher to make valid interpretations. In order to be able to answer the research question, there is a need to interpret the meaning of the claims made. The interpretive validity is therefore connected with the
researchers meaning condensation of the claims made by the participant and relies on the accuracy of those descriptions (Maxwell, 2002). The interpretation of meaning is closely tied to the language in which claims are made. Therefore a valid interpretation stays close to the language of the participant’s and use the same kind of language and concepts to a high extent. The validity of interpretation is in such a way linked to the experiences of the studied subjects. This is relevant in order for the analysis to have accurate claims of the meanings expressed. At the same time Maxwell (2002) claims that it is important to acknowledge the social context of the actors involved in the process and their disposition in regards to their study subject.

5.7 Theoretical validity

The theoretical aspect of a paper refers to the theoretical constructions that are abstracted from the descriptions and interpretations already made (Maxwell, 2002). The theoretical validity concerns the function of an explanation. It is thus the theory of a phenomenon. The theory of a phenomenon is constituted in the construction of the concepts or categories and the relationships thought to exist in-between these. This paper addresses the issue of how lean principles and WO can integrate with PD systems. The authors hereby need to be careful in how such conceptions and categories are constructed. These notions of descriptive, interpretive and theoretical validity are used to highlight how the data have been addressed in order to produce the most valid form of knowledge and to create a transparent method.

5.8 Problems of using interviews to collect empirical data

Kvale (2008) propose a threefold of critical aspects of using the interview method as a way of generating data. Firstly, the whole interview setting is an asymmetrical dominance relation where the interviewer has control over the dialogue with fixed goals and aims for the dialogue. Secondly, the participant can be seen as an instrumental object for the researcher where the participant merely represents a means to an end. Finally, the researcher holds monopoly on the interpretation and conclusions of the interview (Kvale, 2008).

The human element of qualitative inquiry is both its strength and weakness – its strength is fully using human insight and experience, its weakness is being so heavily dependent on the researchers skill, training, intellect, discipline, and creativity. The researcher is the instrument of qualitative inquiry, so the quality of the research depends heavily on the qualities of that human being (Patton, 1988).
Hence painstaking effort from the authors as researchers is essential. In order to address such concerns the authors tried to use two strategies. The first one has been to stay open, this implicating that the authors have been very clear on what the purpose for conducting the interview has been, in order to overcome any issue of a feeling of manipulation on where and for what the interview is done. Secondly, the authors have tried to experiment in the form of the interview. By experimenting with the form of interview and try to overcome the hurdle of it being a question and answer session and more in form of a discussion and storytelling session.
6. Empirical Analysis

The following chapter will account for the empirical results generated based on the research design described in the previous chapter. The purpose is to present primary data as a means to answer the research question: *How can internal lean production principles and work organization integrate with product development systems.* The empirical data presented in this chapter is a prioritized selection of findings with regards to the research question, something that entails the exclusion of material that was not found directly relevant to the subject. All headings are chosen on the basis of words and expressions extracted from statements by the informants. Direct quotes are offered to highlight results generated by the study, but also in order to stay close to the language of the informants.

Coding is a central part of a qualitative analysis and entails a process where the researcher make choices about what words is used to label the concepts or themes that is repeatedly identified in the data. This assists the researcher in organizing an overwhelming amount of data, as well as creating better grounds for interpretation and thereby understanding of a subject (Daymon & Holloway, 2011). The hermeneutic ontology is furthermore based on a notion of working between partial and full understanding of a phenomena why the procedure of coding is an important tool, as it helps identify the important parts that in turn constitute the foundation for the understanding of the phenomena as a whole (Gadamer, 1999).

Based on the literature collection from different sources and the resulting necessary knowledge with regard to the research question, existing theory will enable an abduction of how the respondents integrate internal LP principles and WO in PD systems. Deriving from that there has been gathered certain descriptive words from the interview transcriptions and generated *topic codes* (Daymon & Holloway, 2011). This entails that the researcher creates terms to describe something that is observed in the data, but in which the respondents themselves are not aware of or able to express. Through the establishment of such a construction it is important to make sure not to create concepts that are not really in the data (Daymon & Holloway, 2011). Through analyzing the transcriptions several topic codes have been categorized and put in order to facilitate a better understanding and interpretation of the data. This categorization is grounded in an iterative process of identifying codes which are repeatedly compared with original topic codes, so that new evidence may be labeled under the same category if, and only if, this is appropriate. Based on the coding and categorizing which has been carried out, the primary data will be presented along two dimensions: principles and WO. Four categories
Lean product development systems presents empirical data along the dimension of lean principles applied in PD systems, and include: waste, customer focus, continuous improvement and flow. Five categories present empirical data along the dimension of WO and include: autonomy, cross-functional teams, team consistency, team culture, and knowledge standardization

6.1 Waste

Five out of five respondent’s highlight the principle of waste elimination, but states that the forms of waste most commonly associated with LP needs to be translated in order to be applicable in PD processes. Based on experience from applying lean to a PD system, one respondent claim that it’s challenging to translate the terms related to waste:

…the first problem we encountered was how to define waste in product development processes; in comparison with traditional lean processes. It’s a bit of a challenge to translate these terms into this process (Lean expert, 5).

The same respondent continues to describe the high relevance of waste in PD, but stresses the need for translation. One method for translation is described as a ‘translation matrix’, which defines different forms of waste and enables the calculation of efficiency and improvement in the system:

Waste is highly relevant for us, but we have to translate and we have made a matrix: traditional waste or production waste, what does that mean in our world? We have made a translation matrix where people can see what is regarded as waste in what they do. Then we calculate the efficiency and work to improve it (Lean expert, 424).

Another informant believes that waste in PD is mainly related to idea generation, because it’s impossible to control what ideas are good or bad. This creates a need for many ideas in order to end up with a few successful ones:

…the amount of ideas in a process like that could clearly be defined as waste. So that’s maybe an area where lean and innovation truly collide, because it’s impossible to control what ideas are good or bad. You have 3M for example; where you could ask yourself how many ideas they needed in order to end up with this post-it note which really just emerged through coincidence. We would never have managed to stipulate that on some kind of objective, or by stating that we should have a 1:1 ratio between ideas and realized projects (HoI, 422).
Because this can result in a vast amount of generated ideas, the respondent believe that waste in their processes is mainly related to managing ideation with regards to the priorities of the organization.

I think waste in this process is mostly here (in the first stage) where it is important to find how many ideas is needed or what types of ideas is needed, how many ideas can we manage to process related to our priorities, because it was here (ideation) that we experienced a massive bottleneck by having a blossoming ideation with no direction and where no one felt it natural to grasp the ideas... (HoI, 432).

Despite this the respondent empathized that idea generation is two folded and elaborated on how they loosened the leash on idea generation and allowed for ideas without direction: ‘…we do also let ideas without any direction through just to make sure it can possibly blossom insight we didn’t know of’ (JH, 431). Although this almost guarantees unusable ideas according to Takeuschi & Nonaka (1986) it can’t be regarded as waste in PD as it would be in LP. The mistake of not allowing mistakes results in least risky, incremental concepts (Sethi & Iqbal, 2008). This particular company uses Agile PD and their encouragement for exploration are supported by Takeuschi & Nonaka (1986) which state that encouraging trial and errors and challenging the status quo effect the development of unique new products, quickly and flexibly.

One respondent explain how his company are highly focused on applying lean in their PD efforts, and that they in some extent look for certain forms of waste such as searching for information. However, the informant explain that they have not adopted the principle of waste elimination:

Waste in the form of searching, finding information, looking, and such, is something we look at but we have not adopted that method. Anyway, our new way of working is going to eliminate a lot of waiting and information search, through making sure that the team is functioning better, better communication, and an increased clarity around roles. We are not hunting for those waste elements (PD expert, 245).

The primary data show that the efficient use of resources and elimination of waste, as originally put forward by Womack et al. (1990) and considered to be a salient feature of LP, clearly becomes subject to translation when applied in PD systems. Even though the concept of waste has been developed further by numerous authors (Womack & Jones, 1996; Chen et al., 2010; Karlsson & Åhlström, 1996; Liker, 2004; Browning & Sanders, 2012; Modig & Ahlström,
2012), the concept of waste elimination seem too closely connected with the context of production to have unambiguous and direct applicability in PD systems. Womack & Jones (1996) described the principle more specifically as mapping the value stream and eliminating all non-value adding steps, stating that waste is especially concerned with any human activity that absorbs resources but create no value. Modig & Åhlström (2012) state that lean concerns minimizing variation, and claims that human resources are a dominant source of variation in any process. Since PD is all about human resources, and excel variation in fields like knowledge, communication and creativity, this could indicate that PD is especially exposed to wasteful activities. However the nature of these fields is contradictory, in lean you work to mitigate variations, and in PD the goal is in fact discrepancies. PD is further a process that has to contain an element of uncertainty; this should not be present in a LP process (Austin & Devin, 2004; Cooper & Edgett, 2005; MacCormack & Verganti, 2003). Hence conceptualization of waste in LP will not be directly transformable to PD, as we will see in the preceding sections.

6.1.1 Value

Five out of five informants stress the different orientation towards value creation in PD systems compared to production systems, and that this represent dissimilarities when defining value-adding and non value-adding activities in the process. One respondent explains how value creation is different in PD and production, indicating that an activity may not necessarily be regarded as non-value adding or waste in PD even though it is not making changes to the product:

If you’re developing a physical thing, a car, or bread for that matter, if there is not any change happing to the product or if you’re doing stuff that the customer does not regard as value, there is no value creation. But here, where we basically work with innovation, things are a bit more integrated, because it’s not just creating solutions that is value generation, but also the process of working on that solution (Lean expert, 397).

This view seem to conflict with Modig & Åhlström (2012) and Liker’s (2004) perception of value-adding activities. According to Liker (2004), the only thing that adds value in any type of process, regardless of whether it’s in manufacturing, marketing, or product development, is the physical or information transformation of that product, service, or activity into something the customer wants. Furthermore, Modig & Åhlström (2012) argue that value is only added when something happens to the flow unit, or when it is moved forward (processed). Browning & Sanders (2012) however seem to share the respondent’s view to a greater extent, stating that
waste cannot always be attributed to individual activities. ‘Rather, value stems from how activities work together, and waste from how they fail to do so’ (Browning & Sanders, 2012, p. 6). Another respondent also underpin Browning & Sanders (2012) view by saying that lean PD is about a overall system perspective and contains focus on both top and bottom line, whereas lean in manufacturing is more isolated and attention its efforts to lower the bottom line (Prof.).

One informant describes the creation of a solution and the process of working on that solution as value-adding in PD, and state that this process consists of three main phases: Getting the idea that solves the problem, understanding how to make that solution, then make it. Everything else, however, is regarded as waste. Testing (excessive quality checking), errors, and time when there is no activity, are examples of such waste. The respondent illustrates this by using the invention of the wheel as a metaphor:

The value creation entails getting an understanding of ‘oh, a wheel, that has to be a good solution to this problem’. The time you use to figure out that solution is value adding to us. When you have understood the solution to the problem, you also have to understand how to engineer the wheel, because that’s not trivial either. To make a wheel the first time demands innovation. The third link is to actually make the wheel. It’s actually three steps: getting the idea that solves the problem, understanding how to make that solution, then make it. Everything else, for example testing, is waste. Errors are waste. All time when nothing is happening is waste. The others are quite easy to translate, but what is actually value-adding, because it’s more than just making something, to sit together in a group and just have a discussion and come up with great ideas which are relevant, and understand have to make stuff in a good way. That’s also value adding (Lean expert, 401).

Another respondent supplements the idea of value creation being distinctive in PD from production, and that waste has to be defined differently in PD processes. The respondent indicate that results emerging from the process are more important than efficiency in the process itself, and highlights the significance of choosing right information and thereafter acting correctly based on that intelligence:

…for example, if I want to solve an equation in order to find the dimensions needed for an element of a new product. If someone sits down with a stopwatch and times how long it takes me to lift up the pen, then I put the pen down on the paper and start to write. When I’m finished writing, I may use some time to think a little bit, and he starts the stopwatch again. In the end I may be finished with the equation, but you might tell me there was a lot of waste in process.
There was a lot of waste because I lifted the pen from this point to that, and I hesitated while I was writing, I may have twisted and turned a little bit, maybe I even went for a cup of coffee and so on. There was a lot of waste. But it’s not these things that create waste in PD. What creates waste in PD is the equation being solved incorrectly, or if I have not identified the stuff I actually needed to calculate (Prof., 277).

This statement indicates two contradictory pathways in PD. The first respondent empathized idle time and excessive testing as waste elements. The latter focus on making decisions on the right foundation. Interestingly the former respondent works after an Agile PD method but is influenced by a Lean Startup approach towards PD and produces IT services, the latter after a StageGate system and develops automotive parts. The latter informants conceptualization relates to Cooper & Edgett (2005) and indicate that waste may be generated in PD as a result of acting on incorrect information or basically doing the wrong things, a phenomenon that can be overcome by front-end loading projects. This view corresponds with Browning & Sanders’ (2012) perception of value-adding activities, which argue that lack of value rather stems from doing necessary activities with the wrong inputs, than from doing unnecessary activities. The former creates a need for rework, and is referred to as the ‘garbage in, garbage out’ problem (Browning & Sanders, 2012). Accordingly Cooper (2008) talk about company’s cutting corners in order to save time and money. Speed is essential in a PD-process, but the ones being resolute on making hasty decisions are often the ones who get the value proposition wrong, they fail to deliver on time and as a result the PD process are of weaker quality, ironically they tend to be slower as well (Cooper, 2008).

The latter informant imply that manufacturing is highly waste oriented because the value of a product is fixed, hence LP is about reducing the bottom line by removing waste and minimizing costs. In PD, however, the value potential is not given, a product, which is perceived better and with greater benefits than the competitors may sell three times as much, independently of efficiency in the PD process.

If you look at lean manufacturing you notice it’s highly waste oriented, why? That’s because lean manufacturing is about making a product which is going to manufactured, and if you make the product good enough, i.e. the quality the customer want, the value potential for that product is fixed…The cost underneath the fraction line is where lean manufacturing work in order to remove waste and make the cost as low as possible because you cannot do anything about the value… If you think about product development it’s not like that, the value potential is not given. If you manage to make a product which is even better than the one your competition is
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able to offer, and the customer perceive this to have greater benefits, then you might sell three
times as many products (Prof., 436).

Nevertheless, value will at some point reach a maximum level, a threshold for what the
customers want (Thomke & Reinertsen, 2012). Beyond this threshold customer value will not
increase even though the product is objectively enhanced. Thomke and Reinertsen (2012) call
this a classic PD fall-pit and it is regarded wasteful. Taking the time to scrutinize the real needs
and wants of your customers would both be faster and cheaper than developing superfluous
products (Cooper & Edgett, 2005; Thomke & Reinertsen, 2012). Having the customer in mind
is the key driver for waste removal, everything the customer are not willing to pay for is neither
features the company should use resources on (Nussbaum, 2004; Cooper, 2008). Another
respondent supplements that description and explains how his organization moved from cost
orientation in PD towards a value-based approach where they investigate what the customer is
willing to pay:

We are moving away from the old way of doing things, where we conducted a cost calculation
on a construction and added a contribution margin, while now we are moving towards a value-
based thought where we investigate what the customer is willing to pay for this function… (PD
expert, 295)

This value oriented view is further enhanced by one respondent claiming that manufacturing
generates value through consistency, while product development generates value through
variability. The informant explains:

Lean PD is very value oriented and if you take that further and look at manufacturing, what
generates value in manufacturing? Well, consistency. If you manage to make something which
is identical every time that represents value because then it’s quality and that quality is good
enough. However, if you look at PD what is value creation? Well, it’s variability. If you spend
time on developing a product which has already been developed in the past, then you have not
created any value (Prof., 452).

Mayano-Fuentes & Sacristán-Diaz (2012) state that there is an opportunity to pursue lean
strategies when demand is predictable, something that presumably allows consistency in the
process. However, an agile strategy should be pursued when demand is unpredictable (Mayano-
Fuentes & Sacristán-Diaz, 2012), something that is more in line with the variability the
informant refer to in PD. Browning & Sanders (2012) which confront the notion of lean as a
means to eliminate waste in novel and complex operations, supports this by arguing that lean where pioneered in repetitive production systems characterized by relative stability and certainty. However, PD is not stable or certain and what brings value in PD is more intricate, in manufacturing waste is sunk cost and of little value. Yet in PD typical lean waste such as failures often leads to knowledge generation and might serve valuable in latter situations.

In LPD, you do not have just one value stream, but two. You have one for production and one for knowledge generation. So, if you ask them what waste and value is, which is essential in lean, you have to ask with regards to the project and the problem you are trying to solve there, and/or value generation through new knowledge that can be utilized by the company later, in order to reduce risk in latter projects (Prof., 207).

Knowledge generation is central in a PD-process (Cooper & Edgett, 2005; Takeuschi & Nonaka, 1986). However, it is how this knowledge is preserved and applied in the company over time that determines its value (Sethi & Iqbal, 2008; Jespersen, 2012).

6.1.2 Front-end loading

Three out of five respondents stress the importance of front-end loading in PD systems. Based on the previous descriptions of waste and value in PD processes, front-end loading may be perceived as a method for eliminating waste. Based on substantial experience from the automaker industry, one respondent explain the significance of front-end loading:

…the products who went smoothly were the ones we had front-end loaded with resources, and that’s an important element in lean product development, that you front-end load resources and solve problems early. The projects where we had the opportunity to do this usually went well, while the projects where we started narrowly usually went bad, and they went bad because of things related to the integration of design and production…(Prof., 592)

Another informant supplements this by explaining the importance of identifying and solving problems as early as possible in the process. People with experience from production do not necessarily understand this because they are used to working towards a process with zero defects. In PD a different mindset is required as one informant explains:

…you should identify problems early. A lot of people who have not worked with product development before believe they can approach the process just like in production. In production it’s very important to have zero defects so the process doesn’t stop, but in product development
it’s very important that you discover mistakes as early as possible and solve them. It’s a big difference... when I’m working with production I need to have different mindset than when I’m working with product development (Consultant, 528).

Three out of five respondents indicate that problems can generate value if they are identified early in the process. Errors occurring in the latter parts of a PD system, on the other hand is viewed as waste because they should have been identified and solved before bigger investments were made. Front-end loading PD-projects is something three respondents believe is a mean to mitigate this risk (Consultant; Prof.; PD expert). In this subject the respondents was almost quoting Cooper & Edgett (2005).

Two out of five respondents claims that PD is not about removing waste. On informant disregard waste elimination and instead claim that the process should move from chaos to order, not from order to chaos. When developing new products, the organization look for knowledge gaps instead of solutions, which is done through ‘integration events’. Instead of looking for certain forms of waste, the informant claim that this enables them to reach targets faster. The respondent elaborate:

We have concluded that lean product development is not about removing waste, but to move from chaos to order instead of moving from order to chaos. We look for knowledge gaps instead of solutions. We have integrating events. This enables use to reach targets a lot faster, instead of looking for specific kinds of waste (Sr. Expert PD systems and Processes, 253).

Closing knowledge gaps is a good way to provide the customers with a unique benefit. Customers buy products to avoid problems, solve a problem or to gain benefits (Cooper & Edgett, 2005). Hence innovation stem from closing these gaps and enable the company to offer unique value propositions. An important part of front-end loading is to postpone a decision as far out in the PD process as possible (Cooper, 2008). The reason is simply down to unstable and changing information in the market (Jespersen, 2008). One informant highlighted this; “you want to standardize as much as possible and then you customize towards certain customers as far in the value-chain as possible so that you have some basic elements to use” (Prof., 418).

Although standardization can reduce the necessity of heavy front-end loading it is important that the platform developed are done so with the customer in mind, a focus that magnifies the further to customization you get. Front-end loading connected with standardization is forming the foundation for a more manageable decision-making process and it enables smaller more specific decisions to be made later when the insight is more tangible.
Now, we go from chaos to order. I.e. it’s allowed not to know all there is. And look at the possible alternatives and solutions to this, instead of making quick decisions and solutions. We make these decisions as late as possible. We may recognize that this takes more time in the beginning, but still save so much at the end. Instead of making fast decisions, we build up knowledge to make sure that the solution actually works (PD expert, 175).

Another respondent supplements this by explaining how problems grow throughout the development process, making them significantly more expensive to solve:

Before one conducted a verification check at the end of the PD process, where you always tried the car. If there was anything wrong with the car, that was very serious. But now, we can do simulations and tests early in the process and get indicators on how things are going to become, as well as discover problems early…We focused on simulations and testing early, as to identify all the problems before they grew (Consultant, 642).

Where older PD-systems were a problem amplifier, front-end loading works as a problem funnel. Deriving from the various statements offered by the respondents of this study and the previous descriptions of waste in PD, it may be argued that front-end loading is a method for removing waste in PD systems. This is founded in the logic that errors occurring later is considered more wasteful than the time used to discover them early on. Problems identified in the initiating stages of a PD system, however, may be regarded as value adding. Moving from ‘chaos to order’ as one informant put it so neatly, consumes more time in the beginning but reduces the overall throughput time in the process by saving more time and considerable amounts of money in the latter stages. Although in popular demand among respondents the study found a significant gap between IT-companies and industrial companies. Software company’s seem to favor lean startup and start out slim, they quickly get a useable product in the market, test the response and then go viral or shut it down. This is part of the lean startup approach that has escalated lately (Ries, 2012). IT-companies to a certain degree also do front-end loading, but they do so to quickly get the product out to verify if the concept is viable (Ries, 2012). The interviewee object in an IT-company elaborates:

… if you got a very good bottom line and few requirements related to costs, then naturally you become more top line focused, that means you prioritize broader and recruit more, then you have capacity to increase the speed and by doing this it can happen that you miss the mark sometimes…but you can’t always know if a initiation of a project was right before you tried… by working after the lean startup approach you can say that we limit the PD cost by not putting
in a lot of resources before we actually has validated that it is workable, that we has gained insights and tested it out in the market (HoI, 257).

StageGate was a system designed before IT, Internet and PC’s became household names, although being modernized and modified over the years it’s structure is unchanged. For our three respondents in the more traditional industry front-end loading has been a success criteria, with IT-companies however the competitive environment has changed. This field is also were PD researchers heavily disagree, and is where much of the critc directed towards StageGate is found. Buggie (2002) believe gate reviews and the incentive to kill ideas early hinder creativity and only work as a guillotine for truly radical innovation. Further as information dependencies rarely exist the information decisions are based on can be corrupted and entrap managers flexibility more than it enables learning, flexibility and order (Sethi & Iqbal, 2008; Jespersen, 2012). As one respondent pinpointed:

If you took a survey and asked people if they were to spend 5 hours in front of the computer to communicate with former high school friends after been in employment for 30 years most would say no, yet they do it now when the product is launched (Prof., 569).

The informant was referring to Facebook, and a product like Facebook would probably never been launched by a company using StageGate and front-end loading. The question is then if front-end loading allows for radical innovation. This is a discussion that is picked up later in the paper.

<table>
<thead>
<tr>
<th>Front-end loading</th>
<th>Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical data</td>
<td>PD expert</td>
<td>From chaos to order (look for knowledge gaps not solutions)</td>
</tr>
<tr>
<td></td>
<td>Prof.</td>
<td>Front-end load resources and solve problems early</td>
</tr>
<tr>
<td></td>
<td>HoI</td>
<td>Discover and solve problems as early as possible</td>
</tr>
<tr>
<td>Lean literature</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PD literature</td>
<td>Cooper &amp; Edgett (2005)</td>
<td>Load up resources early and involve every department grasp the comprehensive project. Number one cause of delays in PD is vague objectives, front-end work results in sharper project definitions, speeds up the development stages by reducing recycling and waste.</td>
</tr>
</tbody>
</table>

Table 6.1: Descriptions of front-end loading

6.1.3 Gates and integration events

Three out of five respondents emphasize the significance of gates, or integration events in the PD process. Generally the purpose of integration events, not unlike gates in StageGate, is to monitor activity and make sure that all aspects of the PD process remains integrated and moves in the correct direction. According to three respondents, one important aspect of integration events is to stimulate knowledge capture by the organization so that risk in future projects can
be reduced. One respondent explains the concept of integration events in an especially reflected way:

…these integration events will have two purposes: to make sure that the project team is integrating the knowledge they have generated. You test if you have solved the problems at hand…define the problem that needs to be solved, and then you conduct integration events where you figure out how the problems have been solved as to reduce elements of risk…The other side is about integrating the value-chain of knowledge with the production value-chain. I.e. when developing a car, for example, there is someone in charge for the suspension, the engine, the gearbox, and so on. The car is a product of all these elements working together. It’s about making sure that quality assurance is done based on previous experiences within the company, where you transfer knowledge from the knowledge value-chain to the production value-chain. At the same time, you integrate new knowledge from the production value-chain into the knowledge value-chain in order to make sure you are always learning more (Prof., 211).

One respondent describes integration events in the context of development in the automotive industry, *The integration points are connected with a system that checks if all the components fits together* (Consultant, 720). The same informant explain how his organization initially was lacking structure in their PD, which created the need for a StageGate process in order for them to work systematically. This, however, led to bureaucracy and paperwork that took a lot of time; consequently they started with integration events instead. The respondent put it like this:

> We had this system with gates, and that was good in the beginning regarding the gates because we acquired structure…When it was developed further, however, there was a lot of paperwork which had to be filed and ready, and that took so much time, so now we have started with integration events instead (Consultant, 260)

One respondent critiques the use of gates, and state that they involve a series of questions much like a checklist of tasks. The informant points out that checking off a list in order to maintain control and ensure that everything is according to plan does not work in PD systems, because necessary elements are not on the gates checklist from the beginning:

> …what you are delivering at the gates is given. The questions asked are very much like task-lists…you check off the list and everyone agree that things are done. Then you arrive at gate 4, and everything is done according to plan at gate 4, and asks one critical question: are you able to control the quality of the product? No. Because that was not on the checklist previously,…(Prof., 178)
Another informant supplements this by stating that gates and checkpoints may be a good way of controlling if tasks are carried out or not, but does not say anything about whether the tasks are being carried out in the correct manner: ‘…in the gate review there is a list with things that are supposed to be ready and you check off what is done and what is not done. However, you cannot see if it has truly been done correctly’ (Consultant, 285). The informant further claims that it’s harder to corrupt the integration events, versus gates that consist of PowerPoint presentations where people can just tell ‘we have done this’, but with no real evidence:

The gate system is more about making PowerPoint presentations and show what you have done and then you get approved, but it doesn’t really say anything about the product. I would therefore claim that integration events are important…it’s more difficult to cheat in those, in a PowerPoint you can just way ‘we have done this’ but nobody really knows what you have done and what the quality is (Consultant, 268).

According to the informant, however, StageGate can be a good system for establishing order in a chaotic organization, he states that ‘…if you see there is a complete chaos in a business and introduce StageGate that could be good because they can manage to establish order’ (Consultant, 306). Similar to front-end loading, gates or integration events could be perceived as a means for removing waste and/or assuring value capture in the PD process. Based on the empirical data, forms of waste may arguably include factors like bad decision-making, lack of integration among components, solving problems more than once, and loss of knowledge generated in the process. Moreover, gates and integration events could possibly be understood as activities located within the category of ‘incidental work’ put forward by Chen et al. (2010). Incidental work is ‘processes such as inspection that do not add value to the product, but are required in the current production system’ (Chen et al., p.1070). This is because gates and integration events may be viewed as methods for inspecting progress in the PD system, but also because they put the development ‘on pause’, which by several definitions would not be regarded as a value-adding activity. According to the respondents within the automotive industry, however, gates and integration events are central aspects in PD and therefore assumed to be required activities. An interesting finding is that none of the respondents operating in the service industry mentions anything about integration events nor gates. This may indicate that these two aspects are not that critical in PD among service companies. The table below summarizes the various descriptions of integration events and gates identified in the empirical data.
Lean product development systems

<table>
<thead>
<tr>
<th>Gates</th>
<th>Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical data</td>
<td>Consultant</td>
<td>Checks that tasks have been carried out, but not if they are done correctly</td>
</tr>
<tr>
<td></td>
<td>Prof.</td>
<td>A checklist which does not consider emerging knowledge</td>
</tr>
<tr>
<td>Lean literature</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PD literature</td>
<td>Cooper &amp; Edgett (2005)</td>
<td>Gate reviews are checkpoints to next phases, controlled by senior executives. Important for project portfolio management</td>
</tr>
<tr>
<td></td>
<td>Buggie (2002)</td>
<td>Gate reviews are subjective -&gt; novel ideas turned down</td>
</tr>
<tr>
<td></td>
<td>Sethi &amp; Iqbal (2008)</td>
<td>Strict gate reviews reduce flexibility -&gt; decrease learning failure -&gt; adverse effect on market performance of new products</td>
</tr>
</tbody>
</table>

Table 6.2: Descriptions of gates

<table>
<thead>
<tr>
<th>Integration events</th>
<th>Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical data</td>
<td>Prof.</td>
<td>Integrating the value chain of knowledge with that of production</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>A system for checking if all components fit together</td>
</tr>
<tr>
<td></td>
<td>PD expert</td>
<td>Technical narrowing decisions (not to look for solutions but knowledge gaps)</td>
</tr>
<tr>
<td>Lean literature</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PD literature</td>
<td>Takeuchi &amp; Nonaka (1986)</td>
<td>Under the holistic rugby approach, integration events occurs were everything gets synchronized cross departmental</td>
</tr>
</tbody>
</table>

Table 6.3: Descriptions of integration events

Based on the empirical data hereunder various descriptions of waste and value in PD, it may be argued that five out of the seven original forms of waste put forward by Womack & Jones (1998) can more or less be translated and thereby applied in systemized PD. Three forms of waste seem to have a strong applicability in PD, hereunder defective products, processing, and most of all waiting time. Waste in the form of inventory and overproduction could be viewed as having a moderate applicability, while movement and transportation cannot be translated and thereby have no applicability.

<table>
<thead>
<tr>
<th>LP forms of waste</th>
<th>Applicability in PD</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defective products</td>
<td>Strong</td>
<td>Errors</td>
</tr>
<tr>
<td>Inventory</td>
<td>Moderate</td>
<td>Queuing errors waiting to be rectified</td>
</tr>
<tr>
<td>Processing</td>
<td>Strong</td>
<td>Testing</td>
</tr>
<tr>
<td>Movement</td>
<td>Weak</td>
<td>None</td>
</tr>
<tr>
<td>Transportation</td>
<td>Weak</td>
<td>None</td>
</tr>
<tr>
<td>Waiting time</td>
<td>Direct</td>
<td>All time when nothing is happening</td>
</tr>
<tr>
<td>Overproduction</td>
<td>Moderate</td>
<td>Too many ideas</td>
</tr>
</tbody>
</table>

Table 6.4: Applicability of the seven original forms of waste in PD systems
Moreover, the primary data identifies ten forms of waste directly related to PD systems. Five of these have unambiguously been defined as waste by the respondents, while the latter five have been termed ambiguous because of the indirect nature of their descriptions.

<table>
<thead>
<tr>
<th>Unambiguous forms of waste</th>
<th>Source(s)</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Searching for intel PD</td>
<td>PD expert</td>
<td>Automotive industry</td>
</tr>
<tr>
<td>Ideation</td>
<td>Hol</td>
<td>Online services</td>
</tr>
<tr>
<td>Testing</td>
<td>Lean expert</td>
<td>Online services</td>
</tr>
<tr>
<td>Errors</td>
<td>Lean expert</td>
<td>Online services</td>
</tr>
<tr>
<td>Garbage-in-garbage out</td>
<td>Prof./B &amp; S (2012)</td>
<td>Automotive industry</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambiguous forms of waste</th>
<th>Source(s)</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rework</td>
<td>Prof./Consultant/Lean expert</td>
<td>Automotive industry, online services</td>
</tr>
<tr>
<td>Late problems</td>
<td>Prof./Consultant expert</td>
<td>Automotive industry</td>
</tr>
<tr>
<td>Loss of knowledge</td>
<td>Prof./Consultant/PD expert</td>
<td>Automotive industry</td>
</tr>
<tr>
<td>Bad decisions</td>
<td>PD expert</td>
<td>Automotive industry</td>
</tr>
<tr>
<td>Lack of integration</td>
<td>expert/PD expert</td>
<td>Automotive industry, online services</td>
</tr>
</tbody>
</table>

*Table 6.5: Forms of waste aggregated from the empirical data*

### 6.2 Customer focus

Modig & Åhlström (2012) emphasize customer focus by stressing the importance of defining efficiency from the perspective of the customer, which means that efficiency should be calculated based on the time elapsed from a need occurs until that need has been satisfied. In the words of lean guru’s Womack & Jones (1996): ‘value can only be defined by the ultimate customer’ (p. 16). PD literature also has significant focus on customers (Larson & Gray, 2011; Nussbaum, 2004; Takeuschi & Nonaka, 1986; Austin & Devin, 2004; Thomke & Reinertsen, 2012), where StageGate founders Cooper & Edgett (2005) put it like this; ‘The number one key to success in product innovation is developing and delivering differentiated products that offer the customer unique benefits, solve major customer problems’ (p.39). The study shows that five out of five respondents allocate substantial attention to customer focus and/or integration in the PD system. One respondent, operating in the online service industry, explains how they integrate customers by having a strong focus on customer- and user value:

…first and foremost initiate conversations with the users of the service we want to develop, and thereby investigate the problem or needs that we want to solve in fact exists…The first phase is purely about user- and customer interaction, or integration…There is not too much focus on technology at that point. We also have a continuous surveillance of what our users think about the service…Then you have ‘bruikerlab’ (user laboratory), which is a department in it’s own
right. We bring people in, observe what they do, and try to solve problems based on that (Lean expert, 218).

This relates to how IDEO obtain customer insight. By observing how customers actually use products or features they get different insight than surveys might be able to reveal (Nussbaum, 2004). Another respondent, operating in the automaker industry as a part supplier, explains how they strive to truly understand ‘customer interest’ by involving the client throughout the entire PD process:

The first question is ‘what do the customer want’, and we have a number of sub-activities in order to identify what the customer actually want. We call it ‘customer interest’. What is the client saying in his specifications, and how can we interpret that to make sure that we really understand what the customer wants…Number two regards ‘how do we solve this’, what construction do we need as to cover the customer need…Thereafter you invite the customer and tell them ‘this is how it’s going to be’, and then the customer responds ‘well yes, that’s exactly what we talked about’, the customer has been a part of the process all the way…Then we have what we call a ‘walk in the park’, we don’t have to show the customer everything that we have done, because he already knows (PD expert, 29).

The involvement of experts, lead-users and existing customers are strategies for upholding customer focus. An organization producing speedboats utilize these methods in order to receive feedback on how new concepts is going to be received by the market, but also to acquire responses on the products they have already launched.

…involve customers more directly in the development and gets feedback directly from lead-users concerning how new concepts will be received in the market…They also involve existing customers and get feedback on the boats that are already in the market, what the problems are, what is good, what is bad and etc., and use this information when they develop new products (Prof., 391).

One respondent states that processes and products should be optimized in relation to what creates user- and customer value. Furthermore, focus on customer-and user value influence resource allocation and costs, because there is a closer connection between what resources are used on and what the organization gets in return with regards to the value created.
The fact that we have become better to prioritize customer/user value, which at least is an important brick in lean, to indeed optimize both process and product related to what creates customer/user value. That has done something about how we allocate resources so I believe we have a closer connection between what we uses our resources on and what we get in return of the value we create (HoI, 234).

One respondent explains how their PD unit actually certificate departments based on their compliance with the overall corporate principle of customer and user value. The respondent elaborates:

We have started to certificate our departments based on their compliance with our principles. In order to become certified you have to provide a definition of customer- and user value, who the customer and user is, and so on…Then we evaluate what they deliver based on the customer- and user value that is defined…Everything they launch and exhibit should be rated along the terms of customer- and user value. Then it is controlled through outcome (impact), making sure that it delivers the impact which was forecasted…(Lean expert, 235)

The informant further explains how the organization improves through absorbing feedback from their customers, through displaying live feeds of information throughout the office, hereunder comments and critique made by civilians:

On the screens in Finn you will also notice everything that is written about Finn on twitter, that is viewed as a flow on the monitors. That makes it easy to capture what is said about Finn. Particularly, we have a service center which have gone from being some kind of ‘wall’, a sound proof room where no one is to be disturbed, to some kind of ‘megaphone’. They work systematically with communicating the stuff that doesn’t work to the people who can do something about it (Lean expert, 245).

One respondent stressed the importance of truly understanding the customer needs. Through investigation of knowledge gaps the company could use this information as a foundation for decision making.

It’s about using a lot more time on understanding what the customer really wants, instead of just looking at the specs. To work towards understanding what we do not know, instead of looking for quick solutions. Build knowledge before we make a decision on what we should do (PD expert, 167).
6.2.1 Customer integration

Two out of five claim that strong ties and long-term relationships with customers may be important in a business-to-business context. One respondent with experience from the automaker industry describes how working closely with customers may generate advantages because you can influence the product specifications to your own advantage, something that enables you to maximize the chance of getting new projects. The respondents elaborates:

In some instances they work long-term because they have an advantage, they are an integrated supplier, which entails benefits compared to other suppliers through their close work with the development department at the factory. Based on this you could take part in the establishment of specifications so that they favor ones own products, thereby maximizing the chance of getting the order if they are put out on quoting among other sub-suppliers. That’s the first part, then they work closely with the factory and deliver prototypes and design, design solutions, prototypes on different levels along the whole development process…(Prof., 378).

A different informant maintains close relationships with customers through the use of dedicated teams. This enables them to learn and get to know their customers on a deeper level which stimulates better understanding of their special needs:

…we have smaller teams which are dedicated to certain customers, containing sales, construction, production and so on. They stick together and learn to know their customer and their special needs and how to solve these…It’s a lot faster and more efficient to do it in this way (PD expert, 215).

Perhaps a bit surprisingly only one respondent mention that you also have to create customer needs, because the customer does not always know what they want or may not be able to express themselves in a sufficient manner. The informant explains: ‘…if you’re going to be located in the front you need to, look at iPhone for example, that was not developed because a customer said they wanted an iPhone. They had to create that need’ (Consultant, 411). Every company has a set of values and beliefs that reflects their culture. A clear value for all respondents was that of customer focus. Not only being a principle in lean and PD it has also become an important part of the company culture, ‘The culture in Finn have during the years become very strong in prioritizing the option that create the greatest user/customer value, so that is the principles behind the prioritizations and that it is prioritization criteria’s for everyone’ (Hol, 131).
The respondent further elaborate on how lean has influenced the culture to put the customer in center:

It has influenced the business culture by increasing a user/customer definition and prioritize in terms of this is perhaps the most important results after working with lean principles and lean culture, for getting people to understand that we are here for the customer/users and that they should optimize all values and processes to be more customer centric, I think this as least is an important part of the lean culture in Finn (HoI, 407).

Five out of five respondents consider customer focus as important for successful product development. This is aligned with PD research stemming from the literature review. Indeed Cooper & Edgett state that customer focus is the key principle for lean, rapid and profitable PD. Although other principles can add value, they have to do so in terms of what brings value to the customer (Cooper & Edgett, 2005). This is in thread with Liker (2004) and with regards to customer focus lean and systemized PD don’t seem to differ.

<table>
<thead>
<tr>
<th>Customer focus</th>
<th>Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical data</td>
<td>Lean expert</td>
<td>Integrate customers by having a strong focus on customer- and user value</td>
</tr>
<tr>
<td>PD expert</td>
<td>PD expert</td>
<td>Understand customer interest by involving the client</td>
</tr>
<tr>
<td>Prof.</td>
<td>Prof.</td>
<td>Involvement of experts, lead-users and existing customers</td>
</tr>
<tr>
<td>HoI</td>
<td>HoI</td>
<td>Processes &amp; products should be optimized in relation to what creates customer-user value</td>
</tr>
<tr>
<td>Consultant</td>
<td>Consultant</td>
<td>Involve customers in PD (consumer testing, questionnaires)</td>
</tr>
<tr>
<td>Lean literature</td>
<td>Modig &amp; Åhlström (2012)</td>
<td>Efficiency is defined from the customer perspective</td>
</tr>
<tr>
<td>Womack &amp; Jones (1996)</td>
<td>Womack &amp; Jones (1996)</td>
<td>Value can only be defined by the ultimate customer</td>
</tr>
<tr>
<td>Slack et al. (2010)</td>
<td>Slack et al. (2010)</td>
<td>The flow of products and services always delivers exactly what the customer wants</td>
</tr>
<tr>
<td>Liker (2004)</td>
<td>Liker (2004)</td>
<td>The only thing that adds value is the physical or information transformation of a product, service, or activity into something the customer wants</td>
</tr>
<tr>
<td>PD literature</td>
<td>Cooper &amp; Edgett (2005)</td>
<td>Number one key to success in PD is to create value propositions that offer unique benefits for the customers</td>
</tr>
<tr>
<td>Thomke &amp; Reinertsen (2012)</td>
<td>Thomke &amp; Reinertsen (2012)</td>
<td>Problem definition is essential, to understand customers needs, wants and what they don’t want is crucial</td>
</tr>
<tr>
<td>Ries (2011)</td>
<td>Ries (2011)</td>
<td>Customer input is only a source of information about the products and overall vision, run experiments on customers more than cater their whims</td>
</tr>
</tbody>
</table>

Table 6.6: Descriptions of customer focus
6.3 Continuous improvement

Continuous improvement (Womack et al. 1990) entails ongoing improvement involving everyone in the organization (Karlsson & Åhlström, 1996), where the ultimate goal is a process without any of the seven forms of waste identified by Womack & Jones (1996). Consequently, fault free products or zero defects denote how a lean company works in order to attain quality (Karlsson & Åhlström, 1996).

Five out of five informants consider continuous improvement to be a central principle in PD systems. There are, however, some variation among the respondents with regards to their perspective and focus. One respondent governs a process-oriented view on continuous improvement, stating that results should be measured against targets in the process, and that barriers for reaching those targets should be identified. Continuous improvement is assured through frequent meetings among the PD teams in which they discuss success and failures in the past. Based on this the team has to come up with at least one measure for improvement during every meeting. The respondent explains:

…continuous improvement shall include a model of the process, targets, follow-up on the results, and the barriers to reaching those targets. What barriers do you have now? It shall be visualized. We have stated that, every third week, they shall have a meeting, an improvement meeting, within this team…Then the team gets together and discuss what worked and what did not work during the sprint or period, and then they have to come up with at least one measure (Lean expert, 436).

This is in line with Karlsson & Åhlström’s (1996) description of how continuous improvement is achieved in practice, stating that involving everyone in the work of improvement is accomplished through quality circles, hereunder activities where people gather in groups and come up with suggestions on possible improvements. Larson & Grey (2011) mentions this particular meeting the sprint retrospective. In relation to Larson & Grey (2011), Takeuschi & Nonaka (1986) regard this as a highly involved and vastly intense way of communication and because of daily interaction the ongoing learning makes planning and documentation excessive. None of the informants, however, mention elaborate schemes for implementing suggestions, something that Karlsson & Åhlström (1996) emphasize with regards to rewarding employees and providing feedback on the status on suggestions. Another respondent states that innovation and lean can work together even though continuous improvement may represent only
incremental innovations, because a stable platform enable resources to be freed up and thereby used towards more radical innovations.

An important part of the principle program is that we have a principle about continuously improving process and product and that is still an important part and to a degree the conflicting perspectives between innovation and lean, many imply that because you continuously improve, what happens is just incremental and the larger leaps is absent. Even though Toyota is the example of the opposite, where they have accompanied radical innovation, but we like to say that when we work with continuously improvement then we release resources to enable the larger wows. So continuously improvement is for us to build a culture where we all the time improve in order to create customer/user value so you can transfer this and utilize resources on other areas. That is why we mean innovation and lean can be connected, because you need certain resources to create the radical innovation, you create that by having a solid platform, then you release resources with continuously improvement (HoI, 370).

One informant state that people should not talk about continuous improvement in PD processes, because he thinks it’s more comprehensive. According to the respondent, it’s all about identifying gaps of knowledge and closing these in order to make engineering decisions:

I don’t think we should call it continuous improvement because it’s a lot bigger than that…Continuous improvement entails improving our way of working, in my world. The other side of improvement regards the engineering solutions that we provide. Production solutions. It’s about identifying knowledge gaps, closing these and making engineering decisions (PD expert, 281)

It appears very difficult to quantify improvements in a PD system. Two respondents indicate this by emphasizing the challenge of establishing relevant metrics to measure efficiency. One respondent illustrate this by describing that a product may be well received in the market even though the PD effort was terrible, while another product may be badly received by the market even though the PD system performed exceptionally.

Imagine that we do an exceptional development job on one product, which has the very best materials, but the car doesn’t sell. Then we produce and earn marginally. We may have a very poor construction which barely holds together, but the car is very popular. Is the project then bad or good? It's very difficult to measure this in a good sufficient way. What we try to do is look at the number of ‘look-backs’ and start-up problems, and in some way establishes if the project is good or poor (PD expert, 306).
The constant pursuit for improvement is also something that reflects and builds the lean culture as one respondent describes:

So continuously improvement is for us to build a culture where we all the time improve in order to create customer/user value so you can transfer this and utilize resources on other areas. That is why we mean innovation and lean can be connected, because you need certain resources to create the radical innovation, you create that by having a solid platform then you release resources with continuously improvement (Hol, 381).

However the respondent directed a warning towards the term continuous improvement as this could sound like incremental innovation among employees.

But it is also the choice of words… For us it is about taking radical steps, so the word continuously improvement is something we have wrapped differently to avoid a conflict between incremental and radical innovation, continuously improvement is faded as word, but in practice and what we do every day continuously improvement is something we work with, and we have a very strong culture for this (Hol, 389).

6.3.1 Standardization

In relation to the principle of continuous improvement, three out of five refer to the method of standardization. Liker (2004) claims that standardization of tasks is the foundation for continuous improvement, while Modig & Åhlström (2012) state that the flow in a process must be standardized so that everyone can have the same understanding of how tasks should be carried out. In Spear & Bowen’s (1999) view standardization concerns all work being highly specified as to content, sequence and outcome. One informant refers to knowledge standardization where the organization seeks to capture the knowledge generated from solving a problem, then making that knowledge available to everyone through what is referred to as curve knowledge. This requires a knowledge owner that transfers the hands-on knowledge to information available for everyone in the organization, because the team members do not have time to ensure this themselves (PD expert).

Furthermore, one respondent describes how they have established a system which documents and standardizes the generated knowledge. One importation point is that the captured knowledge has to be exploitable and visual, i.e. that it’s possible to physically see it. If these
factors are not present, the respondent state that the standardized knowledge is not going to be applied by employees and thereby looses its value:

…we have deployed these knowledge owners and a system which documents and standardizes knowledge. We do this very freely, so that every knowledge owner can build knowledge as he likes, but we have different templates that help structure and visualize knowledge…You should make it usable, from curve knowledge to point knowledge. And you should make it visual. I.e. that it’s possible to see it. If you do not have those two factors there is just information which is useless, or at least hard do utilize. (PD expert, 400).

Another respondent refers to the concept of knowledge standardization as well, stating that you can standardize knowledge in order to skip learning cycles and thereby save time in the PD process. ‘With standardized knowledge you don’t need to create learning cycles to find it out, because you already solved it and that save time’ (Prof., 426). Standardizing knowledge is what Takeuschi & Nonaka (1986) term organizational transfer of knowledge or institutionalizing and it is one of their key principles for lean PD processes. However, institutionalizing taken to far can be a potential learning and creativity trap (Hauser et al., 2006; Barczak et al., 2009; Jespersen, 2012).

One respondent supplements on standardization and describes how his organization makes standards and systems in order to maintain control and monitor performance in the PD system. He does not believe innovation should happen coincidental, and that there is a need for an underlying structure in order to work systematically.

Make standards, and systems for monitoring target, results and impact and such…our role or responsibility is to make sure that PD and innovation does not happen coincidental in Finn. We should work with it systematically, and then we need this as a kind of basis (Lean expert, 101).

Another respondent refers to standardizing the process through product platforms, or modules, in the PD system. Even though an organization may have several customers segments with different requirements, it’s possible to establish platforms as the informant explains:

…you can standardize the way you are working, i.e. the process and then you can standardize with regards to solutions that you develop…you want to standardize as much as possible and then you customize towards certain customers as far in the value-chain as possible so that you have some basic elements to use (Prof., 414).
Another respondent supplements this argument by explaining how parts can be built on modules and still appear unique to the customer:

When we are making these unique parts we are trying to be better at building these on modules. A manual gearshift handle for example, may consist of 100 modules, so different combinations may provide entirely different gearshift handles (PD expert, 356).

While lean theory emphasize standardization of tasks (Liker 2004) and standardization in order to create and maintain an efficient flow (Modig & Åhlström, 2012), the empirical data allocate more focus towards knowledge standardization, standardization through innovation platforms such as StageGate, and standardization through the use of modules. Standardizing knowledge and making it available is important for companies to take their knowledge further and can hinder waste related to reacquiring knowledge (Cooper & Edgett, 2005; Takeuschi & Nonaka, 1986). Despite this over-institutionalizing can result in lack of novel knowledge (Hauser et al., 2006; Barczak et al., 2009; Jespersen, 2012). This may be connected with the different value orientation in PD compared to production, where PD generates value through variability while production creates value through consistency.

<table>
<thead>
<tr>
<th>Continuous improvement</th>
<th>Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical data</td>
<td>Lean expert</td>
<td>Include a model of the process, targets, follow-up on the results, and barriers to reaching those targets</td>
</tr>
<tr>
<td></td>
<td>Hol</td>
<td>Enable resources to be freed up and used on radical innovation</td>
</tr>
<tr>
<td></td>
<td>PD expert</td>
<td>Two sides: improvement in the way of working and improvement in engineering solutions</td>
</tr>
<tr>
<td></td>
<td>Prof.</td>
<td>Concerns standardizing processes and solutions, hereunder knowledge</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>Capturing knowledge as to improve latter development projects</td>
</tr>
<tr>
<td>Lean literature</td>
<td>Cottyn et al. (2010)</td>
<td>A continuous process towards perfection</td>
</tr>
<tr>
<td></td>
<td>Karlsson &amp; Åhlström</td>
<td>Ongoing improvement involving everyone</td>
</tr>
<tr>
<td></td>
<td>(1996)</td>
<td>Standardization of tasks is the foundation for continuous improvement</td>
</tr>
<tr>
<td></td>
<td>Modig &amp; Åhlström (2012)</td>
<td>Improvement happens through standardizing flow so that everyone can have the same understanding of how tasks should be carried out</td>
</tr>
<tr>
<td></td>
<td>Spear &amp; Bowen (1999)</td>
<td>Specifying work as to content, sequence and outcome</td>
</tr>
<tr>
<td>PD literature</td>
<td>Cooper &amp; Edgett (2005)</td>
<td>Best performers are better to learn from past experience and have established a culture for continuous improvement</td>
</tr>
</tbody>
</table>

Table 6.7: Descriptions of continuous improvement
6.4 Flow

Taiichi Ohno (1988) famously said that all they do at Toyota is look at the timeline from the moment the customer gives an order to the point where they collect the cash, and that reducing the non value-adding wastes is a means to reduce this timeline. Karlsson & Åhlström (1996) state that one of the ultimate goals with LP is to shorten lead times, while Liker (2004) states that lean thinking focuses on making the product flow without interruption. Moreover, Modig & Åhlström (2012) argue that throughput time often is an indicator of value in itself, i.e. the quicker something is processed the better.

Four out of five respondents refer to flow, speed or efficiency in the PD system. One informant state that ‘it’s about finding a simple solution to that problem, make that solution and launch it as soon as possible. Then learn from it’ (Lean expert, 164). When discussing the use of resources and costs the respondent claim that they rather look at the pace and quality of the process:

…it’s very hard to give a precise estimation on the use of resources and costs. What we rather look at is the speed. How fast do we get things out when there is a need, and the quality. So that’s our main focus, how fast we make things happen (Lean expert, 360).

This seems to be in line with one of Liker’s (2004) descriptions of lean, where short lead times and flexibility enabled higher quality, better customer responsiveness, better productivity, and better utilization of equipment and space. It also seems to support Modig & Åhlström’s (2012) clam of short throughput times being more beneficial, as well as Ohno’s (1988) focus on reducing the timeline from order to cash collection. Also in PD the focus on rapid processes is acknowledged, Thomke & Reinertsen (2012) as well as Cooper (2008) consider a lean approach more suitable when it comes to project portfolio management. Processing in small batches is a lean way of thinking and the same rationale goes for PD, a common fallacy is that higher resource utilization equals better pace and higher quality, when in fact the reality is opposite (Thomke & Reinertsen, 2012).

The same respondent explain how the flow in the company has improved the dynamic:

Previously, ideally, 50 percent of the time was dedicated to working with development. The rest of the time was used on integrate stuff, identify errors, correct errors, and getting it to the market. But now that we have a lot more streamlined flow, the developers are working on development continuously,…There is also a separate department that integrates the release, and
they use 3 days to do that. This happens in parallel. If you start to calculate on these changes, you will find a radical improvement in efficiency, if you look at the time we use on actual changes, versus the time we used on just integrating stuff together. In addition, when you include the aspect of quality, i.e. the number of errors, which has been reduced enormously. Mistakes reduce the user experience (satisfaction), and have to be identified and corrected. But errors, if there are enough of them, they have to be administrated. You need a queue of errors, you need to prioritize, you need to gather resources to fix them… (Lean expert, 366).

This statement seems to be supported by several authors in lean literature, including Modig & Åhlström (2012), Slack et al. (2010) and Liker’s (2004) descriptions of lead-time implications on processes. It appears connected with what Slack et al. (2010) and Modig & Åhlström (2012) refer to as the efficiency paradox, where greater focus on utilizing resources efficiently tends to increase the amount of work there is to do. This includes negative effects such as the need for additional resources, work, and efforts that would not be necessary in a flow-efficient organization (Modig & Åhlström, 2012). Similar to Modig & Åhlström, Liker (2004) emphasizes that long lead times, or throughput time, can act as an important source of waste. The explanation above illustrates how a focus on flow may enable the organization to eliminate several negative effects stemming from long lead times in PD, hereunder administration and prioritization of errors as well as the extra resources needed to finance those activities.

Another respondent takes this view further by highlighting the importance of speed in the PD system. It’s about launching something in order to validate and get insight as quick as possible.

Finn have a mantra from the last restructuring; from idea to market in one day, it is more like a slogan than a goal, but it expresses the swiftness from when we say go and till we get the product out which we then can build experience and knowledge from, but then it is important that we get out the first version so we can begin to validate, learn and get insights. (HoI, 110).

Furthermore, the respondent describes how his organization is able to focus on speed because of their solid bottom line. This puts them in a position to prioritize broader and recruit more, in order have capacity to increase the speed of their PD system. Consequently they are able to get a response on their assumptions and validate their initiatives faster:

…if you got a very good bottom line and few requirements related to costs, then naturally you become more top line focused, that means you prioritize broader and recruit more, then you
have capacity to increase the speed…We believe that by doing this we at least get a faster respond to whether our assumptions and priorities was rightfully…(Hol, 247)

Modig & Åhlström (2012) back up this notion, stating that one of the activities that increases flow efficiency is to ‘add more resources, which increases capacity and reduces cycle time’ (Modig & Åhlström, 2012, p. 45). According to Lawson (2001), available time (or money to buy that time) that is not fully engaged in the current delivery of an organization’s primary product or service is necessary for organizations to have room to adapt, change, and protect critical processes from environmental turbulence. As the description above illustrate, organizations with a solid bottom line may be better situated to facilitate renewal, learning, and adapt to changes, even though the net effect of these activities is difficult to detect.

Another respondent refers to systems that speeds up the PD process, hereunder methods such as quick testing and visualizing (Consultant). This allows developers to show the customers something physical early in the process, which is regarded important in many industries. Moreover, cost of the delay is assumed to be a central factor when it’s important to launch a product fast in order to compete with other products (Prof.; Consultant). In some instances, strategic parts of a market may be lost if a product is launched too late.

If it’s important to launch a product fast in order to compete with other products, cost of delay is an important factor, because if you launch the product too late you will loose important parts of the market. Then someone else takes it…(Prof. 260).

Even though several respondents refer to the importance of speed in the PD system, especially respondents operating in the service industry, one informant states that PD is not about getting things through the process fast. Keeping it simple and reducing the amount of time spent on certain things is not a bad thing, but the primary focus should be on solving problems and doing the right things. Taking shortcuts will increase the chance of missing possible problems early in the process, problems that may emerge later in the process with a lot more strength. According to this respondent, the biggest reason for failure in PD is the lack of problem identification early in the process:

My experience is that lean PD is not that focused on getting things through fast. It’s fine to make things simple and reduce the amount of time you spend on stuff, but it’s more important to do the right things. It’s about solving the problems. Cutting corners will only bite you in the ass with a strength multiplied by ten when you identify problems later in the process…The
problems you don’t identify early will, no matter what, emerge later in the process. And that’s what destroys projects, innovation, and profits (Prof., 269).

Another informant supplements this view and states that ‘what enables a reduction in development time is to solve problems only once’ (Consultant, 518). Deriving from the empirical data it becomes clear that the respondents operating in the service industry put substantial more focus on maintaining a fast PD system, in order for them to validate and get insight before they escalate and make investments. The respondents operating in the automaker industry also seem to allocate focus towards flow, but generally state that doing the right things is more important than arriving at solutions quickly. This seems to be closely connected with the different focus on front-end loading among the respondents, something that those operating in the service industry seem to disregard, while the ones operating in the automaker industry allocate substantially more attention to that aspect. The table below summarizes the various descriptions of flow derived from the empirical data.

<table>
<thead>
<tr>
<th>Flow Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical data</td>
<td>Lean expert</td>
</tr>
<tr>
<td></td>
<td>Hol</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
</tr>
<tr>
<td></td>
<td>Prof.</td>
</tr>
<tr>
<td></td>
<td>PD expert</td>
</tr>
<tr>
<td>Lean literature</td>
<td>Taiichi (1988)</td>
</tr>
<tr>
<td></td>
<td>Karlsson &amp; Åhlström (1996)</td>
</tr>
<tr>
<td>PD literature</td>
<td>Thomke &amp; Reinertsen (2012)</td>
</tr>
</tbody>
</table>

Table 6.8: Descriptions of flow

### 6.5 Autonomy, responsibility and empowerment

All respondents mentioned autonomous, responsible and empowered teams as a crucial element in successful PD. This is well aligned with most of the research done in PD (Cooper & Edgett, 2005; Takeuschi & Nonaka, 1986, Larson & Grey, 2011; Thomke & Reinertsen, 2012; Liker & Morgan, 2006). This is also in line with the principle of teamwork in lean, where Womack et al. (1990) claim that one feature of a truly lean organization is the allocation of a maximum number of tasks and responsibilities to the people actually adding value to the product or service. Likewise, Karlsson & Åhlström (1996) state that decentralized responsibilities are an
important part of lean. One of the respondents said the following: \textit{...we have not come with the one process to follow, we have ensured that the marketplace (department) have managed to define their own} (Hol, 20).

For this company the value of having teams being able to think for themselves was of critical value as the company comprised of many daughter companies, and to aggregate a generic business model and dictate the PD process could become a lose-lose situation. This was also the case when it came to ideation:

\ldots the ideation usually happens on team level where the prioritization related to which customer/user value this action creates as well as which create the greatest, is the ones who get carried away (Hol 135-137).

To enable sovereign teams it was important that the team itself generated ideas, the management sat direction but the means to the objectives was not dictated. This is well aligned with Takeuschi & Nonaka (1986) principle of \textit{built in instability}. It was also empathized by another respondent; ‘\textit{... it is very important that each team prepares a table, because then no one can deliver a table and say this is how you should do it}’ (Consultant, 360). The relatively free role of PD teams is quite clear through the empirical data, and regardless of industry the autonomous role they enjoyed was alike. As one respondent said; \textit{Within PD there is not so much control as in other departments, like production} (Consultant, 371). This lean principle has clearly been transferred and translated to PD processes, and regardless of PD methodologies no respondent distanced themselves from the principle of self-managed teams. Consequently, the match between lean and PD seem to be coherent and the paper support earlier research. This is confirmed by Slack et al. (2010) which state that a key issue of the lean philosophy concerns the involvement of staff in the operation, hereunder to encourage a high degree of personal responsibility, engagement and ownership of the job.

Cooper & Edgett (2005) highlight that teams need to be held accountable for results, this is part of generating urgency for the team members and our research has found evidence of this. The following informant elaborate on the employee responsibility: ‘\textit{...we try to make sure that all participants get an understanding of what they are supposed to deliver and take responsibility that stuff gets done. Even at the bottom level of individuals}’ (PD expert, 234).
This particular company have long experience with StageGate and let the team work freely, but management controls that the team do their job. They rely on management’s contribution and see this as important for successful PD.

We are on a journey, and it’s very important that management takes active part in this, and not only the steering of this journey. Management should not sit in the back seat, something that has happened a couple of times here. That should be avoided (PD expert, 344).

This is well in line with Liker’s (2004) description of the lean WO, where one aspect he emphasizes is the necessity of leaders who understand the work and live the philosophy.

Another company had Scrum as foundation for their PD-process. In Scrum the scrum master facilitates, but are not the leader of the PD process (Larson & Grey (2011). In a similar manner management acted more like coaches, the respondent elaborate;

…so we have helped to implement processes, but we have not come with the one process to follow, we have ensured that the marketplace (department) have managed to define their own (HoI, 20).

However in this company a strong culture for measurement gave the employees an opportunity to be self-assessed and thereby govern themselves, Takeuschi & Nonaka (1986) term this subtle control.

<table>
<thead>
<tr>
<th>Autonomy, responsibility, empowerment</th>
<th>Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical data</td>
<td>Hol</td>
<td>Each department define their own PD process, and ideation happens on the team-level</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>Within PD there is no so much control as in other departments, like production</td>
</tr>
<tr>
<td></td>
<td>PD expert</td>
<td>All participants have an understanding of what they are supposed to deliver and take responsibility that stuff gets done</td>
</tr>
<tr>
<td></td>
<td>Lean expert</td>
<td>The project manager decides how to prioritize and distribute resources, the technical manager decides how, and a product director which manages several product teams</td>
</tr>
<tr>
<td>Lean literature</td>
<td>Womack et al. (1990)</td>
<td>Allocation of a maximum number of tasks and responsibilities to the people actually adding value to the product or service</td>
</tr>
<tr>
<td></td>
<td>Karlsson &amp; Åhlström (1996)</td>
<td>Decentralized responsibilities</td>
</tr>
<tr>
<td></td>
<td>Slack et al. (2010)</td>
<td>Involvement of staff in the operation, hereunder to encourage a high degree of personal responsibility, engagement and ownership of the job</td>
</tr>
<tr>
<td></td>
<td>Sim &amp; Chiang (2012)</td>
<td>Pro-company not pro-employee</td>
</tr>
<tr>
<td></td>
<td>Liker (2004)</td>
<td>Grow leaders who understand the work, live the philosophy and teach it to others</td>
</tr>
<tr>
<td>PD literature</td>
<td>Takeuschi &amp; Nonaka (1986)</td>
<td>Autonomy is a characteristic of self organized team. Important to create incentives, intrinsic motivation and self transcendence within the team.</td>
</tr>
<tr>
<td></td>
<td>Cooper &amp; Edgett (2005)</td>
<td>Empowered teams are more likely to achieve success in PD, responsible teams possess; momentum, passion, accountability and knowledge</td>
</tr>
<tr>
<td></td>
<td>Larson &amp; Gray (2011)</td>
<td>Agile PD requires autonomous cross functional teams consisting of a set of responsible experts to create novelty</td>
</tr>
</tbody>
</table>

Table 6.9: Descriptions of autonomy, responsibility and empowerment
6.6 Cross-functional teams

According to Karlsson & Åhlström (1996), the most salient feature of WO in lean is the extensive use of multifunctional teams. Likewise, Slack et al. (2010) states that the lean philosophy encourages and often requires team-based problem-solving. One respondent describes how cross-functional the PD teams in his organization actually are: ‘People from sales, construction, trials, production, purchase, aftermarket, suppliers, sit down and argue ‘this is going to work’’ (PD expert, 60).

Three out of five respondents have over 20 years of experience in PD, where one respondent could give us an historic perspective on how the perceived importance of teams has increased after the introduction of lean in PD:

> It’s more obvious to management how important the teams are. That they exist, and that they are a part of the project from the very beginning…If the team doesn’t understand what they are doing you can’t move forward. If production is not a part from scratch, it’s going to be bad (PD expert, 337).

The range in these teams means conflicts are inherent, however this is positive constructive conflict that enables teams to proceed with feasible ideas. One respondent told us;

> “...disagreements are positive, working together and solving problems that are positive - early conduct of problems - because then you can solve them earlier” (Consultant, 216). Takeuschi & Nonaka (1986) highlight that overlapping development phases creates tension and is a challenge, it is a more intense process with regards to communication, preparing contingency plans and dealing with uncertainty and surprises. However, this is then tackled earlier rather than later as one respondent could tell us. When they had departmental PD projects, conflicts emerged late and then everything came to a halt (Lean expert). Another benefit discovered with these cross-departmental teams is that it stimulates less bureaucracy, as one respondent said;

> “...you can bring down the number of employees because you work with a whole bunch of things, which you earlier did in every departments, like administration” (Consultant). Karlsson & Åhlström (1996) claim this notion to be an important principle related to multifunctional teams, and label it integrated functions. Such integrated functions increases the number of tasks performed by the team, subsequently allowing the number of indirect employees to be reduced and thereby making support functions less necessary compared to traditional organizations (Karlsson & Åhlström, 1996). Another important benefit with cross-functional teams is considered to be that increased flexibility reduces the vulnerability of the system because there
Lean product development systems

is less dependence on single individuals (Womack et al., 1990; Karlsson & Åhlström, 1996). Not surprisingly, cross-functional or multifunctional teams are well aligned with lean theory, hereunder Liker (2004) which state that multiskilling is encouraged and often required in a lean philosophy. Cross-functional teams are important for a dynamic PD process (Cooper & Edgett, 2005, Takeuchi & Nonaka, 1986; Larson & Gray, 2011; Thomke & Reinertsen, 2012) and for our respondents it is clear that cross-functional teams are an important factor for success.

<table>
<thead>
<tr>
<th>Cross-functional teams</th>
<th>Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical data</td>
<td>Consultant</td>
<td>Brings down the number of employees because you work with a whole bunch of stuff, which you earlier did in every department, like administration</td>
</tr>
<tr>
<td>Lean expert</td>
<td></td>
<td>A team consists of the product manager, the technical manager and the developers. The teams are working separate from each other, but there are lines going across</td>
</tr>
<tr>
<td>PD expert</td>
<td></td>
<td>All participants have an understanding of what they are supposed to deliver and take responsibility that stuff gets done</td>
</tr>
<tr>
<td>Prof.</td>
<td></td>
<td>A team consisting of 7-8 people that work on several kinds of problems simultaneously, it’s very dominated by design and PD in the beginning, but becomes more dominated by production as the PD process moves forward</td>
</tr>
<tr>
<td>Lean literature</td>
<td>Karlsson &amp; Åhlström (1996)</td>
<td>Most salient feature of lean is the use of multifunctional teams</td>
</tr>
<tr>
<td></td>
<td>Slack et al. (2010)</td>
<td>Lean encourages and often requires team-based problem solving</td>
</tr>
<tr>
<td></td>
<td>Liker (2004)</td>
<td>Multiskilling is encouraged and often required in a lean philosophy</td>
</tr>
<tr>
<td>PD literature</td>
<td>Takeuchi &amp; Nonaka (1986)</td>
<td>Agile PD process is born out of cross-fertilization. Team members interplay wide range of expertise is the foundation for new kind of thinking and learning</td>
</tr>
<tr>
<td></td>
<td>Cooper &amp; Edgett (2005)</td>
<td>Core team is cross-departmental and grasp the holistic picture of the PD process. Effective cross-functional team is number one key to driving cycle-time down.</td>
</tr>
</tbody>
</table>

Table 6.10: Descriptions of cross-functional teams

6.7 Team Consistency

Cooper & Edgett (2005) talks about the core team and that this team is consistent throughout the process, people will be in and out and perform minor operations for the core team, but a clear definition on whose on the core team should be acknowledged early. Takeuschi & Nonaka (1986) are also pro consistency although they say the team’s dynamics is most important and that teams should be monitored with members being added and removed with respect to the desired dynamic. On respondent explains how this can take place in practice:

…when the concept shows itself to be promising and shall be developed, based on the experimentation phase, they (the team) just hire people. They establish a kind of department and work just like the rest of the organization. It’s like some kind of incubator that give birth to new markets (departments). The commitment is not handed over to someone else, and there is no change in ownership… (Lean expert, 295)

Another respondent support the importance of consistency: ‘...the same team should be a part from the beginning...That they are allowed and must be part of the project from the beginning, and that you can’t change them so much’ (PD expert, 201).
Three respondents agrees that teams should be consistent as one respondent pointed out; “The more handovers you have throughout a PD process, the greater risk” (Prof., 362). Modig & Åhlström (2012) support this conception by describing several negative effects stemming from handovers, hereunder sub-optimization and defects. Handovers risk the ‘Chinese whispers’ effect where information being passed on becomes more distorted as the number of handovers increases (Modig & Åhlström, 2012). It may also create a mind-set of sub-optimization where people do their part and then leave it to the next, something that entails no real responsibility for the whole (Modig & Åhlström, 2012).

<table>
<thead>
<tr>
<th>Team consistency</th>
<th>Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical analysis</td>
<td>Lean expert</td>
<td>The team hire people when needed and establish a kind of department</td>
</tr>
<tr>
<td></td>
<td>PD expert</td>
<td>The team must be part of a project from the beginning, and you can’t change them too much.</td>
</tr>
<tr>
<td></td>
<td>Prof.</td>
<td>The more handovers you have throughout a PD process, the greater the risk</td>
</tr>
<tr>
<td>Lean literature</td>
<td>Modig &amp; Åhlström (2012)</td>
<td>Handovers create several negative effects, hereunder sub-optimization and the 'Chinese whispers effect'</td>
</tr>
<tr>
<td>PD literature</td>
<td>Takeuschi &amp; Nonaka (1986)</td>
<td>Keep the team consistent, but monitor the team dynamic and adjust the team after what type of team culture is necessary for the given phase</td>
</tr>
<tr>
<td></td>
<td>Cooper &amp; Edgett (2005)</td>
<td>Core team should be held consistent and announced early, Team members can come and go but the core teams stays the same</td>
</tr>
</tbody>
</table>

Table 6.11: Descriptions of team consistency

6.8 Team culture

Five out of five respondents mention culture in the interplay between PD processes and lean. In one company a strong culture for measurement gave the employees an opportunity to be self-assessed, Takeuschi & Nonaka (1986) term this subtle control. Subtle control is the key ingredient to what Takeuschi & Nonaka (1986) calls team transcendence and that is the strength of functional self-managed teams, they go beyond what is required and take responsibility to perform. One respondent told about how the constitution of teams made work more cheerful; “Working in teams is always more exciting, and if you work with projects and have a highly skilled project leader, then you can visualize... and you work really hard to achieve this” (Consultant, 152). With an inspiring project leader he claimed the team could perform miracles. Again this is underpinning Takeuschi & Nonaka’s (1986) principles of self-transcendence and subtle control. Self-governance mechanisms like peer pressure keep the team eager to perform and challenge the status quo.

For another company measurements was all a part of the corporate culture. The respondent elaborated on how the incentives system in that particular company reflected in the culture:
There are several incentive systems in Finn, everyone has a bonus system, but not related to values. It’s more about results. But the value terms are in a way sowed into the feedback you receive. But lean is relatively new, purely historical, so when you initiate a change from working on your own to working in teams, for example, changes the culture immediately. You get more influence, you are more visible, etc. (Lean expert, 467).

Another respondent could tell about how the search for continuous improvement and discovery of problems was implemented in the companies incentive system. ‘They (Scania) talk about deviations. It can seem strange to talk about problems you find, they even got a bonus related to how many problems they can find that they solve’ (Consultant, 517). As a result the organizational culture and behavior in the teams was directed towards finding and solving faults instead of hiding them, as could be the case in departmental PD (Consultant). In that way management control systems, such as incentives system and organizational structures, was part of shaping a culture and values which is all about lean, something the employees almost take for granted, as it has become a part of how they work. In relation to this, an all-inclusive finding was that companies rarely use textbook terminology to describe how they work. As one respondent pointed out, ‘We have such a great focus that we do not talk about lean anymore’ (PD expert, 136).

Another respondent also picked this up and said he rather would term lean knowledge based product development (Consultant). In similar fashion yet another respondent supported this, stating that companies which had implemented lean as a part of their identity did not have to use terminology in order for the employees to react.

When you have a culture that reacts after what you want it to do, then it is not as important what you call it and then it happens that method and theory is faded. Then you find what the answers to lean in values or processes or other behaviors, and not necessarily force the belief that it is important to work after lean principles or other form of labels… but can instead show to the effect of working lean in other ways than calling it lean… it is a sign of a mature company too, that it has become an integrated part of the organization… (HoI, 387)

The empirical data indicates that lean have already become a way of how we do things around here. Lean principles like customer focus and continuous improvement had become company values and team performance was measured with these in mind.
We notice significant changes in the culture. We notice that management is starting to ask quite different questions, and entirely different demands towards the projects and the way of thinking about the future… Instead of wanting to have a solution on the table tomorrow, the boss should ask what is the exact problem. Instead of just pushing forwards, we stop to think about where we are going (PD expert, 325).

According to one respondent, however, lean in production and lean in PD seem to differ in relation to mindset:

You can’t say that PD is this and the firm is like this. Lean PD is an integrated part of the whole business system, so you can’t be lean unless you got the whole system with you… The products are a result of how everyone do their job, not only designers and the PD-team. In manufacturing you can become lean if you do things efficiently, but you can’t be lean in PD that way, here you need a system perspective (Professor, NTNU, 615-621)

StageGate is such a system perspective and well acknowledged by Cooper & Edgett (2005) PD processes should not be designed exclusively for the R&D department. StageGate is an encompassing business system. The same accounts for lean. Several authors state that lean should be viewed as a holistic system, not as a collection of methods (Liker, 2004; Karlsson & Åhlström, 1996; Hofer et al., 2012). Liker (2004) argues that lean should be understood as an entire system that must permeate an organization’s culture, and that it’s the end result of applying TPS to all areas of a business. Moreover, lean production is not a system exclusively reserved for manufacturing activities in a business, but relates to activities ranging from product development, procurement and manufacturing over to distribution (Karlsson & Åhlström, 1996). This is also unanimously supported by the empirical findings in this thesis. Although team empowerment has been established as a de-facto element for successful PD, management plays an important role as well. In StageGate gate reviews are conducted by the management, thus teams and management needs to talk the same language (Cooper, 2008; Cooper & Edgett, 2005). One informant explains:

The most important thing is to establish interest among management, making them actually understand and getting them to implement lean. I can sit here with the best solution in the world but it doesn’t matter if management is half-way in and don’t really want this. It also leads to a mind-set among management, where they need to loose the old way of doing things and actually pursue this new approach (PD expert, 317).
Empirical analysis  
Lean expert  
Consultant  
Hol  
PD expert  

Lean literature  
Mehri (2006)  

PD literature  

<table>
<thead>
<tr>
<th>Team culture</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure and values</td>
<td>Builds culture. Goals and follow-up on results.</td>
</tr>
<tr>
<td>Consultant</td>
<td>Excitement, commitment, spirit and pride</td>
</tr>
<tr>
<td>Values, processes or other behaviors.</td>
<td></td>
</tr>
<tr>
<td>Lean is so embedded in the culture that the term is not used anymore</td>
<td></td>
</tr>
<tr>
<td>Lean focus on a culture in which everyone is striving continuously to improve</td>
<td></td>
</tr>
<tr>
<td>International enthusiasm for TPS results from western observers failure to understand fundamental factors of Japanese culture and business</td>
<td></td>
</tr>
</tbody>
</table>

**Table 6.12: Descriptions of team culture**

### 6.9 Knowledge generation, capture, and standardization

Knowledge has been highlighted in several occasions and contexts, it becomes clear that all respondents believe systems for generating, storing and re-using knowledge is one of the cornerstones in systemized PD. One respondent explain his view on lean in PD:

> It’s a process where you can use your knowledge and create more products. Maybe you want certain parts to be efficient, but it is not the same as production where you have bottlenecks and such. There are bottlenecks in product development as well, but it’s about preserving knowledge, utilizing knowledge and create constructions that you can use in an easier way (Consultant, 993).

Another respondent supports this view, ‘*Kennedy calls it knowledge-based development. That, however, is not a title that sells a lot of books. That’s why they use the word lean’* (Prof., 235).

However, knowledge generation is also about knowing what you don’t know. One respondent explained how his company pursues the unknown:

> Instead of looking for solutions we are looking for knowledge gaps or ‘un-knowledge’. What we do not know. Then we work on closing those knowledge gaps, and when we have closed those knowledge gaps, we always have a number of construction solutions (PD expert, 48).

As one respondent said, lean product development is characterized by dynamism and uncertainty and to cope with that it’s all about generating and re-using knowledge.

> … in a LPD process there is a dynamic situation where you do not necessarily know what problem you need to solve. … Then the project and the problem definition has to be so flexible that the project team can use their resources on solving emerging problems, and the problems related to that… It’s about all the time generating and re-using knowledge from previous projects (Prof., 87).
Three out of five respondents mentioned standardizing in relation to knowledge. As one respondent said, knowledge standardization is done by translating knowledge acquired in a project to a generic understanding and making it visual.

You know what happens if you do one thing, but maybe not if you do it a little bit different … and the whole point is to translate that knowledge into curve knowledge (models). The point is to enable one to go straight into a trade-off or limit curve and see if this works or not. In order to arrive there, we need to have certain individuals, which we call knowledge owners. These make sure that the generated punkt knowledge is transferred to curve knowledge... We do this very freely, so that every knowledge owner can build knowledge as he likes, but we have different templates that help structure and visualize knowledge. There are two things one should do. You should make it usable, from curve knowledge to punkt knowledge. And you should make it visual (PD expert, 392).

Knowledge generation is a process that happens in every part of the company, thus it is required to have a holistic process for knowledge. As one respondent highlighted, knowledge has its own value chain and becomes an asset for the firm.

If you imagine a company that’s working on several projects, some in parallel and some at different times… Across these projects there is also a value-chain, which entails generation of knowledge. What knowledge is generated within each project, which you can update and put to further use as a company asset (Prof., 202).

According to Spear & Bowen (1999), the cornerstone of a learning organization lies in a system that stimulates workers and managers to engage in experimentation. They do, however, mention nothing about how knowledge is spread and captured in the organization. Womack et al. (1990) talk about how Ohno set time aside periodically for the team to suggest ways to collectively improve the process, which is a way of collectivizing knowledge, but do not mention anything specific about knowledge generation, capture, or standardization. Consequently, this finding may supplement lean theory by more specifically highlighting the importance of organizational learning.
Lean product development systems

<table>
<thead>
<tr>
<th>Knowledge generation, capture, standardization</th>
<th>Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Empirical analysis</strong></td>
<td>Consultant</td>
<td>Knowledge based PD: preserving and utilizing knowledge, and create constructions you can use in an easier way</td>
</tr>
<tr>
<td></td>
<td>Prof.</td>
<td>Lean PD = Knowledge-based development: Generating and re-using knowledge from previous projects</td>
</tr>
<tr>
<td></td>
<td>PD expert</td>
<td>Knowledge based development/technical narrowing decisions: look for 'unknowledge' instead of solutions</td>
</tr>
<tr>
<td><strong>Lean literature</strong></td>
<td>Spear &amp; Bowen (1999)</td>
<td>The cornerstone of a learning organization lies in a system that stimulates workers and managers to engage in experimentation</td>
</tr>
<tr>
<td></td>
<td>Womack et al. (1990)</td>
<td>Distributing knowledge among workers</td>
</tr>
<tr>
<td></td>
<td>Browning &amp; Sanders (2012)</td>
<td>Lean practices assume a stable learning curve (cost decrease with repetition of jobs)</td>
</tr>
<tr>
<td></td>
<td>Lawson (2001)</td>
<td>Organizational learning requires slack</td>
</tr>
<tr>
<td><strong>PD literature</strong></td>
<td>Takeuchi &amp; Nonaka (1986)</td>
<td>Knowledge is transferred to the organization by converting project activities to standard practices. The self-organized teams dynamic enable team members to synchronize and share knowledge to form a viable product</td>
</tr>
<tr>
<td></td>
<td>Cooper &amp; Edgett (2005)</td>
<td>Core team possess knowledge that has been generated through the process, shifts in core team results in lack of knowledge. Post launch reviews important for transferring knowledge to the organization</td>
</tr>
<tr>
<td></td>
<td>Larson &amp; Gray (2011)</td>
<td>Sprint reviews are held to learn from the recent experience and the knowledge the teams has acquired.</td>
</tr>
</tbody>
</table>

*Table 6.13: Descriptions of knowledge generation, capture and standardization*

**6.10 Visualization**

Womack et al. (1990) claims that Toyota enables teamwork through simple but comprehensive information displays that allows everyone to respond quickly to errors, and allows everyone to understand the overall situation. Modig & Åhlström (2012) talks about Jidoka in relation to this, and state that the intention with Jidoka is to create a transparent organization in order for everyone to see everything all the time. This is made possible through visualization and continually updating all relevant information concerning the business (Modig & Åhlström, 2012). Karlsson & Åhlström (1996), on their hand, term this vertical information system and argue that information is important in order for the teams to perform according to the goals of the company. One objective is therefore to provide timely information continuously, directly to the lower level employees (Karlsson & Åhlström, 1996). Liker (2004) likewise emphasizes visualization through his principle of using visual control so that no problems are hidden.

Matzka et al. (2012) refer to visualization in relation to Kanban systems, where one aim with Kanban is to visualize in-process inventories. Departing from lean theory and arriving at the empirical data, one respondent explains the importance of visualization in PD systems:

> Visual management is one of the most effective tools, in order to get people on track and work like this (points at the company’s PD process)... It’s very important to be able to show something real, not just an illustration on a computer screen. The same thing goes with planning. Visual planning is important. Do not write things on your computer, put it out there. (Consultant 579).
Visualization was something all informants emphasized. As the respondent above stressed, visualization is a tremendously powerful tool. We found that particular interesting, as little of the reviewed PD theory say anything about visualization, nevertheless one company had in fact visualization as a principle: ‘The first (principle) is to visualize targets. Visualization is just as important as having targets, so if you walk around in our office you will notice a lot of boards where we have put up different targets’ (Lean expert, 80).

Another informant regarded visualization an important part of lean. He talked about visualization as tool for planning, responsibility transfers and knowledge briefings (Prof.). A third respondent used visualization in planning (PD expert). All informants mentioned the importance of utilizing the knowledge generated. One respondent underlined this and told how his organization uses visualization to structure their PD process:

If you don’t know how to place something, where it should be, how it may hold, or whatever. You can talk with the knowledge owner in charge of that area, and he can show you something visual. And by looking at that, both the knowledge owner and the problem owner can agree on what they are talking about… That’s how visualization is done (PD expert, 410).

A lean consultant could tell about how visualization became a revelation for a client, hereunder empowering teams and helping them achieve a more dynamic flow (Consultant, 384). Regarding visualization the respondents especially mentioned two tools: A3 and Obeya or war rooms. One informant elaborated on A3:

When talking about A3 documentation, there is simply a sheet of A3 paper, where the complete problem is compressed into one page. Which, of course, is thought through, with illustration and so on to show connections and stuff that needs to be solved. That’s how this company has worked when implementing lean (Prof., 317).

Another pinpointed the strength of visualizing barriers through A3:

What barriers do you have now? It shall be visualized… In scrum it is called ‘retrospective’, but we have altered it a little bit. I.e. it’s an improvement meeting that shall take place during every release… A method that is often used here… is the A3… We use that a lot, and we teach it to all the certified departments… In practice, most people going through our ‘lineification’ program will have a relevant and ongoing A3 hanging on their board (Lean expert, 436)
On respondent could tell of a time were they had to half the warranty cost in 2 years. They used an Obeya room to visualize. Daily updates on warranty statistics and samples of broken pieces were sent in and by getting this visual overview they controlled everything in the process like generals at war (Consultant). A3 was used more as a document for storing knowledge while Obeya rooms as a tool for planning and visualizing. Obeya rooms could also include previous A3. One respondent likewise focused on the challenge with Obeya rooms for global organizations, though visualization became of even higher importance. The following summarizes the various descriptions of visualization.

<table>
<thead>
<tr>
<th>Visualization</th>
<th>Source(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical analysis</td>
<td>Consultant</td>
<td>Visual management and visual planning: Show something real, not just illustration on a computer screen. Obeya room with all info on the walls</td>
</tr>
<tr>
<td>Lean expert</td>
<td></td>
<td>Visualize targets everywhere, including boards and A3</td>
</tr>
<tr>
<td>PD Expert</td>
<td></td>
<td>Visualization and planning (divided into different levels): show something visual, often a graph, table or picture. Obeya room</td>
</tr>
<tr>
<td>Prof.</td>
<td></td>
<td>Visualize plans, responsibility, and problems (ex. Through knowledge briefs, war rooms and A3 documentation)</td>
</tr>
<tr>
<td>Lean literature</td>
<td>Womack et al. (1990)</td>
<td>Simple but comprehensive information displays which allows everyone to quickly respond to errors, and allows everyone to understand the overall situation</td>
</tr>
<tr>
<td></td>
<td>Modig &amp; Åhlström (2012)</td>
<td>Jidoka: create a transparent organization in order for everyone to see everything all the time</td>
</tr>
<tr>
<td></td>
<td>Karlsson &amp; Åhlström (1996)</td>
<td>Vertical integration systems which provide timely information continuously, directly to the lower level employees</td>
</tr>
<tr>
<td></td>
<td>Liker (2004)</td>
<td>Use visual control so that no problems are hidden</td>
</tr>
<tr>
<td></td>
<td>Matzka et al. (2012)</td>
<td>Visualize in-process inventory through the use of kanbans systems</td>
</tr>
<tr>
<td>PD literature</td>
<td>Nussbaum (2004)</td>
<td>Rapid prototyping is a mean to visualize physical aspects and reduce the likelihood of late design flaws. Visualization is used to sieve out the best viable concepts</td>
</tr>
</tbody>
</table>

Table 6.14: Descriptions of visualization

6.11 Concluding the empirical analysis

The empirical data of this study generally illustrated a high focus on integrating lean principles and work organization to systemized product development. One central finding, however, is the need for translation when applying lean principles, primary because of the distinct value orientation in innovation compared to production. The study shows that value and waste needs to be redefined in order for lean principles to make sense in systemized PD. Value generation in PD happens through variation and the uniqueness the results from the process rather than efficiency in the process itself. In production, on the other hand, units to be processed are already developed and therefore the value is considered to be set. This means that the process creates value by increasing efficiency in order to capture more of that potential value, and waste becomes highly relevant because organizations work to increase the bottom line. Despite this the respondents integrate the notion of waste from LP by translating the forms of waste making them relevant to their specific context. Deriving from the various descriptions of non-
value adding activities, two methods for waste elimination were applied to the PD process. The first concerns front-end loading, which counteracts waste by making sure that potential problems are identified and corrected in the early phases. Arguably, errors occurring in the latter stages of a PD system are considered more wasteful than the time spent on discovering them early on. The two informants operating in the service industry, however, regarded front-end loading as wasteful in itself. This is because the product’s intangibility grants the freedom of post-launch modifications. Actors in the service industry therefore have the opportunity to release the product as quickly as possible in order to validate and get feedback, thereby iteratively optimizing the service based on customer insight. The second finding related to waste elimination concerns gates and/or integration events, arguably because it prevents ambiguous forms of waste such as; bad decision making, lack of integration, re-work and loss of knowledge generated from problem-solving. Customer focus is another principle the respondent’s allocated attention towards, and was applied through the integration of customers in their PD system and by having a strong focus on defining value from the user and/or customer perspective. Processes and products should be optimized in relation to what creates customer value, not in relation to capacity utilization. Continuous improvement makes up another finding of the study, and was integrated by modeling the process, making targets and measuring the compliance with those targets in order to clarify areas of improvement. Continuous improvement may be regarded equal to incremental innovations in PD, but could also allow resources to be freed up and allocated towards more radical innovations. Closely related to continuous improvement is the lean principle of standardization, which the respondents applied to their respective PD systems mainly through knowledge standardization. This was done through capturing knowledge generated from solving problems and creating solutions, thereafter making it visual, available, exploitable and thereby collectivized.

The empirical data shows that the lean principle of flow is integrated in two distinct ways. Respondents operating in the service industry established flow by launching something as soon as possible in order to validate and get insight. The informants working with PD in the automaker industry, however, emphasized the importance of doing the right things and closing knowledge gaps in order to reach targets faster, instead of looking for quick solutions. Turning towards WO the study identified three factors relating to the lean principle of employee empowerment, hereunder autonomy, responsibility and empowerment. Another finding related to WO was that of cross-functional teams. This principle is found to be highly appropriate and is integrated into PD systems by having cross-functional expertise within teams working separately, but also by making sure that connections go across departments and specialties.
Moreover it was found that the core team on a project should remain the same throughout development. Furthermore, closely related to continuous improvement and standardization, knowledge generation, capture and standardization was found to be one of the most central findings of this study related to WO. Concluding the empirical analysis, the principle of visualization is recognized to be used extensively by the informants. Visualization can be integrated through a strong focus on showing physical objects and not just illustrations, as well as making knowledge visual and available in the organization. War rooms and A3 documentation was found to be excellent tools for allowing everyone to keep an overview of the critical aspects of a project.
7. Discussion

This chapter will provide a discussion on the various perspectives concerning the proposed research question:

RQ: How can internal lean production principles and work organization integrate with product development systems?

In the analysis two lean principles protrude as especially challenging to integrate within the traditional context of lean and product development. Companies had instead of forcing the original conceptions to work together translated these principles to interweave with the company’s culture and operational context. Thus lean had become a mindset, a culture and a way to do things, however the lean origin was not followed frantic. The next section will emphasize on the following two lean principles that may seem most problematic to integrate with PD: waste and continuous improvement.

7.1 Waste

An interesting finding in the empirical data is how the respondents perceive waste. The literature review found different conceptualizations of what waste is from the more radical; everything that don’t convey customer value is waste (Womack & Jones, 1996; Liker, 2004) to the more mellow; waste has to be seen in relation to processes (Browning & Sander, 2012). The latter is more aligned with the empiric results of this paper. However, prior experiences and the corporate lean culture could reflect the informant’s conceptualization on lean, waste and PD. Nevertheless an overall finding in this paper is that waste was anything that made the processes more prone to errors, slower and reduced the customer value. Yet the respondents had different labels on what was perceived as waste. Waste in PD is trickier to define than in production because of the uncertainty and unstable element innovation brings along, variation is also inherent in the process. Variation in LP is considered waste, but in PD it is what brings value (Prof.). As one respondent said if you don’t know what value is you don’t know what waste is (Lean expert). Hence time used to investigate a possible solution that turns out to be unviable, are waste of time and resources, but it can convey value in terms of knowledge. Thus waste in PD is two folded, you can look at waste as what you lost of resources in the research process, but this has to be compared to the insight gathered. Knowledge that can be used later and serve as a source for more rapid, accurate and cost efficient PD in the future (Consultant, Prof., Lean expert). As a result all of our respondents described processes that would be considered
wasteful in LP. Especially radical PD has many waste elements due to high uncertainty, excessive risk, unstable information and weaker assessment management. As one respondent said they allowed for ideas without direction to make sure they sustained the range of ideas and the innovative flow (HoI). Hence radical innovation can be categorized as wasteful in lean terminology and as a result waste translations from lean may not be purposeful. But is radical PD really wasteful?

To answer this there is a need to comprehend the full picture of value, that is, value delivered to customer in relation to value the company gets in return. This value doesn’t necessarily have to be monetary value, but could be competitive advantages such as knowledge, unique customer insight or establishing the foundation for future ventures. Lean and PD both have customer focus as an overarching principle. Both fields empathize on using customer surveys and feedback, but they are characterized by being biased towards incremental propositions and minor improvements of existing products (Cooper & Edgett, 2005). Such a customer focus can in PD be wasteful in the long term and make the company vulnerable if newcomers present radical innovations. One respondent focused on the balance between radical innovation and incremental innovation. As he said there is no problem making money today, however companies need to be sustainable units and therefore long term focus and willingness to innovate radically becomes a key factor (Prof.). Radical innovation seems to fly under the radar of customer surveys so the challenge is to focus on customers, removal of waste while still generating radical innovations. To cope with that Cooper (2008) suggest to involve the customers in the process, make them part of the development and get prototypes in front of them to try. However this is after ideation, initially you need an idea, you need to construct that idea and make it function. A strong customer focus demand a thorough scrutiny of what the customers really mean as one respondent said:

There is a lot of communication with the customer on all levels, their purchasers, their technicians, their test-department, and such in order to understand what they have written down. Historically we have looked closely at what they have written, but now we focus on trying to understand what they mean. It’s not about what they have written but what they actually want and need (PD expert, 123).

In highly technical industries like many of the respondents had experience working with, Coopers much empathized concern for involving customers simply becomes too tinny. The engineer’s role are down talked and not even mentioned in Coopers (2008) StageGate. Highly
advanced structures are mostly credited the company and the pool of expertise they themselves possess. Like the Bugatti Veyron, even though customers could be brought in for consultation regarding appearance, none would have a clue how to make a car with 1001 BHP that needed to be reliable, easy to drive, while still reach 400 km/h. VAG has only had expense with the car, but it stands as a pinnacle in motor engineering and it has brought tons of knowledge to the corporation. The chairman at VAG Ferdinand Piëch has done this several times, presenting ridiculous requirements and establishing a team with the task to achieve this. Takeuschi and Nonaka (1986) call this built in instability and it is an important part of radical innovation, however it is not cheap and from a lean perspective it can be regarded as waste. As one respondent said since the company were doing good, they could also prioritize more lunacy ideas and further explained that they perfected the incremental innovation processes to set aside resources assigned for radical innovation (HoI).

In a recent article Erik Reinert - mentioned as one of the world’s greatest economical thinkers in The Worldly Philosophers – share his thought about radical innovation:

> In 1890 London was about to drown in horse excrement’s. There were two possibilities. Move back to the countryside or invent the car. We chose the car and then it was three models – a steam car, an electric or the outsider, that crazy Benz with the combustion engine. We don’t know what the future brings, whether it is wind power, temperature differences in the ocean or what else, that is why we need to do what was done in 1890: throw resources after all (Reinert, 2013, p.34).

It makes sense since radical innovation is not profitable in the short-term perspective, it is not efficient, it is not certain and it doesn’t operate in a stable environment. Lean is about reducing risk while PD is about taking risk. Like investments taking the higher risk offers higher yields, but on the other side chances of losing also increase. The same goes for PD and since the chance of loss is high, waste can seem to be an inherent element in radical PD. So the answer is: yes isolated and with a short-term perspective radical PD is waste, but with a long-term comprehensive perspective radical PD is too valuable to be termed waste. Waste related to PD will then be what you invest in resources compared to what you get in return. Hence waste become highly subjective and leave room for the company to determine what they regard as waste, for some companies using one week and $10 mill on impact assessments resulting in knowledge used in later projects is valuable, for others using 3 months and $10 on research that is corrupted is waste.
Front-end loading is one of the main principles in StageGate. Cooper & Edgett (2005) consider painstaking analysis necessary for successful development. This view was shared by three of the respondents. Similar for these was experience within heavy industries primarily the automotive. On the other side sat the software people, determined on using lean start up inspired by Eric Ries and his rapidly expanding religion. For the first group front-end loading was necessary and seen as a waste removal tool. It helped to early engage departments in the development and work on challenges related to new products. Loading up resources early and working cross-functional is considered to mitigate serious faults later. The rationale is that the work group will be more exposed and responsible for the result, thus they have fewer incentives to sub-optimize and since every department is involved, the process is not relay races but comprehensive stages. Hence time and resources used early on would pay off in the end. For the latter group front-end loading could be seen as waste. To allocate resources front-end was wasteful because ideas, concepts, analysis and business plans, as they said, is only predications and no security for success (Lean expert; HoI). For them the environment they operated in can be described as hyper interactive, with a market that gives rapid feedback and iterations and changes could be performed continuously and within a 24-hour window. Thus loading up with resources before they even know how this new feature would be welcomed in the market was perceived wasteful.

### 7.2 Continuous improvement

Continuous improvement is a lean principle that all respondents mention as a important element in PD. However, as with waste a direct translation may serve incompatible with both StageGate and Agile. One respondent highlighted the need to develop radical innovations, however a too strong focus on continuous improvement could mislead employees to believe continuous improvement only entails minor changes (HoI). In LP were the value potential is given, continuous improvement is incremental. In PD continuous improvement has to be radical as well. Hence the challenge is to maintain a balance. As one respondent said there are two opposing forces that pull in opposite directions, radical innovation is project driven, while incremental is process oriented. Traditionally lean tools and lean implementation in PD has been closer to processes (Prof.). Processes are suited for streamlining and become lean, but overdone processes leave little room for creativity and novelty. Takeuschi & Nonaka (1986) call this over institutionalizing and it becomes a danger when successful companies get stuck with former success recipes. Thus StageGate and Agile methodologies can be taken too far, and
in a way become too professionalized. If every aspect of a model gets tuned and refined until perfection, then the waste necessary for creating novel innovation may be diminished.

Another interesting aspect in continuous improvement concerns how company’s measure performance. In StageGate Cooper and Edgett (2005) highlight the need to put metrics in place. Metrics can then work and underpin as a management control system, motivation and incentive system and as a foundation for continuous improvement (Cooper & Edgett, 2005). Measuring performance make it possible to visualize, benchmark and compare PD projects. This is important for post analysis and serves as valuable lessons for continuous improvement (Cooper & Edgett, 2005). Moreover the respondents emphasized the need for performance metrics. However, how to measure successful innovation is a topic that still has no valid answer (Prof.). Although all the respondents mentioned compliance to plans and compliance to schedule, the respondents had different measurements. This can indicate that also metrics need to be adjusted the specific business in order to grasp what is value to the company. The challenge becomes to establish objectives and metrics that focus on incremental short-term continuous improvement and long-term radical continuous improvement. In other terms what PD has added to lean continuous improvement is a long-term radical element for sustainability.
8. CONCLUSION

RQ: How can internal lean production principles and work organization integrate with product development systems?

This study found that several lean principles are too closely connected with the context of manufacturing to be directly applied in PD. Translations are therefore required, mainly because the fundamental value orientation in PD is distinct from that of production. First and foremost, value and waste needs to be redefined in order for lean principles to make sense in systematized PD. Value creation in PD happens through variation and the uniqueness that results from the process rather than efficiency in the process itself. In production, the unit to be processed is already developed and therefore the value is set (Prof.), which means that the process creates value by increasing efficiency in order to capture more of that potential value. Waste elimination is therefore highly relevant in production because there is a clear bottom-line focus, but does not seem to have the same significance in PD systems because of the top-line focus. The respondents in this study do, however, integrate the notion of waste from LP by translating the forms of waste making them relevant to their specific context. For example, this can be done through a translation matrix (Lean expert) that defines different forms of waste related to certain tasks carried out in a department. Deriving from the various descriptions of non-value adding activities in the empirical data, two methods for waste elimination was applied to the PD process. The first concerns front-end loading, which prevents waste by making sure that potential problems are identified and corrected in the early stages. Arguably, errors occurring in the latter parts of a PD system are considered to be more wasteful than the time used to discover them early on. This is because problems tend to become more harmful as the project progress and the investments become bigger. The two informants operating in the service industry, however, perceived front-end loading to be wasteful in itself. The logic behind this lie in the possibility to modify the product after it has been launched, because of its intangibility as an IT service. This gives the actor an opportunity to release the product as quick as possible in order to validate and get feedback from customers, thereby optimizing the service based on that insight.

The second method of waste elimination in systemized PD concern gates and/or integration events, arguably because it prevents ambiguous forms of waste such as; bad decision making, lack of integration, solving problems more that once, and loss of knowledge generated in the process.
The lean principle of customer focus is well aligned with empirical data derived from this study as well as theory on systemized PD. The respondents applied this principle by integrating customers in their PD system and by having a strong focus on defining value from the user and/or customer perspective. Truly understanding customer interest by involving the client throughout the PD process was found to be a sound way of aligning the efforts of the business with the needs of the customer.

The principle of continuous improvement can be integrated by modeling the process, establishing targets and measuring compliance in order to improve the system. Even though continuous improvement may be perceived equal to incremental innovations, it may also allow resources to be freed up and allocated towards radical innovations (HoI). In lean theory the principle of standardization is closely related to continuous improvement and the same accounts for PD systems. This principle can be applied mainly through the standardization of knowledge. Standardizing knowledge is done through capturing knowledge generated from solving problems and creating solutions, thereafter making it visual, available, exploitable and thereby collectivized. This enables an organization to improve latter development projects, hereunder shorten throughput time and reduce risk. A second way of applying standardization to PD systems is through the use of modules and development platforms, where solutions are generated through the use of existing components integrated in such combinations that they cover the unique need of a customer. Thirdly, PD systems in itself is a way of standardizing PD. However, standardization taken too far may lead to over institutionalization.

The study shows that the lean principle of flow is integrated in two distinct ways. Respondents operating in the service industry established flow by launching something as soon as possible in order to validate and get insight. In this context, front-end loading is defined as waste and should be eliminated because it only serves to reduce flow efficiency. The informants working with development in the automaker industry, however, emphasized the importance closing knowledge gaps in order to reach targets faster, instead of looking for quick verification. In this context front-end loading is perceived as value adding and a means to increase the overall flow efficiency because time is spared due to absent errors in latter stages.

Turning towards WO the study identified three factors relating to the lean principle of employee empowerment, hereunder autonomy, responsibility and empowerment. One technique of integrating this in PD systems concerns that of departmental responsibility,
hereunder allowing departments to define their own PD process. Corporate principles and values can further be used as means to ensure that each department develops a process that is aligned with the overall strategy of the business (Lean expert). Furthermore, all participants should have an understanding of what they are supposed to deliver and take responsibility that tasks are carried out (PD expert). This is highly connected with a lean corporate culture, something that was found to be deeply embedded in all organizations investigated in this study. Even though empowerment is considered central, some degree of hierarchy can be maintained in PD systems to ensure direction. Finally, it is found that there should not be the same extent of control in the PD department compared to other areas such as production (Consultant), which seems to make WO principles even more applicable in PD.

Another finding was that of cross-functional teams. Members of a team should not be switched too much during the course of a project, because this creates handovers that in turn represent greater risk. One way of ensuring the required expertise throughout development is for the team to hire relevant people when needed, while the core team should remain the same.

Last but not least, the lean principle of visualization is discovered to be highly applicable to PD systems. Visualization can be integrated through the use of visual management and planning, hereunder War rooms and A3 documentation. This enables the team to have an overview of the current status of the project. Visualization can further be applied by making knowledge visual through for example graphs, pictures or tables. This allows for knowledge to be available and re-used by other teams and employees, enabling quicker problem solving and thereby shorter throughput time.
9. IMPLICATIONS

This paper uncovers a gap in the success formulas related to PD seen in the light of what is being developed. There is no doubt there is vast differences in making a car and making an online service, and for this the principle of front-end loading can possibly be obsolete for modern service production. This is an interesting field of future research as it may indicate that modern service delivery with the possibility for rapid iterations and instant feedback can make seemingly wasteful PD processes ideal for lean, rapid and profitable innovation.

Several authors state that lean should be viewed as an all-encompassing system, not as a collection of methods (Liker, 2004; Karlsson & Åhlström, 1996; Hofer et al., 2012). This study, however, indicate that only a selection of LP principles can be integrated in systemized PD, and that parts of the logic behind lean needs to adapt in order to be applicable. This raises the question whether combining the two methods compromises one or the other, even both. Does the common denominators of systemized PD represent the stronger or weaker elements of each respective management system? And if combined, do the common denominators represent the same befits as they do within their respective context? Moreover, it might be possible that management methods related to systemized PD become obscured as a result of such integration, leading to a weaker system all-in-all.

A third implication of this study concerns that of sensemaking in organizations. This study found that all respondents had made their own version of lean as well as a StageGate or Agile approach to PD. Such customization raises a concern whether these companies are using any of the management concepts at all, since they have been altered in order to fit a specific context, thereby moving away from their source in theory. So, when are companies actually using lean, and when are they really using StageGate or Agile methodology? These implications require further research in order to truly understand if lean principles carry the same strength in PD systems, or if the need for translation and adaption makes them impaired or maybe even obsolete.
10. Literature


Lean product development systems


Lean product development systems


11. Appendix

11.1 Interview guide

RQ: How can internal lean production principles and work organization integrate with product development systems?

1. The product development process
   • Could you tell us about the product development process in your organization?
   • Could you describe the process step-by-step?

2. Customer focus
   • Could you describe your focus on customers throughout your development process?
   • Could you describe how customers influence your product development system?

3. Front-end
   • Could you tell us about pre-development efforts?

4. Project portfolio
   • Could you elaborate on your project portfolio?
   • Could you tell us about the way you manage the portfolio?
   • Could you tell us about development times?

5. Costs
   • Could you tell us about development costs?

6. Teams
   • Could you elaborate on the use of teams in your product development system?
   • Could you tell us about human resource management in your product development?

7. Targets
   • Could you explain how projects are measured?
   • Could you explain how you measure the product development process?

8. Improvement
   • Could you tell us about improvement?
   • Could you tell us about your corporate culture?
11.2 Transcript: Lean expert (BHV) - 09.04.13

Smalltalk prior to the interview…

BHV: We have worked with this a long time, and the first problem we encountered was how the define waste in product development processes; in comparison with traditional lean processes. It’s a bit of a challenge to translate these terms into this process. But you can talk a lot about that.

MG: Yes, and we would very much like to get back to that later. Can you tell us about the PD process you use? Can you tell us about the Stage-Gate process you have?

BHV: Well, yes You’re asking if we have a Stage-Gate model?

MG: Yes, if you have some kind of steps in your PD process for developing new services?

BHV: That’s something that we have, but finn has been organized in a decentralized way until recently. More specifically until this new year (2013). That entails that finn has been divided into separate companies, which means that finn property was a separate AS med their own board. All the markets (categories) has been working as independent companies. Therefore, we do not have a standardized PD process, formally, anyway, in finn. There exists several ways to do this, but parts of the process is relatively similar for everyone. Especially the things that concern the development itself, and the release (launch). The things that goes on before that, however, has not been standardized. Instead we have defined some principles that tells us how PD should be conducted within finn. Principles that everyone shall follow. Principles are at a higher level, and have therefore created a quite flexible way to work with PD They must, however, support the same principles. The principles are standardized, and we have worked… personally I have worked with PD processes during the past seven years here at finn. Over the past two years we have worked with the implementation of these principles across finn.

MG: Can you tell us more about these principles? I want to inform you that the material will be kept confidential.
Lean product development systems

BHV: That’s good, then I can talk freely. Let’s start from the beginning. The first thing we did, we first major step we did… the biggest challenge we had within the traditional finn organization, was that we worked along a ‘waterfall methodology’, we worked along the lines of typical projects. A project methodology which was pretty circumstantial. The result of this was rare releases, maybe four times a year. We are then talking about major releases of finn products, within finn’s web solution. There was a lot of administration and the quality was poor. That pace was so slow that it was almost impossible to conduct innovation. This was because the time it took from people said that ‘this is something we should make’, until it was actually made, was so substantial that we lost momentum and got there to late. Additionally, the quality was wrong.

MSP: Can you tell us about how you define quality?

BHV: We believe quality is based on two things; user quality, which means that the product is working the way it’s supposed to for the people who are meant to use it, functionally. The second is technical quality; how it is constructed, solid. Everything from bugs in the solution to user-friendliness. This is something we keep copies on. That was basically the problem, and then we implemented the scrum and agile methodology, which revolutionized the way we managed product development. As I see it, the most important things in that transformation was that we defined scrum as a standard development methodology in finn. We then managed to speed up the release pace substantially. We went from four releases to sixteen releases, and now we more or less have releases continuously. More like, when you want a release. So the element of pace. Pace is a highly important term in lean. That was probably the most important change, the influence on the innovation pace. Because then we had 22 or 23 weeks of ‘sprints’, where we could prioritize just a couple of weeks beforehand, we had a very strong learning and implementation curve. We learned a lot faster and got things done a lot faster, which also increased the commitment within finn. The problem with scrum, however, which is a very instructional methodology based on prioritizing the things that generate the most value, and focuses on making the simplest solution you possible based on a certain user need, and getting it to the market fast. As well as working in teams, across departments. The problem with that, scrum tells you little about how you should prioritize, and little about what happens prior to the phases when we know how things can be made. After a while, this was rolled out and people got to understand the instructions, but not necessarily the principles behind it. Therefore we have to think from start to finish in the process. From the start, i.e. an input or an idea until continuous improvement.
MG: That’s how you define the process?

BHV: From a need is discovered until the product is launched and thereafter continuous improvement. You should probably include sales and commercialization as well, we do this in a way, but these principles are relatively generic. Maybe I can show you the principles, I have them right here… We have several versions of them, but we can have a look at the current version. There is basically eight principles, we call it ‘rettesnorer’ on innovation within finn. They are divided into two blocks, the first one is ‘doing the right things’. I.e how you prioritize. Which basically is the most important one, in order to create improvement and impact. The other one is ‘doing things right’. These eight principles are pretty… we have called them ‘rettesnorer’ for innovation or innovation management, or PD management, within finn. The first is to visualize targets. Visualization is just as important as having targets, so if you walk around in our office you will notice a lot of boards where we have put of different targets.

MSP: Are these different rooms a part of the visualization?

BHV: These rooms are just meeting rooms, but if you walk around in our offices where people work you will notice a lot of boards. One, visualize targets and follow up on results. Two, prioritize customer- and user value. This is the short version of the principles, we also have a more detailed formulation. Three, use facts and insights. Four, create room for new thinking. That’s the first part (doing the right things). The other part consists of; learn through experimentation. Secure quality, and by that we mean use quality and technical quality. Then, deliver customer- and user value frequently. Finally, continuously improve solutions and processes. What we have done, this is principles on quite a high level, as you can see, so what we have done is to specify these principles pretty concretely in check lists. Like a EU control, in a way. Something that we, which work in the innovation department, go out and control in order to make sure that people are working according to these principles. This is something we have done in all departments. When we secure quality, we go ahead and define three external, or three copies of external quality, and then this is followed up and then measures are implemented and visualized, and so on. This is how it works with all these principles. What we have done, then, during the course of two years, is to assist all the departments and product managers within finn with the use of these principles and helped them define their own process. Make standards, and systems for monitoring target, results and impact and such. It’s the foundation for innovation, because if you have a underlying structure, it becomes relatively…
our role or responsibility is to make sure that PD and innovation does not happen coincidental
in finn. We should work with it systematically, and then we need this as a kind of basis.

We also have a process, which is very generic as well. It tells us that innovation is not just
about creating good ideas, but also about creating a direction, identify targets, generating ideas,
and realizing this continuously and frequently, in order to learn. Preferably through
experimentation and validation. And when the concept becomes solid, it’s time to escalate,
where we have a more detailed process. You can see that your principles are to some extent
integrated into this process.

Our department consists of four people, which is organized under organizational development.
We are basically working with change management, but with lean and innovation as
disciplines. So that’s a brief introduction on how we have worked with lean, innovation and PD
in finn.no.

MG: You talked about having 4 releases a year, previously, but then you implemented lean and
increased that to 16. In relation to that you mentioned teams, can you tell us more about that?

BHV: Prior to the change initiative we worked more traditionally with ‘waterfall’, where there
was a typical project leader who was the ‘strong guy’ on the floor. He walked around and
talked with those who possessed resources in finn. The bank was, in a way, open once a year.
So we created the budgets, typically in October, which applied for the following year. There
was a planning horizon of 3 to 15 months, and the project leaders walked about asking what the
different markets (departments) where going to develop during the next year. That was the
project leader’s job. The objective then, was to come up with as much as possible in order to
get as much money as possible. Therefore, a lot of the things that was planned did not happen.
It was more like a process of pretending. The project leader was in charge of this, and they had
long lists and diagrams of things that needed to be done. They specified all the tasks, and
distributed these to the developers. You do this, you do the database tasks, you can do the front-
end part, and finally everything was sowed together. This ended up being highly complicated,
the complexity was very high, and demanded a lot of administration while the value creation
was low, the process slow, and finally the quality was poor. We used half of our development
time to correct mistakes, basically. When we initiated change, we said that there was no project
leader anymore. Scrum is based on teams, typically consisting of 5 or 6 people, which together
possess all the competencies you need to develop a product. This team is self-organized, at
least in principle, and take charge of pretty high-level tasks through making something
concrete, and release new products frequent. We did sprints, where you initiate the commitment
(project) and work for three weeks, then deliver something functional. Instead of managing
high complexity we simply reduced the complexity. We only do small bits at a time. Take a
small part, get it out fast, learn, and get value realized frequently. It’s further team based, where
all the competencies you needed was located within the same team and worked across
departments. In fact, it would seem quite unstructured, but very agile. That’s the scrum model.
In that manner, you should launch immediately after each sprint, the day after, and that forced
finn to change it’s entire release regime. It demanded massive restructuring in the technology to
enable such a high pace. But when we managed that, we noticed that the speed was increased
by four times, and that the quality was corresponding to that. So the number of mistakes per
developer dropped by 75 percent, when you increased the pace four times. This basically
resulted from the decrease in complexity, so it was easier to control. You made one thing and
finished it completely, and knew that it in fact worked, then you moved on to the next part. In
that way we reduced batch sizes and got better control of the quality, which meant that we did
not have to correct as much errors, thereby enable more work on the actual value creating
activities. It was a simple initiative, increase the pace, and thereby reducing the number of
problems.

MG: When you talk about one part, is that a part or a function of the product, and then it is
passed on to someone else?

BHV: No, it goes straight out to the users and customers of finn. We do not look at the whole
anymore, we look at the small pieces. We do not start to design a new major product, we base
our development on a certain user need or an unsolved problem. It may be the case that
someone makes some sketches, but we divide it into specific needs. As a user of finn ‘car’ for
example, I have the need to categorize cars in terms of color, so that it’s easier to find the car
I’m looking for. Then, it’s about finding a simple solution to that problem, make that solution
and launch it as soon as possible. Then learn from it.

MSP: So the whole team is together from idea to launch?

BHV: Well, the team is at least involved in what we call ‘backlog’, which comes from scrum.
User stories. But what we have done now, after we started with that methodology, is that what
happens prior to the concept phase, from idea to concept, have to be tightened. That’s why we
have implemented these principles, what is the target? What is it exactly we want to achieve?
Lean product development systems

What effect are we looking for? Who is the user? What is the user- and customer value? Use facts and insights, maybe through customer and user interviews, tests, and then start formulating simple user stories which is going to be realized. A methodology that have been used quite a lot lately, at least in finn, is called ‘lean start-up’. Which is… there is a guy called Eric Rice who wrote a book about this. We have used that quite literally in finn. That is also a quite radical change in the way of doing product development. The first part of the process is based on a typical lean start-up thinking, which support our principles. After a while, when we have learned and understood what works, we start making good solutions with high quality and thereafter escalate. This is the process which I drew here.

MSP: Do you have a scrum master?

BHV: Initially we had a scrum master, but that role was phased out. Scrum also says that there should be self-organized teams, but that did not work so well long-term. Therefore we have now organized this in a different way, where we have a technical manager within each team, which also have responsibility for the members. Further, scrum has been processed and changed a bit here in finn. We have used it for a long period of time, and we have chose to move towards a Kanban approach, where there is a flow of tasks instead of sprints with a start and stop. That demands that we release when that is needed, so the people who knows this works more along the lines of a Kanban approach, but at the same time follow our principles. There are several hybrids, but we do not talk about scrum anymore, where things need to be like this and that, but that everyone shall follow our principles. Therefore there exists several editions, but we demand that things are released frequent, we demand that targets are visualized, follow up on impact, work with continuous improvement, and all of these principles. There are a lot of ways to do that.

MG: Can you tell us about the autonomy of these teams?

BHV: There is a product manager who decides how to prioritize, and does the things prior to development. The product manager is the one who distributes the resources, you could say, and decides what should be developed. The technical manager decides how. On the top of that, there is a product director which manages several product teams. A product team consist of the product manager, the technical manager, and the developers. You got a product director for finn ‘car’, for example. We have divided our solution into market teams, but also people that work across teams. People working on the platform. Search, user experience, those things that
goes across finn. So, the product director decides what to be made through the product manager and the technical manager. You could say that they are working separate from each other, the teams, but there are lines going across. We do not work with projects, we do not use projects a lot. The main task is to generate a flow.

MG: Can you describe how you include customers in the PD process?

BHV: Yes, it’s not easy to answer shortly on that one. It entirely depends on what you want to develop, and a lot of the people in finn works with developing stuff ‘under the radar’. Improve things that are apparent. If we want to develop something entirely new, we usually use something similar to the ‘lean start-up’ approach. That entails to first and foremost initiate conversations with the users of the service we want to develop, and thereby investigate the problem or needs that we want to solve in fact exists. Make small tests. The first phase is purely about user- and customer interaction, or integration. I.e. how to integrate the customer in the process early. There is not too much focus on technology at that point. We also have a continuous surveillance of what our users think about the service. This is something you can observe on various screens located in different parts of the office. As a user of finn you can give feedback, both through thumbs up and thumbs down on every page, as well as written feedback. Live. The question is, how satisfied are the customers? We are aiming at a 80/20 ratio of smiley faces versus angry faces. That is often a copy they use when launching something, how satisfied the customers should be with it. It’s very simple, but still gives good feedback. There is so much activity on finn that it provides us with pretty meaningful insight. Then you have ‘brukerlab’ (userlab), which is a department in it’s own right. We bring people in, observe what they do, and try to solve problems based on that.

We divide between user and customer. Because the users are the ‘normal’ people, while the customers pay for brand exposure and advertising. So, it depends on what we are making. There is a huge focus on customer- and user needs. The principles demand that… we certificate our departments. We have started to certificate our departments based on their compliance with our principles. In order to become certified you have to provide a definition of customer- and user value, who the customer and user is, and so on. All of this needs to be defined beforehand. Then we evaluate what they deliver based on the customer- and user value that is defined. They receive something like a value-score. Everything they launch and exhibit should be rated along the terms of customer- and user value. Then it is controlled through outcome (impact), making sure that it delivers the impact which was forecasted. If you know the finn product, there is a lot of things you can measure in order to see if this actually work, and if it improves or not. To
start by defining the customer and user, the customer- and user value, talk with them, make
small prototypes of stuff, perform tests, userlab, and measure the effect. That’s our typical way
of making sure that stuff actually work for those who are going to use the service. And
continuous feedback. On the screens in finn you will also notice everything that is written about
finn on twitter, that is viewed as a flow on the monitors. That makes it easy to capture what is
said about finn. Particularly, we have a service center which have gone from being some kind
of ‘wall’, a sound proof room where no one is to be disturbed, to some kind of ‘megaphone’.
They work systematically with communicating the stuff that doesn’t work to the people who
can do something about it. In every release, every third Thursday, the product managers shall
stand in front of the whiteboard in the service center up in the sixth floor, and get information
about what people are talking about when calling finn regarding a new version. Then he can
run back and fix stuff.
There is a official release every third week, and then there is a lot of small stuff along the way
as well. But, in order to have releases continuously, we have to conduct a common release
every third week. Every third Monday, from 9 AM to 1.30 PM, we have something labeled a
‘review’, where every product team in finn have 30 minutes to their disposal. Back to back,
which tells, the meetings are open, in these very offices, they tell about the stuff that are
developed until the next release. That follows a certain structure. They should not only tell
about what they have developed, but also why and what effect they want to achieve. Then this
is followed-up on the next review. There is a lot of activities in the hallways, everyone working
in finn comes to have a look, at least those interested, at the different markets and teams, in
order to update themselves on the next stuff. An entirely open forum, questions, critique,
clarifications. It’s important for sales, those who communicate our products to the customers.
The service center who answers questions from the users, and other teams which are dependent
on our services. Its very transparent.

MG: Can you tell us about what you do before any investments on a new commitment?

BHV: That entirely depends on what we are developing, if it’s a small improvement or a major
release. That varies a lot.

MG: If we take a major release as an example?

BHV: What we have done in finn is the establishment of a department called business
development. They work a lot with analysis, they work in a very early phase of the process.
They monitor trends in the market, and work pretty traditionally and broad. But what we have done lately is to create a department who focus on new marketplaces. Their job is to crate and organize new marketplaces for finn. Entirely new services that we do not offer today. Finn ‘oppdrag’ was an example of this. That department are now working on launching a lot more concepts in a higher pace. That’s the responsibility of that department. What do there is, they have a business developer, or two, one on design, and a product director/architect. They work a lot with trends, monitor the market, what is happening? What services are promising? Locate niches, identify needs, potential in the Norwegian market. They do a lot of business development rapidly. They also use the lean start-up thinking and business model kanvas thinking. They have a sheet of A4 paper where they define; what is customer value, what is the product, what are the segments, and so on. Earnings models and costs. Basically a A4 sheet that flows through the process. They run tests and escalate. Then they ask for more money when they have more knowledge. Finally, the launch a new service. That’s also an agile approach.

MG: Does the team pass the commitment over to the development team when they are through?

BHV: No, when they concepts shows itself to be promising and shall be developed, based on the experimentation phase, they just hire people. They establish a kind of department and work just like the rest of the organization. It’s like some kind of incubator that give birth to new markets. The commitment is not handed over to someone else, and there is now change in ownership. The product is owned and developed by the same department. They may, however, receive help external from supporting departments, for example business development, marketing, and so on. The principle is that the development is own by the markets (departments). These product teams. How they work depends on the size. If you’re working with smaller changes, the process is easier and more simple which goes a lot faster. It depends on the size.

MG: You talked a bit about getting new stuff out fast, 3 weeks, do you have any guidelines on how the development portfolio should be managed?

BHV: I think it’s 18 teams in finn at present time, which work in parallel. And those teams can launch what they want, in a figure of speech. Remember, we do not use the word project.

MG: Not projects, but concepts?
BHV: Let’s say you’re working in finn ‘job’. They have two teams, a couple of product managers, a product director, and they use some designer resources from shared teams and such. Shared support departments. It’s their job to make a roadmap, and work based on that. They make their own stuff. You got all the markets in finn, including finn ‘oppdrag’, new marketplaces, finn ‘travel’, penger.no. I think there is 18 teams that work with market tasks and shared tasks. In parallel.

MG: Can you tell us about how you rank commitments (do not want to call it projects)?

BHV: You have some large cross functional commitments in finn. Mobile, for example, where finn needs to be a lot better in order to function well as a mobile and tablet service. That’s our highest priority right now. And then things are managed through some principles which are generated by senior executives in finn. These principles could include that every commitment should be developed for mobile first. You have some of these, self-service and so on. You also have some global commitments. The prioritization is not done on a PD level, on the PD level the team has a certain amount of resources, where the team and their director needs to prioritize how to utilize the resources allocated to them. Everything is very self-managed, it’s up to every product director, the market, the sales people, and everything in relation to the market group (department) how to prioritize what they want to do. But, we have said that there should be some criteria when prioritizing. We shall make it clear what the customer value is, what effects it should have, but there is not a top-down prioritization of everything that is going on. That’s pretty rare, actually.

MSP: So you could say that every department is like a company in itself?

BHV: Yes, they actually used to be independent companies. At present the independencies have been dissolved to a certain extent, but not entirely. Finn property, finn car, the ‘square’, employment, are not independent companies anymore. In that way the old structure is dissolved. But previously, up to the new year, the departments where independent companies with their own budgets, CEO’s, and board of directors. Then, it was difficult to manage centrally. Now it’s easier, because we have gotten rid of some bureaucracy, so we can prioritize resources a lot more efficiently if we have the need to do that. Still, there is a pretty strong sovereignty in the different teams. But there is a strong transparency, everything is very visible.
MG: With regards to costs, can you tell us about the changes in the use of resources after you began the lean initiative?

BHV: Hmmn…

MG: For example, the number of people involved in PD process, what tools you use, and so on…

BHV: That’s almost impossible to answer, because finn has grown so fast. When I’m talking about the change in finn, which has happen over the past seven years, from the first time we started working with scrum on a small scale, to the way we do things today, finn has grown by a factor of three with regards to employees. When I first started we where below 100 people, now we are 370. Therefore it’s very hard to give a precise estimation on the use of resources and costs. What we rather look at is the speed. How fast do we get things out when there is a need, and the quality. So that’s our main focus, how fast we make things happen.

MSP: Can you tell us about bottlenecks in the process? Previously and now?

BHV: It’s easier to look at the amounts of time we used on development, administration, and get stuff out. Previously, ideally, 50 percent of the time was dedicated to working with development. The rest of the time was used on integrate stuff, identify errors, correct errors, and getting it to the market. But now that we have a lot more streamlined flow, the developers are working on development continuously, as a matter of fact. They work in 3 week sprints with kanban, with a free flow. There is also a separate department that integrate the release, and they use 3 days to do that. This happens in parallel. If you start to calculate on these changes, you will find a radical improvement in efficiency, if you look at the time we use on actual changes, versus the time we used on just integrating stuff together. In addition, when you include the aspect of quality, i.e. the number of errors, which has been reduced enormously. Mistakes reduce the user experience (satisfaction), and have to be identified and corrected. But errors, if there’s enough of them, they have to be administrated. You need a queue of errors, you need to prioritize, you need to gather resources to fix them. All of that is gone. We do not have that regime anymore. We have a pretty simple system in place to correct mistakes, but there is so few that they are handled continuously. If do some calculations on this I think you would find an enormous improvement in efficiency, when it comes to the time used on actually working on the product versus administration. However, we have not done any calculations on
this. You could say that we don’t count costs in finn, because we have the people we have. The question is what we used them for. We do not have traditional cost management in that respect, where you ask for resources. You have resources, the question is what you are going to use them for.

MG: Errors can be regarded as waste, and you mentioned that it’s difficult to translate the terms in lean production to lean product development. Can you tell us more about that?

BHV: When we start implementing these principles in a product team, a technical team, we start by defining the customer- and user value. What value shall this team create? If you don’t know what value is, you don’t know what waste is. Then we draw a process. How we work today, which often entails getting insights from a customer, familiarize with the case, sort and prioritize, then some meetings where we discuss solutions. You have a lot of steps like this. Then they decide which of these steps that actually create value for the customer or user. In the traditional lean there should be some kind of change. If you’re developing a physical thing, a car, or a bread for that matter, if there is not any change happing to the product or if you’re doing stuff that the customer does not regard as value, there is no value creation. But here, where we basically work with innovation, things are a bit more integrated. Because it’s not just creating solutions that is value generation, but also the process of working on that solution. We use the invention of the wheel as a metaphor. We imagine how that happened. Most likely they had some huge rocks that needed to be moved, where they used a lot of time, energy and health on moving extremely heavy stuff. Then they sought someone smart and said ‘we have a problem. We have some big stuff we need to move. You have to help us figure out smart solutions to handle our problem’. The first thing you need to do is getting an understanding of the need. The value creation entails getting an understanding of ‘oh, a wheel, that has to be a good solution to this problem’. The time you use to figure out that solution is value-adding. To us. When you have understood the solution to the problem, you also have to understand how to engineer the wheel, because that’s not trivial either. To make a wheel the first time demands innovation. The third link is to actually make the wheel. It’s actually three steps: getting the idea that solves the problem, understanding how to make that solution, then make it.

Everything else, for example testing, is waste. Errors are waste. All time when nothing is happening is waste. The others are quite easy to translate, but what is actually value-adding, because it’s more than just making something, to sit together in a group and just have a discussion and come up with great ideas which are relevant, and understand have to make stuff in a good way. That’s also value-adding.
MSP: Doesn’t testing then become a part of the development process?

BHV: When I use the word testing I mean quality insurance. Testing is good, because then you are providing a solution to someone who uses it and makes sure it works. That’s learning and improvement of the product. Most likely do some changes based on that as well. But to make a code, and then sit down together with someone and test it and make sure there are no errors, that’s waste. Begin with the test and then make the code afterwards, for example. Waste is highly relevant for us, but we have to translate and we have made a matrix: traditional waste or production waste, what does that mean in our world? We have made a translation matrix where people can see what is regarded as waste in what they do. Then we calculate the efficiency and work to improve it. I have a slide about this, but I do not know if it’s that interesting.

MG: Maybe we could look at the slides at the end if the interview, just to make sure that we don’t use to much time. I think that you have elaborated on a lot of interesting areas until now, but with regards to improvement and continuous improvement. Can you tell us about how you work with improvement?

BHV: Continuous improvement within PD is regardless of the projects (commetiments) at finn. It varies among the different teams and departments. We have stated that work on continuous improvement shall include a model of the process, targets, follow-up on the results, and the barriers to reaching those targets. What barriers do you have now? It shall be visualized. We have stated that, every third week, they shall have a meeting, an improvement meeting, within this team. In scrum it is called ‘retrospective’, but we have altered it a little bit. I.e. it’s an improvement meeting that shall take place during every release. At least every third week. Then the team gets together and discuss what worked and what did not work during the sprint or period, and then they have to come up with at least one measure. A method that is often used here in finn is the A3. The A3 problem solving methodology. We use that a lot, and we teach it to all the certified departments. There is a lot of focus on understanding the problem and the root causes before any changes are implemented. In practice, most people going through our ‘lineification’ programme will have an A3 hanging on their board, which is relevant and ongoing. In order to become certified you have to maintain an continuous improvement, either through the A3 or other measures, in order to prevent barriers. That’s on a certain level, there is also improvement happening on other levels as well, but the most structured approach used is the ‘retrospective’ that runs in every product teams every third week.
MG: Can you tell us about the changes in culture and how that has affected the whole?

BHV: That’s a very difficult question to answer, especially in a short manner (laughing), and especially this has happened over a long time. But we believe that structure builds culture, in a way. You start by creating a structure, and then the culture changes based on that. In finn we have worked with culture continuously through values, we have 4 values: hunger, precision, headroom and mood. These are used not only as foil ware also pretty actively in measurement and follow-up. Finn have had such a measurement culture from the beginning, during the 13 years of livelihood, in that every employee in finn is scored and measured based on these values by their colleagues and their managers.

MSP: Can you tell us about incentive systems?

BHV: There are several incentive systems in finn, everyone has a bonus system, but not related to values. It’s more about results. But the value terms are in a way sowed into the feedback you receive. So goals and follow-up on results has been an important part of the culture in finn. But lean is relatively new, purely historical, so when you initiate a change from working on your own to working in teams, for example, changes the culture immediately. You get more influence, you are more visible, etc. I really don’t know where to start when answering that question.

MG: In the traditional way, you may have functional silos and departments working on their own stuff, this is mine and I’m going to do my best until I pass it on to the next, and what happens next I don’t really care to much about, while with lean you typically work across departments, you collaborate and focus on the whole etc. Can you tell us about these things in finn?

BHV: We have done major changes with regards to that. Previously, in the traditional finn, everyone doing development was working in a separate company called finn tech, which was fin had only 50 percent ownership in a certain period. They delivered solutions to finn, and finn basically consisted of managers, salespeople, and a few project leaders. They then ordered solutions from the technicians working in finn tech. That was a extremely slow process, because finn tech was delivering to a lot of others as well, internationally, they sold the platform. And that was the point when finn was performing the worst, working in that way. Everything stopped completely in the end. A lot of conflicts. At that time we only managed 4
releases, and we barely even managed that. Then we did some changes through dissolving finn
Tech, and everyone working with development was organized in finn. Employed in finn. Then
people who working together and we focused on development close to the market. From
being an IT department which delivered solutions to the markets (departments) and product
people, everyone was now working together. The product managers got their own teams, so we
focused on the customer- and user instead. Everyone located in finn ‘employment’, for
example, consisted of developers, product people, designers, which was physically located in
the same offices together with their managers. In that way you are moving the resources from a
traditional separation of specialties to a concentration around the markets (departments). That’s
how we work now. The product director is sitting with his salespeople, it’s organized a bit
differently now, but physically and practically they are located together. The culture is centered
around the customer- and user need, and not divided into different areas of expertise. Everyone
is working together. It was basically scrum that introduced this entire model, which we sowed
into the organization. This resulted in a entirely different culture.

MSP You told us a bit about customer- and user influence, but can you tell us about other
factors that influence idea generation?

BHV: A big thing we did a couple of years ago was to make a internal web, which is called
‘finnopp’. It resembles facebook in a way, where all the employees in finn can post ideas. It’s
entirely transparent. You can go in there an comment, improve, connect ideas and so on. It’s
like a innovation, or idea generation tool. It’s open for everyone, with disregard to what you’re
working with and you can come up with ideas on absolutely everything. This created enormous
commitment and incentives connected to the people generating the best ideas, the most ideas
and so on. We realized some of them. The problem was that we had a tool that generated a lot
of ideas, enormously, several thousand, but we had not thought about how to prioritize and
select. This resulted in a big database of ideas that where just sitting there, and people thought it
became a negative thing, because people thought ‘why are nobody using my good idea’. People
felt like they had launched and worked on something, but no one use it. We had not thought
this through from start to finish. Today that tool is almost gone, and we have to think a bit
differently. What we do most concretely on idea generation now, is to use a innovation
generation tool called ‘what if’, which is a workshop model used to generate good ideas. It’s
more physical, in a room. It’s a lot more concrete, using our hands and minds.
MG: We do not have that much time left. There is one thing I was curious about with regard to
the process you showed us. Do have some kind of gates in that process, where you pause and
put forward some criteria which should be checked before you continue?

BHV: That depends, there are two levels here. Every team, product manager or technical
manger is prioritizing continuously. They have some prioritization criteria, which is defined
based on customer- user need. There are typically five to seven criteria a case needs to hit and
scored in relation to that, in order to be implemented. So that’s on a relatively low level.

MG: This happens continuously?

BHV: At least while working on the 3 week sprints, this happens every third week, but often
every week. That’s the list prioritizations. You do this earlier, where you have a roadmap and
use the same kind of criteria, but then there are bigger units or ‘epics’, i.e. bigger things that are
prioritized. You also have prioritization on a higher level, on the manager or product manger
level. Where they prioritize resources. That’s quite new, and they are working on establishing
criteria’s for that presently. For example, if we are launching a new marketplace in finn, there
is a pretty formal process, and it is ultimately the board of directors who allocates resources.
There are several levels to prioritize on. If people are given resources, it’s basically up to them
how to use the resources, prioritize and define their own criteria. You could say that you have
more strategical prioritizations, but also on the floor. It’s more traditional on the high level,
where the board gives a go or no go to a certain thing. But that’s regarding the bigger
commitments.

MG: If you have a checklist like that, and one point is not approved, is that a go/kill decision or
do you go back and improve?

BHV: On the team level, the product manager is sorting and saying ‘we do this but not that’,
and what they do is scored based on these criteria’s. How well are they hitting our criteria, and
then present that on the reviews. In that way it’s easy for everyone to follow what they are
prioritizing and why they prioritize the way they do. There is no active process to stop stuff.
It’s more about being aware if there is not created any good effects. On a higher level you have
more formal processes where stuff can be stopped entirely, which is very rare, most often
things go further before it is stopped. This is changing right now, because we are a lot more
focused on experimentation. Commitments is a very risky way of doing things, so we are a lot
more focused on doing experiments frequently in order to verify the things we are uncertain about. We verify and then escalate instead. In that way we are removing a lot of uncertainty early, and it’s easier to make go/kill decisions.

…
11.3 Transcript: Consultant (JD) - 08.04.12

When you speak of Stage-Gate I can take the story from Saab, it was in 1986. When Mazda were buying Saab, I was not there, but the CTO and some more were over in Japan, and then Mazda showed a process for them, they had never seen it before, never heard of stage-gate or anything. And the Mazda asked can we look at your process? And Saab had no process, the responded we present it tomorrow. And as they sat in the hotel room and showed the process the following day and showed Mazda that this is how we work for. But when they got home we started up the first one, it was called the Pop process. It was the first process and we used it for about 10 years and then GM bought Saab. Then I went to Germany, I went down to Opel to learn the new process here, and then I went over to Detroit and learned what was called the 4 face process. And then we implemented it in the early 90s in Saab in Trollhattan and have since developed it and at the end we called it Saab VDP (Saab Vehicle development process). But we actually began in the 80's working with a process.

So it was long before GM entered Saab?

Yes GM entered in 1990, but then they had a process and said now you should implement this process and then I went over to USA and stayed there a year to learn the process.

Do you have any possibility to sketch a brief overview over this process?

Yes I can send it, but we have an SOP that is start of production. It's here when (outlines) and then you have the start of production, but it is also a number of phases before this, I can not recall now I have not worked with this for a long time, but here (outlines) is the production preparatory stage. And here one can say that there are two verification phases, here you verify production equipment and then here you certify the final verification of the product then, here (outlines). Then you have a construction phase and here you have a market phase where you'll translate customer requirements to product requirements. And then you can easily construct and verify. But due to it is no longer secret I'll send the Saab VDP as it appeared in Saab in 2008. Later, it probably evolved, they changed it all the time. We had a development time of 35 months, but came down to 25 months and there is a need for the getting through the projects as fast as possible.
So it was 35 months from here (points)

Yes from SOP, but if you go back to the 80’s then it probably took 75 months so it has declined, I believe it is down to 23 months now. We took a Cadillac BLS which stemmed from Saab 9-3 and that was done in 3 months.

And that was a result of lean?

Yes it was a result of the way Saab worked, we worked very lean by integrating. We had a project leader group and then you have different stages downwards, let say you have chassis development, bodywork, engine and drivetrain, interior and this was how the organization looked like. Then you lend out people which you put in cross-functional teams, where you have people from engineering, manufacturing engineering, marketing, purchase and blend those in a cross-functional team, we started very early with this in Saab already in the 90’s.

That is interesting because we intended to ask about teams, did you have a core team for the project?

If you talk about projects we had a project management from the functions like purchase, production, market and central. Under those it was cross-functional teams and then Saab has something I have seen other places as well, capability teams in crash test for an example, comprises of several functions, you have deformation zones which inflict the engine and body, we had a VPM, vehicle performance manager with the responsibility for the different capabilities of the car I believe we had 18 capabilities in the cars then. So they had the responsibility to make sure the car had driving capabilities from crashes, ergonomics and everything else because these was cross-functional.

You said this was technical development?

Yes let’s say the man in charge for the technical development, he is in charge of a number of departments like a line organization, but then you have the projects across this and then you pick people, if it is a huge project then you get people from each department and they are committed to work on only that project, then it is to work with yearly changes then it could be people that works with several similar or smaller projects simultaneously.
How was the responsibility for the teams?

They had the responsibility for the part they worked with. If it was development of the engine, they had to report upwards but they had a huge responsibility, but economic wise it had to be raised to the project management because it needed to fit the rest of the car project.

The person who is project leader what kind of responsibility has this person?

The project leader reports, within GM it is called Vechicle Line Manager (VLM) this person has the responsibility for a platform, compromising several car models. So in this organization it is several project leaders dependent on what kind of model, but the VLM had responsibility for the platform where you perhaps built a Saab, Opel and a Vauxhall and then it was different project managers here, but they were forced to stick to their platform.

How big was the authority for the project manager? Was it possible for the project manager to take decisions without counseling higher up in the hierarchy?

Yes it depends, he can take decisions within his mandate, but bigger costs for an example then he needs to bring it up should the decision exceed the budget. And it is here the gates where decisions were presented. So within this several projects runned simultaneously, GM was so big so it was many projects. You cold have SOP here, here and here. That meant you had to balance the projects and resources in the projects. The project managers had the responsibility for that.

Was there any changes in the structure of the teams and how they were organized?

Yes, the further you came SOP more people within production was involved, but that was before, I heard possibly wrong, you said?

I thought about how these teams were organized, the human resources how they were organized before and after lean implementation?

When we started the word lean didn’t even exist. That word have come the lasts 10 years, but before projects were done at line organisations where the lines developed the cars. It was often the technical boss who had the responsibility, if we go back 20 years, but it was when we
started to work in cross-functional teams and they started to work, because it is important that
the teams functions.

You talked about different projects, did you have any project portfolio?

Yes it was a portfolio plan. We had year let’s say 2020, 2015 here and 2010 and then we lay a
plan, we had to platforms; 9-3 and 9-5 and in this platform here a majo facelift will come in
perhaps 2012, and here a new car will be presented in 2018. It was like a map, the plans was
way ahead, 10, 15, 20 years into the future, but naturally they wer revised every year and then
projects were moved back and forth and some were discarded. We were also were influenced
by GM, it had to fit GM’s project portfolio.

How was the project portfolio revised?

We had portfolio meetings, and it is the market divisions responsibility, you try to look ahead
and on these meetings you can decide that this car hould come earlier as a lot is happening in
the market, or we discard this one as the customers don’t want it, they had these meetings
frequently.

How where the customers involved in the PD-process?

Yes, I can take an example, I was with GM when we did customer surveys I can take an
example, we were developing a car it was 15 years ago I think, we were developing a active
suspension and the car should behave in a certain way, we then brought in lots of customers,
and so they had runs in these, a constructor in the backseat and an interviewer in the frontseat
and the customer did not know what car it was for there were prototypes so the customer did
not know whether it was a Saab or whatever. We had brought in customers from professions
like, in this case with Saab, doctors, lawyers, etc. who had competitor cars or who had bought
competing brands, Lexus and so on. And they had a questionnaire the interview could say, in
hundre meters we encounter a bump, can you tell me how this bump feels like, so then they
wrote down what the customer ment, so that was a way toinvolve the customer in the PD. And
then there are many other customer research methods.

How did lean affect the PD-structure?
Well it was as I mentioned earlier, before we worked like this (line organization) in these divisions. The divisions like engine development, chassis development, it becomes silos where the connection happen higher up in the hierarchi. But now with projects or StageGate we started with these team. So earlier we had silos.

We talked about you reduced the cycle time, did any other results inflict?

Yes in my opinion it become much more interesting to work in these teams and work with persons from other departments.

How did this influence the business culture and the working environment in the company?

Well this was the Saab way, the part of working together so it underpinned this. Working in teams is always more exciting, and if you work with projects and have a highly skilled project leader, then you can visualize the car and you work really hard to achieve this. In the car industry you can see how the product takes shape, in other industries it is not always possible to sit down and fiddle with parts.

Was there any difference in the number of people involved in the development of a new model?

Yes you can bring down the number of employees because you work with a whole bunch of things which you earlier did in every department, like administration. So it went down and because of the reduction in cycle time it went faster to develop. If we look at Saab, the R&D in 1995 consisted of 2000 engineers, but in 2009 it was 800.

Can you explain about the alterations in terms of tasks in the teams?

Well you worked in teams so you distribute that work within the team, and then you get better to perform certain tasks so you get more efficient. And then we got better simulations tools, which brought down the cycle time.

Can you tell more about these tools?
Simulation models, that you early in the development can simulate the outcome of the product. In SOP it is a lot of simulations because you don’t have any hardware. Later on you when you got hardware you can start to experiment. When I started working in the development department in Saab they said we can’t do anything, because we don’t have any hardware. But then with IT-revolution you could simulate stuff like crash test, but to do this you needed solid information about hardware and translate that to a model. So this resulted that we could simulate to a much larger degree.

Can you tell more about what happen before you initiate the development before and after lean?

Well yes front-end loading is when you put in the resources early. I’m struggling a bit at recalling this, but before when we developed a car, if this is resources, then it went slowly uphill and then we reached SOP and then it became hectic, and then a problem from the market emerged, what we tried to live by was to get the front-loading were we utilize the resources earlier and try, test and simulate early. So in a way you begin with more people and then naturally this number increase, you get another curve.

Before you got an idea and built on that, but could later find out it didn’t worked, what happen then?

We stubbornly tried and then it went to hell so to speak. We worked on development with several concepts simultaneously, and then more and more concepts are killed as we proceed. When arriving at the construction phase there was a couple of concepts left. Previously, however, we went for one single concept all the way and then you’re forced to continue because you do not have any other options to choose from if problems emerge.

What about the conflict between different divisions like design versus engineering?

Then you mean styling

Yes the shape, what if the engineers wanted functionality over design and the designers shape over functionality how was this solved when yo had divisions?
Design was under bodywork, but it happend that you had to alter the design in the middle of a process because it didn’t work. Now design is brought in early and all the engineers included when the design is presented and look at how this will work. In the car industry it is a term called wrapping. You wrap all the systems, and all features are required to be wrapped, then it is a physical space for all hardware. It is a verification point.

And how to you solve conflicts today?

Often, well disagreements are positive, working together and solving problems that are positive, early conduct of problems because then you can solve them earlier. Before, problems were hidden and then when reaching SOP problems emerged and alterations became expensive. You should grap problems early and everyone needs to realize and not be stubborn, it is about making compromises.

If we jump back to project portfolio, can you tell about how many paraller projects going on simulatanously before and after lean?

At Saab before in the 70’s and 80’s we worked with one project. It took 6-7 years to finalize a car before looking at another. Today Saab worked with two projects simultaneously, but within GM perhaps 100. In GM a car was introduced every 25th day.

Did you have any guidelines on how many paraller projects you could do?

No, we had a system that displayed how much resources we used and then you could find out by looking at this system that at this project will not make it, we need more people and then it could happen that we brought in consultants or got othe people from GM to help. So it was a balance with resources.

You had a system?

It was called work load model.

Did you focus on maximum capacity utilization or a focus on singular projects and pushing the cycl time down?
If we had a deadline, and we could tell it wasn’t possible, then we had to put in resources, hired consultants, but then it became more expensive.

**How did you establish objectives, ex deadlines and how did you measure it?**

SOP was sacred, if a car should be launched autumn 2013, you have the cars shows in the spring it is were you should present it and build up market awareness and then you launch the car 6 months later, then it needs to be found in the showrooms so that deadline was rigid. You didn’t want to come to spring and say; no this is not possible, we can’t make the deadline and we will have to postpone it half a year.

**What would happen then?**

Well you lose sales you are not first.

**Related to the team?**

They had to continue on the project and then postponing other car projects. That is why it is positive to have an efficient process. We had this system with gates, and that was good in the beginning regarding the gates because we acquired structure. Previously there was no order in how we developed, there was no structure. When it (the PD system) was developed further, however, there was a lot of paperwork which had to be filed and ready, and that took so much time, so now we have started with integration events instead.

**Integration points?**

Yes in the car you integrate the different systems, chassis, engine and so on. The gate system is more about making PowerPoint presentations and show what you have done and then you get approved, but it doesn’t really say anything about the product. I would therefore claim that integration events are important. The gates is for economy and so on.

**So before you had these PP presentations where you approval decisions was made, but now you have theses processes?**

Yes, integration points and then you meet and go through the features and make check if everything works and that it works from a technical perspective.
Is it a verifing test?

Yes precisely, you verify everything, you verify simulations and you verify the hardware. And in these integrations points you connect everything, so certain elements need to be ready for these integration points. If chassis is suppose to be this far, and engine this far, interior and so on, then you gather all together and you look through each others constructions before you continue, in the gate review there is a list with things that are supposed to be ready and you check off what is done and what is not done. However, you cannot see if it has truly been done correctly.

(JD).

But who is the people that decide to push the process forward?

You got senior engineers who see through the integration. And when they see it work, then the development continues, but it may happen that you need to do some alterations.

So they got authority to let the project pass on?

Yes the project leader is naturally part of this activity, it’s more difficult to cheat in those, in a PowerPoint you can just say ‘we have done this’ but nobody really knows what you have done and what the quality is. So I think StageGate is going to disappear, I think it’s going to be dimmed down.

So it has been more focus on other divisions and how you integrate these divisions?

Yes, precisely what is important in a car is the integration of all the systems and that each capability fit each other. If you go to a company that doesn’t have control of anything, then StageGate can be suitable because you got something to guide you, if it is chaos and you implement StageGate then it can improve the company’s direction.

You talked about each divisions attempt to maximize their own contribution and deliver the best?
Yes it is a compromise, chassis can't be so good, that the engine will turn out badly, you have to find the balance to make it work, and that's what's important.

How was that earlier?

It could be sub-optimalization. And for one of the divisions they could be very content about that, while for the others it was shit, and when it comes to the customer, they don't care as long as the car function.

Was that usual previously?

Yes that is how it gets. Now when we use cross-functional teams instead of these silos then they solely work with the project. It depends on the size, it is certain people who are dedicated to one project.

And then everyone reports to the project manager?

Yes the team has a team leader, which reports. They have a meeting once a week where they go through challenges and then it can be they say, we got a problem here and need more resources, then this gets vented at the meeting and then you get resources or you don't.

Can you explain how this team leader directs his team, motivate, responsibility, cooperate, tell whole dynamic?

Yes the team leaders have to possess leader capabilities, and can bring out the potential in people. Often you got certain time limits and quality objectives you work against and then maybe they plan together, in lean you plan with tables and stickers. In a meeting you put up stickers over what to be done like a workload scheme. The two first days in the week is planning and then you meet every second week, and then you can say I'm not going to make this goal and then you postpone, restructure and plan.

Was there any method to pick the team leader, any criteria's?

You should have experience and then you had to be a good leader, perhaps been a manager it is a big difference between being a manager and a leader. A manager points, a leader make sure the best suited person is put on the task.
Do they emerge from a special background?

Well, leaders tend to emerge in a way.

So no special background like engineers or the market?

In this case the team consists of engineers, sure the market team can also contribute, but with these plannings you can do it in smaller scales too. Have you had anything about planning?

I had about project management last year and there we were presented with schemes like workload schemes.

Yes because it is very important that each team prepares a table, because then no one can deliver a table and say this is how you should do it

How is the teams autonomy, can they work with what they want?

No not what they want, they got a target they work against and have to deliver on, they have an integration point. If they got a interation point here, then they need to make sure they are ready to integrate and that is what they do, they don’t work on their own.

I was thinking more in terms of how much control downwards?

Within PD there is not so much control as in other departments like production.

So you can say that the team is relatively autonomous between these integration points?

Yes precisely, if there is something the team leader perceive and believe they will not be able to reach, then he talks to the project leader. Then the project leader has to decide whether or not they shall get more resources. And then you got a division manager, like chassis, then you have a chassis manager and he can decide if you can get more resources or lend other personnel to solve it. That is the strong point of having a workload planning.

How was that earlier, when having silos?
I can tell about once I had been in Trondheim and visited a corporation that worked like Saab did 20-30 years ago. So I introduced a chart in the construction department, the construction boss was 70 years old and not used to having meetings every 14 days, he told you what to do, but I had them do the chart and then a girl called Hanne and said, this is great now I know what Torgeir is doing, I had no idea what he was doing previously and then you get a dynamic because you the employees is taking part and having responsibility and help eachother when they see others are struggling to keep up, they find it out themselves and then the boss don’t need to decide what the team should do, because the team to a certain degree is self managed, so it is a incredible strength in this with visualization. Visual planning is good.

I was thinking about previously it was a boss telling you what to do, how did get information?

Previously?

Yes, let’s say your boss say we are building this car?

Well first of all it is the corporate management who decides we should make the new Saab, it should be ready to a certain time, previously it was like that. But before that you used the portfolio plans and then you decided this car shall come there etc. and then you get intel on a new Volvo is approaching and then you have to parry, well then we have to presten this earlier to be first and then it was a discussion there. But earlier developing a car was a big task, so you looked at what the competitors was doing and then you started planning in another way with the portfolio plan for an example.

But did you listen to what for an example the sales personnel said, if they got a lot of request from customers that a car was good but they wanted more space?

Yes you naturally listen to hva the dealers say, but if if you’re going to be located in the front you need to, look at iPhone for example, that was not developed because a customer said they wanted an iPhone. They had to create that need.

How did the managment get insight on what to produce then?
To be honest this is something they never tel, but it is something called Skunk-work. Let us take Saab and the turbo, then it was some engineers thinking turbo that is what we need, then you develop that without the management knowing anything, a lot of the larger innovations stems from secret work without caring for what the management will say, these jobs happens and the turbo was skunk-work. Saab was first with turbo and when they had a testdrive down in Germany and asked the CTO if he wanted to present it within a couple of years he said I want this on the car show next month! A lot is actually Skunk-work.

Does this also occur today?

Yes, but it is kept on a hush hush basis, if you ask a professor he can’t say anything about it as he hasn’t seen how it works, but if you believe so much in an idea you can take that liberty and develop something without sanctions because usually it get’s sanctioned and stopped. But only if you have got it through and present it for the CTO who belief this is something workable. I was in a company here in Oslo. Cisco, they are developing conference facilities, they don’t include sales not even when they are finished with their product, they even got a knowledge president. He told me and another colleague related to a sales meeting and we were there to help them, but they was so far ahead they didn’t need any help.

So they chose not to include the customers, but they still have a system?

Yes they are ahead of the customer all the time, what they present to the customers is perceived as this is great we have never though of this before.

But do they also have a structured process?

Yes they have a certain skech, we didn’t talk that much about it, but they have a tremendous freedom those who worked there. No engineer was suppose to have time pressure and to many jobs simultaneously, and in the departments they had several games so you could stand there and play it was enjoyable.

It is kind of like 3M where the employees can spend 30% of the time to develop their own projects.
And when they hired new engineers, let us say we are a department with 10 people, then all the
10 interviewed that guy and if one ment the person did not fit in, he didn’t get the job. You
really had to fit, they looked like what yo would call geezers.

You mentioned how the cycle time was significantly reduced can you tell more about how you
managed that?

It was partly through that when we verified earlier you needed to build the hardware, you had
to build a prototype, but if you can simulate then you can verify many times and very fast and
then it is a lot of solutions you can just skip.

So technology was a big…

Yes technology and that you put the people together in teams. Cross-functional and simulation
tools that you could present virtual how things would look like.

How did the use of resources change, did you need less resources for each project?

Before it was test engineers who did the tests, they were skilled in hardware, but then we hired
some who knew these tools, they were termed development engineers. They started working
with practical testing and then they made the models, because they needed to know about
hardware to design the models, so they went back and forth between practical testing and
simulation. A problem I observed in many companies is that those who simulate they only
simulate and then they loose control of the reality, they have to know the products to be able to
do simulations otherwise it will be so-so. So this tools and working cross-functional that
reduced the development time significantly.

What about bottlenecks in the process, was these changed in any way?

Yes you don’t call them bottlenecks perhaps, but you are concerned about things that do not
work, or they never get done with something, then you have to look at what causes this and
then it could be the process is wrong or the necessary competence is not there. Competence is
often a bottleneck in a production facility it is obvious those places were a machine is not
working, but in PD it is very important with competence, knowledge based development. That
you, that is what’s most important in PD now, that you build up the competence you need that
you can apply it. Those construction solutions you got in a car, that you can transfer those to
other cars instead of doing the whole process over again as they did earlier. Reuse knowledge and constructions. In the car industry we talk about carrying over details, parts and systems to other models. Certain parts are modified carry over, then you do some modifications and others you have to do over again. We got a color system, green is carry over, that is what you transfer in several models, yellow is modified carry over, and red if it is a Saab, then you have to carry over from a Saab. It is a way to apply that knowledge, and if it is green then you transfer and use the same construction and that reduced the PD time and enable more models.

Did this occur earlier?

No, then it was stored within people, one constructor could say - it was about 7-8 years between each car was developed - how did we do 8 years ago? Well we did it like this, but if he had forgot it or retired then they did the same mistake again. Knowledge based development is in fact the most important now, that is the big bottleneck. Toyota is experts in exploiting and preserve knowledge, I can take an example, when we worked in GM we had a test track in Milbrooke in England, were we tested. You drove 10 000 miles in a couple of weeks, it was simulation and stress tests of the cars, you were suppose to drive on 10% Belgian cobblestone and everything like that. As soon as a fault occurred, they called, it could be Opel, Saab or whatever and said we now discovered this and western constructors had a tendency to claim the test, they didn’t accept the fault in the construction, but said you did the test wrongly. If they call to Korea or Japan, then they came to England, thanked them and said very good that you found that problem. And rarely that problem never occurred later, but in the western constructions same problem occurred repeatedly. They had a system to store this knowledge, which the western didn’t. That is very important.

Porsche had a chief developer and when he left a lot of the knowledge was gone with him.

Yes and that is what is the danger, you need a system with A3 and similar, where you document how you do things. And then young constructors work together with the experienced to transfer knowledge and you need a system for that all the time. Look at this Milbrooke test track, we understood that when Asians became aware of a problem they had a system to take care of that problem so it never occurred, that is the challenge. That is what reduce the cycle time, only solving one problem at the time. If you take Scania in Södertelja, they have come far with lean. They talk about deviations. It can seem strange to talk about problems you find, they even got a bonus related to how many problems they can find that they solve. This mean you
find the problem in a early stage of the development and that is cheaper than discovering it in
the field. It may cost 1 krone to fix the problem, out in the field it may be 30-40 000 kroner so
that is why you should discover faults early.

Lean, six sigma and the perfect slender process, that if you misunderstand can mean you don’t
do any mistakes at all.

Yes precisely, but you should identify problems early. A lot of people who have not worked
with product development before believe they can approach the process just like in production.
In production it’s very important to have zero defects so the process doesn’t stop, but in
product development it’s very important that you discover mistakes as early as possible and
solve them. It’s a big difference. I have been working both with product development and
production in Norway, and when I’m working with production I need to have different mindset
than when I’m working with product development.

You said that in GM when you started with lean you tried to transfer lean principles from
production to PD?

Yes in the beginning in Saab for 20-25 years ago lean was only in production and then when
applying it to PD we thought it could be directly derived. But that is not possible. You have to
think in another way. So you can’t take a person that only has worked in production in PD, he
will not understand what PD is. But one that has worked with PD can work in production
because he understands the difference.

In lean we talk about waste, can you tell about that in PD?

Yes that was as I mentioned earlier waste in production is such a thing, but in PD finding
problems is not waste. By doing many tests early in the process, let’s say you are going to test a
capability, if you went to IKEA then they have stress tests of chairs and madrasses. In the car
industry it could be you open and close a door. And many times if we set 10 000, 100 000 and
1 000 000 cycles, then if we do a test and have a door that opens and closes all the time, then a
requirement can be it should make 50 000 cycles. Then you take two doors and let’s say this
make it to 100 000 and another 75 000, then we say this test went fine, then we go for this
construction, but that is too few tests to make up a valid answer. So the most important is to try
a many doors, because then you learn, if one door doesn’t make the test then you will see that it
will be a number of doors that don’t make the requirement, so you have to try a certain amount
of samples. And in production it is not good to break something, but in construction you can do that because then you learn about the life time and then you know how solid the construction is. But if you do tests in production then it would be called waste, because then you think the sample that is worn to exhaustion could be used.

That is probably how warranties are decided?

Yes I can mention that it was a pLatform in GM that had warranty cost on over 1 billion. It was a team dedicated to half that cost in two years. We succeeded, in one year we halfed the cost because we worked truely lean. We had a obeya room, a room were you got everything on the surrounding walls. Every day we had updates on the warranty statistics out in the field, we got the pieces that was broken down and has several task force teams who worked, we controlled everything from this rom and had all the information, just like in a war when the genrals get the information from the fronts. We really applied lean tools then.

M: And one of those tools was to have all the information put up on the walls of that room.

J: Yes, visual management is very important. I don’t show up and say things should be like this and like that without preparing, just like you have prepared for this interview. You don’t come here without some kind of interview guide. Therefore, visual management is very important.

MG: Did you apply any other tools?

J: Visual management is one of the most effective tools, in order to get people on track and work like this.

MG: We where wondering if you could tell us about performance metrics and how you rank projects. Is there any difference before and after lean implementation in the Stage-Gate process?

J: In the end of a project, the product is released into the market. Previously, the project was considered finished at that stage. Now, however, there is a lot of focus on the aftermarket phase. Like we mentioned before, stuff like guarantee periods and alike. That can tell us something about how well the project was conducted, based on, for example, how high the
guarantee costs are. If they are high, the project may be seen as a failure, but if they are low the
project may be regarded a success.

MG: Can you tell us about what improvements you had in these performance metrics? Before
and after you implemented lean, in SAAB for example.

J: We were quite satisfied if we had made a good car at the market launch phase, a car that
was happily received by the market.

MG: When you say ‘good car’, what do you mean?

J: It’s not until the customers start using the car that we can really know the quality of it. Based
on the guarantee and such. You may have a guarantee increase after 2 months, after 6 months,
after 1 year, and then after two years. So that may vary in different ways. Sometimes you could
say that, after 2 months, we see a very good result, but after 6 months it may not be so good.

We have this product ‘bathtub’ curve, which shows a common tendency of product failure over
time. The problem that you have after two months is often based on a production failure, where
something went wrong in the actual production. You may have installed something wrong, and
so on and so forth. As a customer it is not very nice to experience a malfunction this early, it’s
important to establish a robust production apparatus. After that there is only infidelity, where
the curve is flat and there is a low degree of malfunctions in the car. Finally, you have an
increase in the curve as a result of wear and tear on the car. The Japanese are extremely good at
forecasting this curve correctly. If you buy a Japanese car, we often say that you will
experience all the malfunctions there is after about 6 years. Because at that point you’re
supposed to change car. Meanwhile, a lot of western companies have a lot of problems quite
randomly throughout the curve. Except that, when we talk about metrics, SAAB had something
they called Q L E H. That stands for quality, delivery precision, efficiency/economics, and
humans. Each one of these categories had key numbers.

MG: Was this something you implemented as a part of lean?

J: This was implemented in SAAB around 1989. It was also a way to prioritize. Quality
problems were the most important, then delivery precision and economics. The human factor
was equally important. Quality was important for the customer, but also punctuality and
economics. Everything was along with the human element. In this way you’re building KPI’s (Key performance indicators). KPI’s can be built along with this prioritization system.

MG: Could you explain how these indicators changed throughout the lean implementation process?

J: Yes, it would increase all the indicators. Delivery precision, for example, is connected with the integration points where you deliver at the right time. Economy is self-explanatory, where you have costs. H may be the wellbeing of employees, but also competencies. There exists competence matrixes.

MG: Did you see any improvement after you implemented this?

J: Yes, there was continuous improvement. Customer surveys etc.

MSP: Where there more testing when the vehicle was fully developed, prior to the initiative?

J: Most often, before, one conducted a verification check at the end of the PD process, where you always tried the car. If there was anything wrong with the car, that was very serious. But now, we can do simulations and tests early in the process and get indicators on how things are going to become, as well as discover problems early. Because the testing of the car, when you actually test drove the car, was in the very end of the process. If things went bad at that point it was a disaster and very expensive to fix. We focused on simulations and testing early, as to identify all the problems before they grow.

MG: Regarding the stage-gate process you drew in the very beginning of the interview, can you elaborate on the time consumption among the different stages?

J: We used 23 months on the entire process.

MG: Can you tell us about the time distribution among the various stages?

J: The most important thing is to provide the right resources in the beginning of the process. You basically have development before the process is even initiated. The more time you put down in pre-development, the shorter time consumption you will have in the latter stages.
MSP: How was the situation before?

J: Then you didn’t have any pre-development. You just started to construct and try things out, and then things went bad later in the process. The more prepared you are… It’s the same thing with the interview you are conducting right now, you have prepared this. Imagine if you showed up here without having anything written down, that would have been messy. It’s the same thing. One have to prepare. And that’s very important in product development.

MSP: Previously, it was common to make prototypes out of mud. Isn’t that right?

J: Yes, most definitively. That’s been very common.

MSP: And that took a lot of time.

J: Sure, but now we have systems that speeds up the process. Quick testing and visualizing. You don’t have to use mud, you can use plastic models very quickly. Let’s say that you want to show a customer something early in the process. Then it’s excellent to show a model in some kind of way. Mud is quite hard to work with, but now you could instead use a plastic model or whatever.

It’s very important to be able to show something in real, not just an illustration on a computer screen. The same thing goes with planning. Visual planning is important. Do not write things on your computer, put it out there. MS project and so on, it’s not that efficient. The important thing is, when you plan, is that you have these integration points. Then it’s up to every single one to plan in a way that enables the project to reach these integration points. You don’t need someone to plan and control.

I can take Volvo Areal as an example. Their name is GKN now. Do you know what they did two weeks ago? They fired all planners. To a lot of people that sounds completely crazy. They must be out of their minds to work without planners. The idea was the planners fix stuff when they are wrong. The make sure that things work as they should. But in a lean organization the problems should be very visibly as early as possible so that they can be corrected. The production director at Volvo Aero was previously the production director at SAAB, and we went in and completely revolutionized that company. They fired all the production planners because they hid problems. The problem did not become obvious because of them, and when
you can identify the problems then you can correct them. This new production director, he just
wanted to see the problem as soon as possible. He wanted to find the core of the problem.

MG: These things seems pretty obvious in a production context, but is it so obvious in PD?

J: No, it’s more difficult. But still, it’s important that problems are made visible in the early
phases of development. It’s all about identifying problems early.

MSP: How early should one have a prototype with all the components working together?

J: That depends on what you’re developing. I’m working with development platforms. You
may have prototypes in paper or whatever. When we have an entire car as a prototype, we
called it a ‘mula’ within the car industry. Then you had an entire car. Those types of prototypes,
however, are very expensive.

MG: You talked about this room with all the information put up on the walls, in the form of
stickers and so on, can you explain how you planned?

J: First of all you could see the integration points up on the wall. You could also see a picture
of how the car should look like, and such. In addition, there is enough space in the room to
actually get a car in there. A prototype. We could have the hardware standing there, inside the
room, so that everyone can see different stuff. You should also be able to show your simulation
models.

MG: And these integration points, what where they based on?

J: The integration points is connected with a system that checks if all the components fits
together. It’s therefore important that the people who work there do their own planning. They
plan what they need to do before the next integration point. Toyota are extremely good at this.
In Toyota they have a ‘section manager’, and he knows exactly what needs to be ready for the
next integration point. They call it a chief engineer.

MG: I was wondering a bit more about these gates, or integration points, because you have a
system, but maybe there can be deviation when it comes to resources for example?
Lean product development systems

J: Yes, but in the team that is working on the project, if they see that there is a need for more resource they put that forward, and thereby receive more resources.

MSP: If you are working on an engine and figure out a way to make the engine better, with less emissions for example?

J: That comes before all of this. There is a technology development process where you develop new technologies. In a car project you figure out the technology and resolve problems related to that prior to the product development. In the portfolio plan, as I mentioned, you may plan to release a new engine in 2013, which has this kind of emissions. When you develop that technology, you need to make sure that the engine is tested in a sufficient manner and works when you implement that in the car project. So that’s a different process, and is not allowed to go on when you initiate the actual car project.

MSP: Can you tell us about the situation previously with regards to this?

J: Well, then it went straight into development. Someone came up with an idea and, yes… Everything is a lot more structured now, because there is so much money involved. It costs billions to develop a car.

MSP: You were talking about scunk work and intrapreneurship…

J: That was earlier, then.

MSP: Okey, so there was more of that before, where you got the ideas implemented straight into development.

J: When you have initiated the process, you should not have to much new ideas coming into the project. When product development is initiated, you should maintain the knowledge that exists from the previous stages. Do you know about kennedy’s arrows?

MG: In lean, you often talk about standardization in order to be efficient but at the same time you need flexibility. What is your experience with that, in regards to product development processes?
J: …

MG: You where talking about having an idea, which you build on and control from the early phases. Front-end loading. And you said that you should not change the concept when development is initiated?

J: Yes, you should not make a lot of changes. You can work with several concepts in the beginning, and then screening makes you end up with a few. But you cannot have new developments throughout the process. With regards to a new engine, for example, you need to have all the specifications ready early on.

MSP: That’s the phase that Cooper calls research and planning

J: Yes, that’s right. If you look at the car industry, you need pre-development, as we call it, where you work with ‘advanced engineering, as they call it in GM. There was an individual department that worked with this exclusively. Launching a new engine in 2020 for example, which has certain emissions and so on. Then you need to conduct research on that. You cannot mix that with the car project. If you want a certain engine to be released on 2020, that need to be ready in 2018 so that it can be implemented in the car development project.

MSP: Let’s say that SAAB wants to develop an SUV, what preparations and research are then conducted prior to the actual development?

J: SAAB developed a SUV, and they first looked at the different platforms they could build it on and choose the Subaru platform. We could use that platform, and then we developed that SUV based on that platform. We did not start all over. We tried to ‘SAABify’ it. We looked at carryovers, what we could use from the Subaru that would fit the new SUV, hereunder the platform and maybe parts of the chassis. Then you need to look at the stuff that needs to be completely new, the design and such. We categorized this using color coding. In this way we could utilize old structures from the Subaru, because if we where to start from scratch it would be a lot more expensive to develop the car, with a new platform and everything.

MSP: With regards to customer surveys…
J: Sure, that something they most definitely have. They figured out that SAAB needed to come up with this kind of model a certain year. They certainly made surveys and such, but I did not take part of that. But still, you have to make investigations in order to vindicate a demand for such a car. This is highly connected with expectations, because if you’re the first one to offer a SUV you can charge a premium price. If you’re to late, then maybe a couple of other automakers release the product earlier and the customers go to them instead.

MSP: Did you also look at competitors?

J: Sure, competitor analysis was used in a extensive manner. We dismantled competitor cars and such. But that was more about figuring out how they developed a certain construction. For example, if we had a challenge with corrosion, we brought in another car and looked at how the competitor had solved that problem. How they solved that architecture.

MSP: Did you look at any specific type of cars?

J: Everyone that was in competition with SAAB. We could, for example, buy three cars and drive 10.000 kilometers with them, in parallel with our own vehicle, and then dismantle and analyze the wear and tear.

MSP: Is that what you call benchmarking?

J: Precisely. Benchmarking can be done at all levels.

MG: Can you tell us about your experience with improving the product development process, or Stage-Gate system?

J: There was a guy who had responsibility for the entire process. He now works at ‘svenska vattenfall’. I’m actually meeting with him next week and discuss how ‘vattenfall’ is working on their projects.

MSP: What was that position called?

J: He was in charge of the product development, VDP, Saab vehicle development process. He was responsible for that; he owned that you could say.
MSP: Can you tell us more about his role?

J: He had worked as a project leader. You have to have experience as a project leader in order to understand what it’s about.

MSP: Did he function as an observer?

J: He interviewed people and had control over the project with regards to progress and improvement. However, he was to a high degree controlled by GM, so he could not do whatever he liked. He also educated new employees through lectures.

MSP: So you could say that he was responsible for bringing the generated knowledge in one project over to the next?

J: Precisely, especially process wise.

MG: Can you tell us about incentives?

J: Personally I regard bonus systems as harmful for the entire organization. It sub-optimizes. It is completely terrible. I’ve seen companies where people… it does not work. If bonuses are to work everyone should receive the same bonuses. If people receive different bonuses you will establish competition and get people to focus on the wrong stuff. I visited a company, and there it was very important to produce the maximum number of tons. That was the most important thing. Then, the employees received bonuses based on the number of tons produced. The problem, however, was that they produced more that they could sell which resulted in an ever increasing inventory. That inventory, of course, costs money.

MG: Can you tell us about these things in product development?

J: Well, I don’t think there was any bonus system.

MG: Can you tell us about other forms of incentives then?
J: In SAAB, there was an enormous commitment among the employees. It was embedded in the SAAB spirit. Therefore, you didn’t have the need to go there and necessarily create additional incentives.

MSP: All right, because there is considerable difference from the US and Scandinavia, for example. In the US you got bonus systems for everything. Can you tell us about the difference in GM and SAAB?

J: In GM they had bonuses, most definitely. I do not think that was a good thing. They received bonuses based on the wrong premises. With regards to bonuses, it should rather be based on the performance of the company in its entirety, so that everyone can receive equal bonuses based on that. A percentage of that for example.

MSP: When they establish a goal, where the car should be finished on that date…

J: No, there was not any bonuses in relation to that. Instead of bonuses, you could for example be rewarded with a trip where you got the chance go and look at a GM factory or something. That’s a lot more interesting.

J: I can tell you about this team that was working on getting down the guarantee costs. I was a part of that team. The team consisted of 10 people and we received GM’s most prestigious award called the chairman award. That was a sufficient bonus you could say. The honor you felt by receiving such an award. Things like that, you can give. But awarding money for hitting a certain target…

MSP: Have this changed?

J: I’m not sure.

MSP: What about the companies you have worked with here in Scandinavia?

J: In a lot of the companies, as with the concrete producer awarding bonuses based on tons, the bonuses was based on the wrong premise. They produced stuff they hadn’t sold. The managers was focusing on the completely wrong stuff, because they got the wrong signals from senior executives. Further, senior executives was incompetent so they didn’t get this.
MG: So it seems you have other types of incentives when you’re working with product development?

J: It’s about honor. The honor and ownership of being part of developing a new car. You have a pride in… you can imagine what pride you have when a new car model is released, when you can tell your kids ‘I’ve been part of developing a certain component of that car’. It’s the greatest pride you can… That’s highly relevant.

MSP: I know that in Ferrari, they engineers working on the engine actually sign the product.

J: Precisely. And it doesn’t cost anything. But the pride of having your name on the car is great.

MG: It creates value also because it shows that the product is unique.

MG: When we talk about processes, are you familiar with the term system boundaries?

J: …

MG: When we talk about processes, you have to define where the process starts and where it is finished. It’s possible to define a process as you like, where it starts and where it stops. I was therefore wondering if you could tell us about how you defined the Stage-Gate process?

J: We had a definition on when it was finished. That was one year after start of production (SOP). At that point there was a gate, in fact, where you analyzed how well the project has succeeded over the past year after launching the car. The starting point of the process was the time when a decision was made to develop a new car. You pressed the button, you could say, and the process was initiated.

MG: These teams that we have talked about…

J: They are not part of the project throughout the whole process. A lot of the teams finish earlier, or, other teams take over when you reach certain phases. Production preparations and such. Then more people from production are involved, in the end. A year after the car is released; you have a aftermarket team working on the project. People from aftermarket and
market is a part of this team throughout as well. In that way, the team get a different
composition and focus throughout the process. So in the end there, you have production guy or
woman that functions as a team leader. But in the beginning, it may be a constructor or
something.

MG: When you where working in this room with all the notes on the walls, just to use that as
an example. Can you describe that process?

J: Different people came in and out of that room. The most important thing was that all the
information was visible on the walls.

MG: In order for everyone to have a complete overview?

J: Precisely.

MSP: It didn’t go so well with GM and SAAB in the end…

J: That was because GM in the US went bankrupt, and then they where forced to get rid off
everything outside GM. In that way, they sabotaged for SAAB. There was a lot of ‘proposals’
towards SAAB. Personally I worked, 2 hours ago, in 2011, a lot with the companies that wanted
to buy SAAB. But GM blocked everything, because they where afraid that their Asian partners
would take over. SAAB was highly demanded and several automakers wanted to buy it. GM
stopped it. The 19th of December 2011… we still working into the final… we where working
very hard to develop a development process, in which we where going to use with the Chinese.
And then this happen, and we realized that… it was time to look for another job.

J: Several engineering companies has grown as a result of this… NEVS, which develops
electrical vehicles and a Chinese company which bought that. There is a lot of engineering
companies that works with engineering consultancy… People are saying that SAAB performed
badly and so on, but SAAB was forced to by more expensive engines from GM. We could have
gone to BMW, but we weren’t allowed to do that. We where not allowed to buy cheaper
engines to put in the car. There was internal pricing, which illustrate how a powerful companies
like GM can exploit as much as they want. We had to buy GM engines that was more
expensive than the ones BMW could sell to us. In this way, SAAB did not stand a chance to
make a profit. We where supposed to break, you could say.
MG: To finish off, our research question was how the implementation of lean affect Stage-Gate systems. Is there anything you want to add?

J: I believe Stage-Gate is a thing of the past, and that we are moving towards a system of integration points. That’s the most important point. Using that method you are able to integrate the different parts of the vehicle better. So, Stage-Gates… I don’t think you can use that in a lean organization. It’s more about the integration points. Stage-Gate establishes a hierarchy. Let’s say you have a gate planned for the 1st of May, then the managers start getting terrified in march because everyone needs to prepare for the gate. In that way the development comes to a halt prior to the gate because everyone needs to prepare the materials to be exhibited. You need to figure out another way where you can work with development all the way. Stage-Gate is just about having various activities that needs to be done.

MSP: Can you tell us about potential downsides of implementing lean?

J: Well, I don’t see any downsides. Of course, I have my opinion of what lean is. But I do not want to call it lean, I want to term it knowledge based product development. Remove the word lean, instead you can mention knowledge based development. Highlight knowledge, because that’s what it’s all about.

MSP: You wouldn’t regard it as a slender process?

J: It’s a process where you can use your knowledge and create more products. Maybe you want certain parts to be efficient, but is not the same as production where you have bottlenecks and such. There is bottlenecks in product development as well, but it’s about preserving knowledge, utilizing knowledge and create constructions that you can use in an easier way.

Mr. Darnemyr takes out his computer and shows us slides from a presentation he is going to use in a seminar about LPD and Knowledge based product development... (Unfortunately, he did not agree to share the slides with us)
11.4 Transcript: Head of Innovation (BHV) - 09.04.13

Can you tell about the PD-process in Finn.no?

The way we have implemented lean principles have been that we until November last year have been fairly autonomous in terms of divisions. Every market was a corporation with full responsibility for top and bottom line, and that makes the way to work very individual within each market division because each market has close connections to their customers. Both real estate and cars are absolutely dependent on having a good relationship to the car and real estate industry, it is in a way they who possess information and makes Finn a two-folded marketplace. That entails that we have not has any ambitions that Finn Innovation shall force a process definition onto the marketplaces. So we shall administer principles everyone needs to follow, but the way they follow them, whether it is the practices or to a degree the process can be adjusted.

And through this we want to get the amount of structure we want to build strong innovation cultures and that is where we have found to have flexibility, because if we say that the principles here they are undisputable, they should all follow, instead if we say the principle of quality whether you achieve it by doing it this way or another way, that is of no interest to us and so we have helped to implement processes, but we have not come with the one process to follow, we have ensured that the marketplace have managed to define their own. So they find something that is suitable, which they think is relevant. It is also a challenge when you have different business areas with a slightly different business model and if you present a process then maybe it become an aggregation of everyone and is not relevant for no one really, because it is too generic. So that is the history behind the process. Finn has now been organized by sales, product and technology, so now there's a few common prioritization mechanisms, there are some common processes earlier happening across the marketplaces will now be common on Finn and then we will need a process at least at level 1, which means that we can agree on where we are now and then we have tools that support the stages of the process. It is difficult to have tools if everyone has different processes, then no one knows how to use them.

The first phase is called intelligence, here we want to emphasize that we in Finn are governed by objectives, we should find meaning in what we do and the innovations we want to create by being clear on where we are going. So intelligence is all about setting goals and tying this to the
larger promises for the strategy, make sure there is a direction, whether it is product
development or innovation, and then it is also about to provide insight so we know that
intelligence is also correct, so it is user involvement and customer involvement then we know
we have a good starting point to start generating ideas. Then generate ideas are next and it is
possible that one can present a good idea in Finn, but we want to create a direction for the
ideation so not all are fantasy. We have experience in that field in Finn, we were very early to
present a value management solution with crowd searching and if you open the organization
you get a huge range of ideas you will get it, I don’t think the challenge in Finn is that we
don’t have creative employees, because we are a knowledge company, the challenge here is
about priorities, it was the product managers who got all these ideas from the right and left and
you have to give feedback to the people unless it will not create any ideation culture. But if you
have 1000 ideas in FinnOpp and you divide it on 5 marketplaces, then you leave quite a job to
the product managers. They have their own road map to follow and then they get a lot of input
because the ideas are not really aligned to the strategy so that became a massive bottleneck and
in terms of lean terminology that is waste. You create a lot of enthusiasm and ideation, but
there is no pull effect it is all very push.

Then we have a realization and validation phase and here some of the challenge with StageGate
emerge. The ideas we prioritize, they do we wish to use a lean-startup approach towards, that
we develop these incremental and iterative, and that is a challenge without a business case
consisting of 40 pages which in reality is just a scenario you believe is true, and then after
getting through gates you have all the time based it on an assumption which not at all needs to
be true. So through lean startup we want to be very clear that we will continually quickly
understand customer and user value and through insight into what customers and users want.
We are somewhat fortunate because we have a marketplace where we get immediate response
on what we introduce, the validation act to find out if we are on the right path. So this could
affect the future outcome, because if we find that what we thought was a good idea based on
insights and metrics, then it may turn out that already after a few iterations and low cost
prototypes the concept does not hold water at all. And then we must either change direction or
close the project, and we also can avoid such projects where we need to put down 20 million
NOK on a 2 year project and sit here for 2 years and we believe the airplane is flying when it is
not, so here (pre-phase) we need very quick iterations.

And then we have the scaling phase, based on what we have verified is good. We begin to
connect into sales and marketing and all the push factors connected to commercialization, we
release the business model and ensure that we have the elements it takes to make it possible to
escalate. So this is if we should call a Finn level 1 PD-process, the closest aggregated strategy
for how Finn work to ensure both incremental product development, but also more radical
innovations, but there are differences related to the size of the project as well as the range of
ideas in the process.

Who are the people or the teams in these processes?

Some will be on team level some will be on Finn corporate level. The former process are
implemented in the part of the organization that is responsible for commercialization, all the
banners, displays and adverts that not make up the publishing income. It is the publishing
income and branding income that creates the two main streams of income. The product
manager, responsible for his products are totally dependent of the sales departments being part
of the process, because they are out in the field and talks with the customers who wish to use
this part of the marketplace to expose themselves, so when he is saying this is the direction or
goals for this product, then that have to rooted with sales. So in this situation setting the
direction would be for both sales and product together, and then the ideation and the individual
salesman who contributes with revealing customer needs and the actions needed to reach the
targets is initiated. So here the project scope can be fairly broad and so in the validation and
realization phase be solely for his team or the technology resources he is given and then sales
are connected on the project in the scaling, because then they need to have sales activities to
create the desired boost. But I can also be a single team who both set their objectives and are so
to speak more self-supplied. And then again it can the larger challenges for Finn, because we
are now empathizing mobile transformation and could say that this was of strategic importance
and used the whole corporation for ideation and put aside much resources to experiment on a
Finn level to validate.

So it is flexible in relation to team structure, dependent on what you develop, can you explain
about the usage of time within each phase in the process?

We have now for the first time worked on getting good recipes for measuring how we are
performing in PD and innovation. Thus we have managed to get the following up on the
corporate strategy plan; from one prioritized idea to first minimum viable product, the lean
startup definition on the first user value you deliver, first we want to measure this, how long
from when we say go and until we have something that expel some sort of user/customer value,
that is a number we are very interested to find. Finn have a mantra from the last restructuring; from idea to market on one day, it is more like a slogan than a goal, but it expresses the swiftness from when we say go and till we get the product out which we then can build experience and knowledge from, but then it is important that we get out the first version so we can begin to validate, learn and get insights. Because it is this it is all about and finding the speed here is what is most interesting for us in the first run. Whether it is based on teams or corporate level, we can be earlier onto insights for a corporate decision of great strategic importance or for a team it could be a workshop and then they have figured it out. So I’m not so sure it is here (pre-stages) it is critical with speed, but we wish the time at this phase to be as short as possible. And here we have little to benchmark, so to get it up as an KPI, it is the first time we have got attention up on a corporate level for such a thing.

Can you tell about how you select ideas?

If you take it on a team level then it is the principles, it is that you should prioritize customer/user value, so the prioritizing mechanisms implemented in all the development teams here in Finn is about this, how to select, how we prioritize and all the team have now their own prioritizing criteria’s so those are not a corporate level prioritizing list. Then we can by time probably find more strategic prioritizing criteria’s, but to date the prioritizing has been very specific for each team and those criteria’s is attached to customer/user value. The culture in Finn have during the years become very strong in prioritizing the option that create the greatest user/customer value, so that is the principles behind the prioritizations and that it is prioritization criteria’s for everyone. And then it is the influx of ideas or actions on team level, it is often the team themselves who generates or get input from other parts of Finn. However the ideation usually happens on team level where the prioritization related to which customer/user value this action creates as well as which create the greatest, is the ones who get carried away.

Is there some other criteria’s than customer/user value?

Yes, you get it implicit through in the short and long term, because as an example what is defined as internal teams not necessarily with the final user in mind, but they have an internal customer and user definition, so you can say that for an example architecture, modeling the architecture in Finn, getting that to become a service architecture, that is not easy to tell what makes up the customer and user value this service delivers, but it has been decided that it
should be prioritized because we mean it make up what is necessary to offer a multichannel
Finn service which in turn have what the users want. More and more of the traffic at Finn
happens through mobile units and then we find a rationale for that, but it is more a long term
priority than a shot term priority like teams fiddle with, where it is about getting the button up
to the right or down to the left or placed in the gallery, if we do it like this and this then we
could create more customer and user value. So through an implicit thing of short term/long
term priorities, dependent on what kind of team we speak of, then you get in stuff which maybe
are more strategic decisions which imply the long term customer and user priorities versus the
shorter customer statements of what they want.

Is there any changes in the balance between short term and long term objectives before and
after lean?

I started working here in may last year so I don’t have the longest history here, but lean
implementation has been ongoing for many years in Finn, so I just have to base my opinion on
what others say. First and foremost, we have a strong culture for objective, although yet we
have moments where we are very good to prioritize measures and not goals. So it usually gets
down to a list over measures, and then we are not so clear on why this measure. So what lean
implementation has contributed to through these principles is at least to be better at beginning
with objectives so we don’t jump straight to measures.

When it comes to project portfolios, Bjørn Henrik Vangstein was very clear that you don’t call
it project, but initiatives can you tell about this initiative portfolio?

Projects are a word we use in Finn, but it is room for a more waterfall related project, internal
projects with structural changes in mind or that you have distinct deliveries or milestones then
it is okay to use a project methodology, but within the development teams there is no waterfall
methodology because you have connected waterfall to the word project and equate those terms,
that is why project has become some kind of cursing. But I mean you can have projects and
conduct project management methodology above and the deliver incremental and iterative
below so it is not necessarily so that you have to say project equal waterfall. So when Henrik
says we don’t use projects what he is saying is we don’t use waterfall methodology. We don’t
have any project portfolio management, but work to get product metrics in place to enable
project portfolio management and then it will become natural to see which measurements we
have to do to balance the project portfolio and then it will become natural to connect it to
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incentives in which we can direct the portfolio. But currently, whether you call it project
portfolio or initiative portfolio, this is not in place. It is one of the things we have in line and
become a natural part, when we get this (generic PD model) in place, because I believe the
most important isn’t necessarily the project portfolio, but to implement strategic backups
approximation. Finn is whether you like it or not in the desktop world which we have lived in
now and been stable, but is about to transform, so Finn’s position is in turn in change, because
it opens up for newcomers who can offer a multichannel experience, making the customer
finding it on mobile units, because they find Finn on desktop, but eventually less is desktop and
more is mobile. So we see the necessity of innovation for us it is extremely strong anchored
from the top, so inventions, growth or whatever you should call it, it is an important part of this.
To live this in practice, to make the right priorities, we have to take a step back and say before
we prioritize, we have to agree on the share of our resources we should use for the different
activities. So let’s say 20% should be radical innovation, 50% operation and 30% improvement
of the product and then we will not get an priority mechanism were these 50% always win,
because it burns on the toilet and there is always something that needs to be done, because we
are clear on these shares before we start to prioritize, this means that these measures here (the
two others) will never compete against the others. You can then never say you will use more
than the 50%, so whenever someone approach you it is stop on 50% and so these measures here
will never compete against these, but as long as you have not been very clear on this resource
allocation, because you know strategically you need to use more to boost it, just because of this
multichannel world a priority mechanism without this allocation would favors this (not radical)
because it is easy to present business case, it is easy to know exact the amount of money, here
(radical) it is often vast uncertainty, so I believe this the first step to begin the implementation
of a project portfolio management, then we will start to get control on these incentives
(allocation diagram), but we have no intention of implementing project portfolio management
because it sounds corporate and it is something we have to have because some say we have to,
we have to implement it because we see it will give us a boost or a value, something we don’t
see today. Probably we begin here, it is here it is most important to improve.

Being pedantic on this, if you reached 20% for incremental, what if you then get an promising
idea?

That can become a trap and the numbers here can be corrupted, it can become a trap if we are
to rigid, but if you begin with an assumption about the allocation, and that is what we do in the
strategy, we shall improve existing marketplaces significantly, we shall launch 5 new market
places within 2015, that entails you have to put aside resources on something you don’t have
information on, and which you today don’t have and then over time we have to conduct due
diligence, if you see that it is a vast part which falls on the outside, then we need to learn and
alter and not only once a year, but often, then you say okay it is probably 15% or 50% that is
the right number, then you have to learn by doing, but we have to start with a allocation we
assume is the right and not be too rigid on this.

And again you will have priorities within these?

Yes

In terms of cost related to PD, we wonder how lean has influenced the PD costs, ex use of
resources, number of people involved in the projects and bottlenecks?

The fact that we have become better to prioritize customer/user value, which at least is an
important brick in lean, to indeed optimize both process and product related to what creates
customer/user value. That has done something about how we allocate resources so I believe we
have a closer connection between what we uses our resources on and what we get in return of
the value we create. That has been an implication of lean. Then it is not necessarily the case
that we initiate a project just because some got an brilliant idea while taking a shower and felt it
would be fun to do, gut feelings and then initiating of huge projects, we have very little of
these. But historically it has probably been more of this in Finn when it was a startup, then it
usually becomes a few peoples gut feelings who function as a priority mechanism. We have
restructured this so it is more clear what we prioritize, so if not the costs has declined I believe
the cost has become more relevant, in terms that it is related to the value that are being created.
That is perhaps the most useful contribution. And since Finn are performing well our priorities
can possibly be influenced by this, because if you got a very good bottom line and few
requirements related to costs, then naturally you become more top line focused, that means you
prioritize broader and recruit more, then you have capacity to increase the speed and by doing
this it can happen that you miss the mark sometimes because you encounter priorities with the
same resources and then it is possible that the cost increases in some fields even though we see
it is probably not the most reasonable to do, but you can’t always know if a initiation of a
project was right before you try. So what we believe is that by doing it so at least we get a
faster respond to whether our assumptions and priorities was rightfully, so by working after the
lean startup approach you can say that we limit the PD cost by not putting in a lot of resources
before we actually has validated that it is workable, that we has gained insights and tested it out
in the market.

Does that also include the number of people involved in a project from start to end?

Yes, we did that for an example in Finn real estate, on the leader meeting last year we had some
assumptions on a showing app, that was good stuff, that is something people need and want.
We had more or less decided to make this both as a respond to become more relevant in mobile
channels and the wish to grasp a bigger part of the value chain then just the screening, we
wished to follow the user longer in the value chain and bring them with us on showings. But
being clear on validations we did this project through insight and launched small products to
low costs and observed customer/users on showings and interviewed them to a greater extent
then we do on other area. It was a product manager and a part time concept developer that
during 2 months turned the ideas around by learning from the validations realized that people
don’t want this showing app. You can just observe that on showings, there is no one who use
their phones, taking pictures, they don’t use checklist, they walk in, feel and smell and observe,
open windows and doors and after a quarter they are out, it is an emotional decision the choice
is based on. It is not very rational and few uses check lists, but most use the gut feeling. And
then we took it from here to here with one product manager and one part time concept
developer, in an old Finn approach we had already here (pre-development) start to utilize with
developers and made that app and used considerable time before actually validating that this
idea is not flying, so we hope even though we don’t have too many of these examples yet, but
we got a dozen. And that is the point to drive the cost down and be very clear on this validation
of customer/user value happens faster with less use of resources.

I, will presume that you used relatively long time, since it was only two persons and over two
months to develop that concept it was probably not that high prioritized, on the other side using
more people and getting the result sooner?

Yes, it took time since Finn real estate was dependent to play ball with the brokers so time and
maturity was elements we couldn’t fully control and then it possibly could be worse to utilize a
lot of development resources before really getting that maturity to happen, so I believe that was
a rational priority, on the other hand if we were on our own without the brokers then probably
we could have made this process in two weeks, we had managed to come here (verification) in
two till three weeks.
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When the product is launched, how do you measure success or quality?

Quality is a funny discussion, quality is if you ask a developer in Finn or one who connects the brand Finn and wish to induce an impression related to the brand and our corporate values then you often will get diverging perceptions from the quality we wish to put into our first iteration, because it is a fairly easy product here (initiation) it could be the case of a button, so the experiment is about the button, how many pushes the button, how big is the conversion rate and that is not a term usually aligned with quality from a product definition point of view, so we have worked to ensure we have the right quality at the right time, not everything needs to sparkle before we dare to launch it, because we need to learn and validate, that was the first what was the other?

Success, depending on how you measure it?

To use the example from real estate once again, what we work with is this circle here, in a way the definition for an experiment. We have a hypothesis of what the outcome is and then you build something that enables analysis and learning, it is really a PDCA cycle (Plan do control act) in getting product relevance in terms of customer/user value and for real estate it was to concrete ambitions they had with the first experiment. One showing the brokers that they got new persons, new leads and verify that this could be a lead generator for the brokers, so that was a success criteria for the experiments and they should show that this was right and if this happened then we believed it would become a larger part of the PD. Then we used the same success criteria towards the users because we are a two folded marketplace we need to validate and reach both. So then we had put up some absolute criteria’s for what the experiments should validate related to brokers and users and then it is important that when these experiments are ongoing the focus is on whether or not these hypothesis stand or fall, because either way learning has taken place, so experiments is about learning, not about anything else. And that has been an important part internally in Finn that when we talk about experiments they should entail learning. It should not be that we call it a pledge, because a pledge means someone has put their head in the guillotine and are supposed to pull it off and then it is not about learning then it is about fulfilling a top or bottom line. So experiments can be part of a pledge or several experiments in a pledge, but isolated experiments are only about learning. We are very clear that what we have gathered of insight after an experiment, that information should we be aware of, so we know what we actually needs to validate through the experiment.
And these experiments are probably in all projects you do, criteria’s needed to be achieved?

Yes, new marketplaces like Finn growth is a department which solely work to create the 5 new marketplaces after a lean startup approach after this process here, what we do now with the new large marketplaces which will make up the generators for Finn is to work very incremental and iterative, so they have got few resources, but authorization in terms of experiment, so they use experiments a lot to learn and then they reach a point where they experience this concept is workable and then you can start to utilize resources, in opposite of StageGate where the cost and risk increase over time, but we wish to move the cost decision to almost being here but in practice it comes here (development) so that means we can validate and verify in small batches long into the process till we decide to take the decision of whether or not we should put in considerable resources. That means we don’t have much time to make complex business case for the first gate, we don’t use much time on being fully secured for uncertainty, so what we do is small scale and that means we can have more incentives in the beginning before narrow down.

In StageGate the two first stages has focus on utilize resources to find out what the customers want, trends analysis, competitor analysis etc. here it is more like a ketchup effect, but you get immediate response and perhaps the reason why you can do this?

Sure, if you develop a yoghurt for Tine then it is different.

And that is perhaps where the line between what is a service. In these types of internet services you can use experiment, but I recall you had Beta tests previously, then this was clearly communicated, do you still do Betas?

Yes we have Finn users, where you can sign up if you would like to be a beta user, but the beta definition is also under alteration when working under this method, after doing some experiments to validate then we reach a point where we a product is close and you can say this can be some sort of a beta, it is first then you can say you have some more than just features of a solution. We have not been concerned with dispelling beta as a word, but it is dependent on which level we talk about, for some product ideas it will not be possible to isolate features who create customer/user value, you need to make it a certain scale and then you can say the product
we launch for validation is a beta version. So to a degree of pragmatism concerning levels is natural.

A significant part of lean is continuously improvement, can you tell how you work with improving?

An important part of the principle program is that we have a principle about continuously improving process and product and that is still an important part and to a degree the conflicting perspectives between innovation and lean, many imply that because you continuously improve, what happens is just incremental and the larger leaps is absent. Even though Toyota is the example of the opposite, where they have accompanied radical innovation, but we like to say that when we work with continuously improvement then we release resources to enable the larger wows. So continuously improvement is for us to build a culture where we all the time improve in order to create customer/user value so you can transfer this and utilize resources on other areas. That is why we mean innovation and lean can be connected, because you need certain resources to create the radical innovation, you create that by having a solid platform, the you release resources with continuously improvement. But it is also the choice of words, now we have some trends surrounding us, taking the mobile transformation so to speak, we need to weigh our words internally, continuously improvement will by many who not are lean geezers be viewed as we shall only improve this product and that will happen if we just improve a button, add color or similar, but that is not the case. For us it is about taking radical steps, so the word continuously improvement is something we have wrapped differently to avoid a conflict between incremental and radical innovation, continuously improvement is faded as word, but in practice and what we do every day continuously improvement is something we work with, and we have a very strong culture for this.

Is this also the reason why you will implement that one (portfolio management)?

Yes, it can be a response on that one, because you can say that even though you do continuously improvement and also radical innovation, when they first is launched then you will have to work through a continuously improvement context also here, so it will become overarching all these three dimensions, but I believe the most important for us is to clarify that continuously improvement is something we work with to release resources for the radical innovations. But there is also something about being keen, we have a value called hunger and in hunger it is natural to add what you should improve. So the fact that you continuously
improve and always to things better tomorrow is something people understand and it is
naturally to attach this to the value hunger. We have to realize that it is not good enough today
and make it better tomorrow.

That is also a big part of a business culture, can you explain more about how lean influence the
business culture?

It has influenced the business culture by increasing a user/customer definition and prioritize in
terms of this is perhaps the most important results after working with lean principles and lean
culture, for getting people to understand that we are here for the customer/users and that they
should optimize all values and processes to be more customer centric, I think this as least is an
important part of the lean culture in Finn. I experience many other companies talk about how
lean is a process improvement and then forget the customer and user perspective and then lean
become just a excuse for cutting heads or lean consultants enters and it is not because of
improvement in customer/user values, it is because they are there only to improve processes
and the management think this is okay as they will not cut costs. I believe it is important for the
lean culture in Finn that we have focus about the things that creates value for customer/users
and having the customer in center and then you improve from this perspective and this is what
these priorities of customer/user value been an important part of

In lean we talk about waste, what is your view on this in terms of innovation processes like?

I mentioned earlier ideation. And it is probably this area where lean and innovation clearly
clash because there is no control on which ideas that are useful, you have 3M where many
ideas formed the Post-It that emerged from a coincident. We had never been able to get that up
as a objective or saying we want a 1 to 1 correlation between idea and realized project, because
you will maybe want a strong connection between less ideas and more direct correlation
between the idea and what you achieve, but we have concluded that as long as the ideas have a
direction then we mean it should be a fairly large ideation. But we to also let ideas without any
direction through just to make sure it can possibly blossom insight we didn’t know of. I think
waste in this process is mostly here (drawing, not sure what) where it is important to find how
many ideas is needed or what types of ideas is needed, how many ideas can we manage to
process related to our priorities, because it was here (ideation) that we experienced a massive
bottleneck by having a blossoming ideation with no direction and where no one felt it natural to
grasp the ideas and this created both frustration for the ones who didn’t get feedback and for
those who got hundreds of ideas and tried to read, understand them. So we have worked on
how to create ideation and priorities to make sure we don’t get waste in this process. I think by
working incremental and iterative this will rapidly validate and then we can manage to
minimize ideas to bring further and they will hit the customer/user values much more specific,
thus it will be less waste in what we launch as product features.

Theoretically you will have a graph pointing up representing the value of ideas and one
representing the cost of implementing and an optimum where these intersect. Do you have any
ways to measure this?

Not present. It will become a natural part of the extension when we begin to measure the speed
from launch decision to validation and is clear that being fast related to cost in this phase is
something I have thought about as a objective. First and foremost we want to broaden this so
we get a more clear connection between ideas and what kind of value we manage to create. But
we don’t have any metrics on this and I don’t think we will get an overview of this neither in
the foreseeable future.

Is there something you wish to add that you feel we haven’t talked about?

No, I come from innovation and have worked with this field and then I came here and leading a
department which comprises of both lean experts and innovation processes and innovation
cultural building in Finn as a task. So every day we scuffle to get these things to fit and we
experience that we have managed this, that we have lean as a part of the Finn culture is
something we have worked with through the years - and it was also before I started here - to get
a solid platform to increase the innovation pace and for those to fit well together and then as
mentioned it depends on which words you use to create the right behavior and of course most
organizations get an maturity on terminology, you get some labels related to activities, so both
continuously improvement, lean and others. When you have a culture that reacts after what you
want it to do, then it is not as important what you call it and then it happens that method and
theory is faded. Then you find what the answers to lean in values or processes or other
behaviors and not necessarily force the belief that it is important to work after lean principles or
other form of labels. And I think Finn has reached a maturity where we don’t need to use it as
an argument for why, but can instead show to the effect of working lean in other ways than
calling it lean.
It becomes the way of Finn. We talked to another company they didn’t use the word lean but
used their own terms?

Yes it is precisely that. And it is a sign of a mature company too, that it has become an
integrated part of the organization and that you don’t need to use fancy words to describe why
you should this or this. If you look at healthcare lean has not been associated positively.
Because there it is not about customer/user value, there lean consultants has been hired to
improve bureaucratic processes and I believe there has been no goals to create a better
experience for the patients and then I think it is still many out there who perceive lean as a
generic improvement of processes and cutting cost, but nothing about customer value. And I
think there is many managements who still haven’t considered lean as a culture rather than a
process improvement they can use as a tool or hire lean consultant and then clean up the
organization and save some money and then get a positive bottom line.
11.5 Transcript: PD expert (SE) - 13.05.13

Introduction of our thesis...

MG: The first thing I would like to take about is regarding the product development process
that you use in Kongsberg Automotive. Can you tell us about that?

SE: I can talk about that I four days, so you have to be more specific.

MG: Could you explain the PD process shortly step by step?

SE: Officially, we are still using an older PD process which is a StageGate model. It has six
stages and six gates. We are in a process of phasing out that process, and are presently working
on implementing our new process, which we call KPD. Knowledge based development. That
process has 4 stages and 4 gates.

MG: Maybe you could tell more about those stages?

SE: In the KPD process everything starts with a ‘proposal’. If we get a client, or a client gets in
touch with us, our salespeople make a proposal ‘this sounds exciting and we would like to do
this’. If some inventor gets an idea and want to do research or develop something, we also
make a proposal. This is brought up in something we call a managing committee
(styrkommite), which shall have an overview of all the proposals that emerge, and prioritize
among these competing proposals. As usual, one has limited resources, so different proposals
are prioritized an approved. When a proposal is approved the defining (code?) stage.
The first we do is to gather the team which is going to work with this. Make sure that everyone
is on board and has a clear picture of where we are going. The first target is to make a decision
on the defining (quote?). There is basically three main questions to be answered in relation to
that. The first question is ‘what do the customer want’, and we have a number of sub-activities
in order to identify what the customer actually want. We call it ‘customer interest’. What is the
client saying in his specifications, and how can we interpret that to make sure that we really
understand what the customer wants. That was number one. Number two regards ‘how do we
solve this’, what construction do we need as to cover the customer need. Both the first and
latter part is completed with an ‘integrating event’, i.e. that we make a decision on ‘do we understand what the customer want’ and ‘how do we cover the customer need’.

The third activity is to integrate this in a project. What does this entail in time consumption, costs, use of resources, how do the milestones look like, what targets to we have in this project, and initiate the preparations for a negotiation. Then we have a last meeting where we conduct a project review, where the project teams decides ‘this is the way we want to go forward’. Then we can choose a path and go down to a quote approval, i.e. you get your case approved and shipped out, or you go directly to the gate. If you choose to go approach the quote… when you send a quite and notice that time passes by, you could go to the gate and initiate the next stage. Or await orders. It depends on the situation you’re in. That was the first stage.

The next stage is called development. You go through a gate in order to arrive at that stage. The first thing we do is to review and ensure that ‘this is what we should do’. Conclude on milestones, ‘are we on the right track’. Then you use quite a lot of time to process what you had defined already in the defining quote stage. Eehm, those gaps. Instead of looking for solutions we are looking for knowledge gaps or ‘unknowledge’. What we do not know. Then we work on closing those knowledge gaps, and when we have closed those knowledge gaps, we always have a number of construction solutions. Besides that we should work ‘set-based’. Which starts already at the defining quote stage. Then we solve the different ‘sets’ until they are on a level we have termed ‘success assured’, or ‘baseline’. I.e. we know that this is going to work. This is something we do through simulations, testing, trials, calculations and all of the above. So that we feel like all the component systems work. Then you arrive at an integrating event where you do a ‘final design decided’, i.e. we decide ‘this is the way we are going to do it’. Thereafter, the ‘set-based’ approach ends, and we know what we are going to do. Then we go on and do that, and decide who is going to deliver what, generate prototypes, what we call ‘DV’s’, which means ‘design validation tests’. We basically prepare everything so that we know how things should be. Then we have a big integrating event, which is very important, and is conducted with the team. People from sales, construction, trials, production, purchase, aftermarket, suppliers, sit down and argue ‘this is going to work’. Thereafter you invite the customer and tell them ‘this is how it’s going to be’, and then the customer responds ‘well yes, that’s exactly what we talked about’, the customer has been a part of the process all the way. Then we agree on how it’s going to be. Then we have what we call a ‘walk in the park’, we don’t have to show the customer everything that we have done, because he already knows. Then we arrive at the ‘Tooling gate’. At that gate one is allowed to buy the expensive tools, machines and such, which is required to produce this product. Then we go into a phase which is termed pre-
production. That stage remains similar to before, and is not especially updated. But the
principles is that you order, collect parts, tools, run trials, educate, line things up, do what we
call ‘run-at-rate’, which is a speed trial. We run PV, product validation. I.e. we make sure that
the product is still covering all the requirements. Then we prepare what we call a ‘pepapp’,
production part approval process. It documents that everything is prepared and ready. Then we
arrive at the pepapp gate, then we show that we are very prepared and deliver that to the
customer. Then the customer signs the pepapp, and at that time we often get some money, and
often send a start order start-of-production. And within the (open-close) phase we have a
containment plant. I.e. extra controls which are conducted under initiation, to make sure that we
do not ship of any scrap. Then we go to the customer and make sure that all problems are
solved before anyone sits in the car, which may happens too often. Then we do ‘lessons
learned’ and production takes over when we arrive at the ‘closing gate’ where we close down
the project.

MG: I see, and that’s the last stage in the process, which means that the project is over?

SE: The project is not finished. The project moves on to production. If there is any changes
during production we go in and conduct the so called ‘pit-process’, which stands for product-
 improvement-process. So there may be small sub-projects with updates and changes.

MG: You mentioned integration events, can you tell me more about that?

SE: We call it ‘technical narrowing decisions’, and builds on the idea that we do not look for
solutions but knowledge gaps. And that we always have a number of different ways of solving
the customer need. If you take a hammer, for example. It may have a wooden shaft, a steel
shaft, or a polymer shaft. The customer wants a good hammer with certain capabilities, and we
have noted that the customer thinks it important that it feels good in the hand, that it gives a
straight punch, and other stuff. Then we can look at a wooden shaft, does that fulfill the
customer interest? Maybe. Does it withstand the force required? Maybe. It was beautiful but it
may not hold. Then it’s an alternative that we may dispose quite early, because it doesn’t fulfill
the requirements. On the other hand, we have made steel shafts before, so we know a lot about
them from before and we know that it does this and that. That may be what we call a ‘baseline’,
or ‘success assured’. We know that if we make it in steel the customer is going to be happy and
we are able to make it. However, the customer may want a little more and a little better. If we
use polymer instead, maybe it will be a lot better and a lot cheaper. But, we know so little about
that. In that way we have a lot of knowledge gaps, and need to close those. What force does it actually withstand, does it stand heavy hits, what happens when it lays in the sun, and whatever. When we know this, we may use a integrating event to make a decision on whether we should use polymer or steel. In the old way of doing things we where very quick on thinking that polymer was the best material and then went on and used that. Then it may not work, because we do not know all there is to know. Then you make a decision on whether to choose the secure path of using steel, or the new path of using polymer. This is done as late as possible, but not a day later. This is done in integrating events.

MG: Okey. I got some areas I want us to cover, in a completely open manner. I would very much like for you to speak as freely as possible, so that we make sure to focus on what you think is important. You mentioned a little bit about using customers actively. Could you tell more about how you focus on customers in this process?

SE: Generally, as we are a supplier to the car industry, the customer has quite specific demands. Very specific. We can get everything from something drawn on a napkin, to two thousand pages of product specification which concerns the entre car, where we have to choose what concerns us, and if we should cover it all. The customer on their part points to two thousand sub-demands which points to some standard, or that industries own standards. So it may be incredibly complex. It’s up to the customer how to describe what they want. There is a lot of communication with the customer on all levels, their purchasers, their technicians, their test-department, and such in order to understand what they have written down. Historically we have looked closely at what they have written, but now we focus on trying to understand what they mean. It’s not about what they have written but what they actually want and need. It may be that you want to buy nice shoes, but really they should be made for hiking in the mountains. If you buy nice shoes, your feet will have a hard time hiking the mountains. But if you go to a good supplier which accounts for what you actually need them for, you may turn up with mountain shoes instead, and be very satisfied when you walk in the mountains. That’s where we are headed.

MG: What is your focus on lean principles in this process?

SE: We have such a great focus that we do not talk about lean anymore.

MG: Could you tell us more about that?
Lean product development systems

SE: We have been to lectures, we have been educated by Michael Kennedy, and Prof. Solbekk has visited us, and a number of others. We are a member of the Norwegian forum, we’re active in lean product development in Sweden. I’m going to have a lecture for LPDE, a European conference. We are very focused on these things. We keep contact with other organizations which is working on this, and believe we are in the very front in comparison to others. In this development.

MG: Exactly. You do not call I lean but do you use the lean principles?

SE: I would say we do, indeed. We have a number of institutions who have investigated us. I just received a book from Chalmers, ‘improving engineering change processes by using lean principles’. There, a gentleman called Micheal Strom recognize that we use several of those principles. We do not necessarily look at the principles and do exactly what they say, but believe that we have understood what they mean.

MG: Could you elaborate on the effects that the implementation of lean principles has made on the product development process?

SE: We are under deployment, so the majority of the organization is using the old. But we receive very enthusiastic feedback, everyone is very positive. We notice that we’re doing a double-investment. Firstly an investment in education, secondly a front-loading of the projects, and quickly realize that mistakes we have made previously. It’s always a bit though, but also very positive and creative. We have a number of examples where we get a lot smarter and approach what we need to do more hands on, thorough the utilization of these principles.

MG: Could you tell more about the front-end loading you mentioned?

SE: It’s about using a lot more time on understanding what the customer really wants, instead of just looking at the specs. To work towards understanding what we do not know, instead of looking for quick solutions. Build knowledge before we make a decision on what we should do. Before, we went from order to chaos, we took decisions fast, let’s do this and that. Later you realize that this doesn’t work. Imagine that you decide to go for the polymer shaft on the hammer, but it turns out that doesn’t work at all. What do you do then? When you’re sitting
there with expensive solutions, equipment and everything. It’s almost like you can’t change
anything because everything is set.

Now, we go from chaos to order. I.e. it’s allowed not to know all there is. And look at the
possible alternatives and solutions to this, instead of making quick decisions and solutions. We
make these decisions as late as possible. We may recognize that this takes more time in the
beginning, but still save so much at the end. Instead of making a fast decisions, we build up
knowledge to make sure that the solution actually works.

MG: Could you elaborate on possible alterations in how you manage the project portfolio, after
the implementation of lean?

SE: It’s undergoing great change. The idea is to integrate something we call ‘business events’.
That’s where we approve proposals. Instead of bringing up everything we see, we look very
carefully if this is good business, and prioritize and make decisions on what we actually should
commit to.

MG: You touched upon the factor of development costs. That the use of lean tend to increase
the costs in the beginning, but reduce costs later. Could to elaborate more on how the use of
resources develops throughout the process?

SE: We do not have a lot of statistics, as this is getting deployed. What we have noticed,
however, is that when customers make decisions, which is radical, we can tag along because we
focus on knowledge instead of a solution to a problem. In the old times, we have not managed
to do this because we would have lacked knowledge on how that worked.

MG: Could you tell more about the use of teams?

SE: We had a process called MPI earlier, which builds extensively on project teams. Those
teams have not really changed, where the same team should be a part from the beginning. The
management’s understanding of the importance of these teams, however, has increased quite a
lot. That they are allowed and must be part of the project from the beginning, and that you can’t
change them so much. You can’t change people a lot. In such a way the weight of teams have
increased with the new, but we also used it earlier.

MG: Is there any specific methods in which the team use in the process, or organization?
SE: Hmm, can you be more precise?

MG: Often, you go from a more departmental separation towards cross-functional teams.

SE: Purely process wise, it’s the same as before. It’s old news to us. But insight around this, the old departmental mind-set where the teams are more present on paper than in real life, has increased among management, where we try to make sure that the teams proposed actually happen. We often call it ‘customer focus team’, where we have smaller teams which are dedicated to certain customers, containing sales, construction, production and so on. They stick together and learn to know their customer and their special needs and how to solve these. In addition, they contribute on updates and so on. It’s a lot faster and more efficient to do it in this way.

We also use ‘obeya rooms’, where we have project facilities, which is not quite simple in our global environment. Both us and the customers are very global. Because of this we are present in Europe and North-America, which demands both communication and time. Night and day and so on. There are a lot of challenges related to this and functional teams. To goal is to achieve well functioning teams.

MG: Is there other methods besides ‘obeya rooms’ in which you use?

SE: You need to be more precise.

MG: I’m wondering if there is specific methods you use, obeya rooms may be categorized as a practical method in order to visualize and establish an overview.

SE: Yes, we try to work on visualization and planning, and divide this into different levels. We are not at the front regarding this, it’s a lot of talk at this point, but we try to make sure that the participants get an understanding of what they are supposed to deliver and take responsibility that stuff gets done. Even at the bottom level of individuals. The middle-manager then controls of individual members of the team actually delivers what is planned.

MG: An important part of lean, at least in it’s origin, is the element of waste. Could you explain how you perceive waste, in relation to the PD process?
SE: We discussed this a lot in the beginning, and we said that’s probably not where the big
gains are. It’s like in Toyota, where it’s said that 80% of work in organizations is not value-
adding.

Waste in the form of searching, finding information, looking, and such, is something we look at
but we have not adopted that method. Anyway, our new way of working is going to eliminate a
lot of waiting and information search, through making sure that the team is functioning better,
better communication, and an increased clarity around roles. We are not hunting for those
waste elements.

MG: Okay, but do you think there might be other kinds of waste in PD?

SE: It’s very different from production so it’s hard to approach in the same manner. We have
concluded that lean product development is not about removing waste, but to move from chaos
to order. Instead of order to chaos. That we look for knowledge gaps instead of solutions. That
we have integrating events. This enables use to reach targets a lot faster, instead of looking for
specific kinds of waste.

MG: You mentioned that the customer usually provide specs on what they want, but can you
tell us about other forms of measurement that you use in the pd process?

SE: We have worked hard on establishing useful measurements. Now, we have establish one
classic way of measurement which is ‘contribution margin’. This is something we have used
for several years, and has basically been the only way of measurement. It’s not a very good
measurement, but its not bad either. Presently, we make sure to put up the most important
‘customer interests’, while making these coverable. And that’s the target in every project, and
that shall be measured. The important element is to make these customer interests coverable.
The customer may want a good or happy feeling through a gear shift handle. How do we cover
that? But because that’s what the customer actually cares about, we have to sit down with the
customer and figure out what they actually mean by that. And put a lot of effort and time in
covering that need. The projects has to be coverable, and should in principle be based on
customer interest.

MG: Another important part if lean regards continuous improvement. Can you elaborate on
how you work with that?
Lean product development systems

SE: Continuous improvement is something that can be done in numerous different ways. Our
development process, which is my job, we have a process that is called MPI. This has
undergone a number of major improvements, and was implemented in 2004. It was further
updated in 2006. Clearly improved in 2008 and considerably improved in 2010. Now we are
working on a new process which is called KPD, which is a complete make-over. I don’t think
we should call it continuous improvement because it’s a lot bigger than that. In the process part
we have a high focus on improvement and change, and we try to have updates every 6 months
or so. Continuous improvement entails improving our way of working, in my world. The other
side of improvement regards the engineering solutions that we provide. Production solutions.
It’s about identifying knowledge gaps, closing these and making engineering decisions. When
those decisions has been made there is no way of changing that. It’s a good decisions and a
construction that works, in an ideal world. Then you can try to reduce costs, which means a
project within the project. You approach it in the same way, what are the knowledge gaps, what
do we want to achieve, and how do we get there etc.

MG: You mentioned costs. Could you tell us about the costs after implementing lean
methodology?

SE: We are moving away from the old way of doing things, where we conducted a cost
calculation on a construction and added a contribution margin, while now we are moving
towards a value-based thought where we investigate what the customer is willing to pay for this
function. Then we put cost targets on the development of this construction, which entails
another focus. i.e. we do not specify a car, we specify a rolls Royce, a Skoda or whatever.
Because a rolls Royce has completely different cost targets than Skoda. Then we work to
uphold these cost targets instead of solving a construction and try to force this on the customer.
This is intimately connected with understanding the customer need.

MG: Have you experienced a decrease in costs as a result of this?

SE: We have statistics which can show that, but it’s very important to know. Imagine that we
do an exceptional development job on one product, which has the very best materials, but the
car doesn’t sell. Then we produce and earn marginally. We may have a very poor construction
which barely holds together, but the car is very popular. Is the project then bad or good? It’s
very difficult to measure this in a good sufficient way. What we try to look at is the number of
‘look-backs’ and start-up problems, and in some way establish if the project is good or poor.
MG: At this point it believe we have covered the generic points I had in mind, but I was wondering if there is something especially important that you want to highlight in relation to the effect of implementing lean methodology?

SE: The most important thing is to establish interest among management, making them actually understand and getting them to implement lean. I can sit here with the best solution in the world but it doesn’t matter if management is half-way in and doesn’t really want this. It also leads to a mind-set among management, where they need to loose the old way of doing things and actually pursue this new approach.

MG: Could you tell us about potential changes in the corporate culture?

SE: We notice significant changes in the culture. We notice that management is starting to ask quite different questions, and entirely different demands towards the projects and the way of thinking about the future.

MG: What about the culture outside management?

SE: There is also a change on the team-level. Instead of wanting to have a solution on the table tomorrow, the boss should asks what is exactly the problem. Instead of just pushing forwards, we stop to think about where we are going.

MG: You also mentioned that the teams have greater importance.

SE: It’s more obvious to management how important the teams are. That they exist, and that they are a part of the project from the very beginning. The insight regarding the gap analysis. If the team doesn’t understand what they are doing you can’t move forward. If production is not a part from scratch, it’s going to be bad.

MG: Is there any other major changes that you would like to highlight?

SE: We are on a journey, and it’s very important that management takes active part in this, and not only the steering of this journey. Management should not sit in the back seat, something that has happened a couple of times here. That should be avoided.
MG: Can you explain how you work with standardization?

SE: Platforms are highly transferable to PD, but this differs a lot internally in the business.

… Goes on and explains a highly technical part…

We move from selling 2000 units of one part, to towards making entirely unique solutions for every customer, and every product. That there is a product which only is made for that particular car, and is not found anywhere else. When we are making these unique parts we are trying to be better at building these on modules. A manual gear shift handle for example, may consist of 100 modules, so different combinations may provide entirely different gear shift handles.

MG: Very interesting. I though maybe we could just summarize. Our problem definition was what effects the implementation of lean has on product development. If you maybe could summarize what you think is most important regarding the effects you have experienced with regards to implementing lean?

SE: To move away from looking at quick solutions, and towards understand what the customer actually wants. To close knowledge gaps before you decide how to solve a problem.

MG: We have heard that companies are moving away from lean and towards knowledge based development. In your understanding, could you explain the difference between lean product development and knowledge based development?

SE: I do not necessarily see the difference, because lean is a holistic way of approaching development processes with lean perspectives. Knowledge based development has a stronger focus on making decisions based on knowledge, instead of wishful thinking. KPD is a better way of explaining how one should conduct product development than lean product development, where you look at waste and principles. I think that is a bit weird. We want to make decisions based on knowledge. KPD is more than developing new products, it’s about our ability to understand customer interest and the physics needed to fulfill them. The knowledge built up will enable Kongsberg to develop and deliver great products at the right
time (JMF MODEL). It’s not about developing products, it’s about building knowledge around the products we are going to make. …talk about the model…

MG: just to sum up, one thing which has been mentioned in relation to waste is that of not transferring knowledge generated in one project to the next. Knowledge loss, which can be seen as a form of waste in PD. In that way it’s important to store the knowledge created in one project and build further on that during the next. Can you explain how you work with that?

SE: We call it knowledge standardization, and we have a program called robust learning. You solve problems in a robust way. Then we use principles called ‘LANDA’. We call it Kaybriefs, which resembles A3s. We try to focus on how solving a problem generates knowledge. You know what happens if you do one thing, but maybe not if you do it a little bit different. I.e. you have ‘punkt’ knowledge, and the whole point is to translate that knowledge into ‘curve’ knowledge. The point is to enable one to go straight into a trade-off or limit curve and see if this works or not. In order to arrive there, we need to have certain individuals, which we call ‘knowledge owners’. These makes sure that the generated punkt knowledge is transferred to curve knowledge, because the projects do not have the time to transform the punkt knowledge. If they have solved a problem they move on to the next, without this being documented. Therefore we have deployed these knowledge owners and a system which documents and standardizes knowledge. We do this very freely, so that every knowledge owner can build knowledge as he likes, but we have different templates that help structure and visualize knowledge. There are two things one should do. You should make it usable, from curve knowledge to punkt knowledge. And you should make it visual. I.e. that it’s possible to see it. If you do not have those two factors there is just information which is useless, or at least hard do utilize. Then it’s not going to be used.

MG: When you talk about visualization, what do you mean?

SE: If you don’t know how to place something, where it should be, how it may hold, or whatever. You can talk with the knowledge owner in charge of that area, and he can show you something visual. Often a graph, a table, a picture etc. An by looking at that, both the knowledge owner and the problem owner can agree on what they are talking about. Then hopefully, in the future, you could say ‘okay it’s on that side of the curve, then its not a
problem’. We also make a choice in a trade-off between what’s important in this and what should we choose regarding a level on the scale. That’s how visualization is done.

Rounding off the interview…
11.6 Transcript: Prof. (TW) - 11.04.13

The interview started with a short introduction of our background and the topic of our thesis…

When talking about this, we were wondering if you could use an example from your experience in the industry?

TW: I have worked quite a lot in the industry, including implementation of Stage-Gate and early-phase PD, in fact together with Bob Cooper. We worked together on a project some time back, so I’m pretty familiar with the Stage-Gate discourse. In addition, I have worked quite a lot with LPD the last six to seven years. However, that’s more from an academical perspective. I’m also a part of projects that are going on presently, which entails implementing lean PD or knowledge based development, in organizations that have an existing business system or process which is highly Stage-Gate oriented. I know the research area.

MSP: It would be very interesting if you could tell us about implementing Stage-Gate together with Cooper

TW: If you go back to the time when Cooper started with this, he’s probably one of the most referred within PD literature, he began with Stage-Gate already in 1984-85 I believe. But that’s a traditional stage-gate process which is more focused on what happens after the idea phase. I.e. when you have a kick-off on a programme, where you make a go decision, until market launch. That has been the traditional Stage-Gate process, to begin with anyway. People like it or don’t like it, but it has been proved that approximately 80 to 90 percent of companies has implemented Stage-Gate in some form. It has been a success based on that. Even though they have implemented it, firms fail with innovation and so on anyways. In spite of Stage-Gate, or maybe because of it. But enough about that, he was working on this and has published a lot of books. You have probably read a lot about it, because it’s typical literature to be used in business and among engineers, such as myself. You have probably read a lot about it. The critique has been, based on various company’s but also academics, that the stage-gate process is too rigid. This is something that Cooper adopted, and in 2007 he released a paper on having a ‘leaner’ process. A leaner stage-gate process. He then customized the process towards projects, where you did not have to go through all the phases, where you could skip phases, skip gates, you could make simpler processes on types of projects which had been done previously, if there...
was a small risk, for example. If you work in an organization and improvement on a existing
product could in itself be a project, but that does not entail the same risk as a project where you
are working on a completely new product. These different kinds of project categories do not
need the same degree of stage-gate process, in a way, or the same kind of stage-gate process.
This is something he approached, and came up with some suggestions in his paper from around
2008. I think he calls it a lean or flexible stage-gate approach. That’s some of the background.
When I got in touch with Cooper, which was before that time, we wanted his help to implement
stage-gate. Not in the conventional process, which starts at the go decision point, but the phase
regarding research and everything that goes on early. Idea generation, collection of ideas,
evaluation of ideas, initiating technological projects that will possibly enable new products etc.
The product in which the company is going to feed on, not only tomorrow but maybe 10 years
forward. So, we implemented a stage-gate process in the company I worked with, based on
Cooper’s approach, but with validity in early phase product development and research. That’s a
little bit about my background.

MG: You said initially that you recently worked on implementing lean in a stage-gate
process…

TW: Just to make sure how we define stage-gate and how we define lean, because when we are
talking about lean there are various perceptions, theories and ‘religions’ around what lean is.
Especially when you bring it out of manufacturing, the factory, and over to offices, and product
development environments. The research question that you are working on, as I see it, is based
on stage-gate being a process that controls a business process which enables a company to
utilize it’s resources in the best possible way, with regards to generating value for the business.
Put simply, that’s what it’s about. To make sure that you are always investing correctly
throughout a product development process. To compare different projects simultaneously,
evaluate, and make go/kill decisions. Is there other opportunities or not, and so on. That’s what
it’s basically about, if you look at it in a generic way. The stage-gate process is more or less a
governance process, i.e. a management process for the business.

MSP: That’s what stage-gate is about, it’s not only a system for PD and production, but also a
strategy for the business on a higher level.

TW: Cooper says that a PD process is nothing else than an investment. You are always
focusing on using the company assets in the best possible way. From a business perspective.
The question is, are you using the available resources on the most valuable activities. It boils down to new-present value and that kind of stuff, commercial value etc., and there you have our portfolio at any time. Then you remove projects as the risk become to high, because new options emerge which are more interesting with regards to maximizing net-present value. That’s basically a stage-gate process. It’s a governance process that secures the business. If we can agree on that, we can move on to lean, and LPD.

LPD is not to use manufacturing lean and convert it to office functions like PD. LPD, to me, is very focused on how the business use, generate, standardize, generalize, re-use knowledge with regards to minimizing risk within individual projects. I.e. how one shall, from a development perspective, make sure that the project are doing the right things. That’s lean, in short. If you then think about LPD, it’s a process in need of a lot more guidance. It’s about all the time leading the ones that develop products so that they work on the right stuff, in order to answer the questions that are unknown at any time, with regards to reducing risk. A LPD process can’t be set up in the same way as a stage-gate process, where you say that gate 1 is like this, gate 2 is that, 3 is like this, and then you do the same things. Someone reports from a project and you go through a list and look at the different stuff. Yes, we have done this and that, everything is ok, but the product doesn’t work anyway. That’s stage-gate. But in a LPD process there is a dynamic situation where you do not necessarily know what problem you need to solve. You need a product that brings in money, but for example if you need to make a product that is difficult to manufacture, you need to install a new manufacturing process, you learn stuff as a result of the project. Then the project and the problem definition has to be so flexible that the project team can use their resources on solving emerging problems, and the problems related to that, instead of focusing on the gates at a business level. It’s about all the time generating and re-using knowledge from previous projects; make sure that there is a dynamic way of approaching things. Guidance more than governance. As I see it, that’s the difference between lean and stage-gate. They are more or less contradictive. LPD is a process for the PD team, and how they should work and prioritize their resources and assets based on solving problems, remove risk, making sure that the product emerging from the process is as good as possible, based on what they have learned along the way. A stage-gate process is a process established for the governance of the business and all it’s resources, with regards to maximizing net-present value on the portfolio.

MSP: We are definitely talking the same language, but what would you regard as similarities between stage-gate and lean?
TW: I’m sending you an illustration…

TW: Have you read a lot of literature on this matter?

MG: We have read about lean, the history of lean, and what lean has become. We have also read about Stage-Gate and other forms of product development regimes. We have chosen to focus on stage-gate because it’s a dominant concept within the world of PD. Lean came from Toyota, but has grown to become a concept of it’s own right, which to a large extent is not connected to production anymore. We therefore think it’s interesting to investigate how that actually works in product development processes.

TW: Remember that lean manufacturing and lean PD is not the same. If you look at TPS, and read books about that, the Toyota way and so on, which Likert wrote, you will notice that it’s not the same thing. It’s two different things, but they use the same word which is lean. Lean is highly context related, so Toyota, Japanese culture, organization, size, types of projects, i.e. the automaker industry, is not transferable to a small start-up company consisting of two or three people. You have to make your own lean version, what lean is to you. Based on your situation. If you look at the different stuff published within various areas, you will notice that…

one religion takes lean from manufacturing and look at queuing, and that kind of stuff, and then use a lot of that stuff, the tools from manufacturing, and use it in PD. That’s one school. Others say that lean is knowledge based PD. Everything that has to do with the process of knowledge generation internally in the company is lean. A third school thinks that lean is about selecting a bit here and there, based on principles, and then you make your own version. There are some underlying principles, but make your own adjustments independently of Toyota. Another school thinks that lean is just an outcome. It’s the results that matters. All the tools you can use in that regards, which enables you to have a better process and a better outcome from the PD process. The last part concerns re-labeled lean. If you talk about lean stage-gate, for example, they have no history together. Lean and stage-gate have entirely different origin, and serves entirely different purposes. That means using lean might be a way to sell books, right. Then it’s often called re-labeled lean. Therefore, there are no general perception of it, i.e. there is no right or wrong answer to what it is.
The illustration I sent you, slide two… I wrote a paper on this. That slide basically summarizes what I have been talking about. It’s about knowledge, autonomy and product engineering knowledge. To what extent is the process governed by knowledge, engineering knowledge related to developing the product, is the Y axis. If you look at the top there, I have illustrated what I term ‘a firms engineering knowledge standard’. If a company has a knowledge standard, that means ‘this is how we do it, and everything we do is based on that’. You just use what you know at any time on every product you develop. Product engineering knowledge govern everything you do. It’s the highest level. If we look at the bottom level, you are located at the opposite end. I call it governance. That’s where the stage-gate process is involved. At that stage product engineering knowledge is not that relevant at all, regarding what you do. If you’re developing a service or whatever, but I assume you’re developing a product. Then you have the stage-gate process on the bottom, which govern things from a business perspective all the way through. The degree of governance from product engineering knowledge is very low. In middle, between those two, we talk about lean product development. How you should merge those two. How should you merge when you have a standard in the bottom, that’s what you know, but you all the time have a value chain of knowledge where you build on that standard through learning in the projects. And how you are able to use that towards the team and make decisions and come up with solutions to problems. It’s not that easy to understand, I’m not even sure I understand it myself. The stuff in the middle, about transfer, generation and new knowledge. It says integration as well. That’s the lean process. That’s lean product development. We are then talking about events, not gates. Events where we solve problems and use a flexible process which may include a certain number of learning cycles in order to solve problems. You have a certain number of design reviews, depending on what problems that emerge along the way, which you have to solve in order to make a good product. Then you have some stuff concerning design integration, process integration, etc. I have tried to symbolize that the lean product development process moves from engineering knowledge towards a stage-gate process as the project is initiated. When you talk about integrating a product into production, you will more and more talk about such gates or events. The same things. For example, if you have bought some tools. Does the tools work? The production equipment, is that working, according to speed? Are we producing the quality that is determined. Have we defined a value-chain without problems. The questions are basically the same as in the stage-gate. They are melted together. The big difference lies in the beginning, where you don’t really know what problems you are going to encounter, which you have to solve. Then you can’t make a stage-gate model that suits every project and at the same time make good products.
Lean product development systems

MSP: In stage-gate you have an initial phase which is termed discovery, and you can’t always know what problems that will emerge later in the process...

TW: That’s impossible to know, but what you are delivering at the gates is given. The questions asked are very much like task-lists. There is a task-list, and you ask: have you done that? Yes. Have you done this? Yes, etc. Then you check off the list and everyone agree that things are done. Then you arrive at gate 4, and everything is done according to plan at gate 4, and ask one critical question: are you able to control the quality of the product? No. Because that was not on the checklist previously, but something they learned as a part of the process.

MSP: We had a conversation with Jan Darnemyr, in lean communications, he has worked in GM and SAAB. He told us about running in to you, and that we should say hi.

TW: We met at a seminar in Kongsberg this winter.

MSP: He told us that they used some kind of stage-gate in SAAB as well, but where moving away from that and towards what they called ‘verification processes’ where they tested all the systems together. Instead of having the checklist and gates, they used had a verification period serving as a checkpoint.

MG: He called it integration points.

TW: Integration events. That’s what we’re talking about here. Have you read any of the stuff Michael Kennedy has written? Regarding knowledge based PD?

MG/MSP: No

TW: If you imagine a company that’s working on several projects, some in parallel and some at different times. Then imagine that every project has it’s own value-chain. You start with development and then you produce. That’s a common value-chain. Across these projects there is also a value-chain, which entails generation of knowledge. What knowledge is generated within each project, which you can update and put to further use as an asset of the company. Knowledge you can use in other projects. In LPD, you do not have just one value stream, but two. You have one for production and one for knowledge generation. So, if you ask them what
waste and value is, which is essential in lean, you have to ask with regards to the project and
the problem you are trying to solve there, and/or value generation through new knowledge that
can be utilized by the company later, in order to reduce risk in latter projects. Therefore, these
integration events will have two purposes: to make sure that the project team is integrating the
knowledge they have generated. You test if you have solved the problems at hand…define the
problem that needs to be solved, and then you conduct integration events where you figure out
how the problems have been solved as to reduce elements of risk. That’s one side of the
integration events. The other side is about integrating the value-chain of knowledge with the
production value-chain. I.e. when developing a car, for example, there is someone in charge for
the suspension, the engine, the gearbox, and so on. The car is a product of all these elements
working together. It’s about making sure that quality assurance is done based on previous
experiences within the company, where you transfer knowledge from the knowledge value-
chain to the production value-chain. At the same time, you integrate new knowledge from the
production value-chain into the knowledge value-chain in order to make sure you are always
learning more. That the company is learning and has a greater foundation towards solving
problems in the future.

MSP: Can you tell us about the companies you have worked in and how they have used and
communicated knowledge?

TW: Hmm, there is so much to tell. I can send you another e-mail…

MG: Is it possible to call knowledge based development a continuation of lean? Just to make
sure that we are keeping within the frame.

TW: Kennedy calls it knowledge based development. That, however, is not a title that sells a
lot of books. That’s why they use the word lean. Still, it’s a lot of the same stuff. The one that
tells you that those things are not the same, I would really like to have a word with.

MG: In lean you have various tools/principles, could you elaborate in a concrete manner what
your experience is with these in PD processes?

TW: I have several examples on that. But there are not too many tools in LPD, compared to
lean manufacturing. In manufacturing, you have several tools like kaizen and so on. Techniques
that you use. Value stream mapping, events, for example. In general, processes that remove waste. There are several methods like that in lean manufacturing.

MG: We have defined lean on a high level of abstraction, so that it can be used in all kinds of industries. We have looked at throughput time, i.e. getting a unit through the process fast, for example when you are developing a new product vs. maximal resource utilization. We therefore argue that lean puts more focus on throughput time than maximal utilization of resources.

TW: That sounds correct.

MG: Can you tell us more about this with regards to PD?

TW: In my experience we have looked at several of the things that you mentioned, queuing theory, throughput time and so on. There’s a guy called Don Reinertsen, he has written several papers and books, including a book called ‘design factory’. He investigates throughput time and such. Most importantly, regarding those things, is the products that is sold to the end user. If it’s important to launch a product fast in order to compete with other products, cost of the lay is an important factor, because if you launch the product too late you will loose important parts of the market. Then someone else takes it. I have not worked too much in that kind of industries, I have worked more with industries and PD that deliver something on a certain date, because there is integrated systems with several suppliers etc. Then things need to be delivered on a certain date, and it’s up to you if you deliver on time or not. You need to make sure that the process delivers the product into the marketplace at a certain time. The product moves one step down in the value-chain, you could say.

My experience is that LPD is not that focused on getting things through fast. It’s fine to make things simple and reduce the amount of time you spend on stuff, but it’s more important to do the right things. It’s about solving the problems. Cutting corners will only bite you in the ass with a strength multiplied by ten when you identify problems later in the process. If you don’t identify problems early, the problems will identify you later. That’s my experience from PD. The problems you don’t identify early will, no matter what, emerge later in the process. And that’s what destroys projects, innovation, and profits.
Of course, if you look at PD like a production process… for example, if I want to solve an
equation in order to find the dimensions needed for an element of a new product. If someone
sits down with a stopwatch and times how long it takes me to lift up the pen, then I put the pen
down on the paper and start to write. When I’m finished writing, I may use some time to think
a little bit, and he starts the stopwatch again. In the end I may be finished with the equation, but
you might tell me there was a lot of waste in process. There was a lot of waste because I lifted
the pen from this point to that, and I hesitated while I was writing, I may have twisted and
turned a little bit, maybe I even went for a cup of coffee and so on. There was a lot of waste.
But it’s not these things that create waste in PD. What creates waste in PD is the equation being
solved incorrectly, or if I have not identified the stuff I actually needed to calculate. See what I
mean. It’s those things that matter with regard of becoming lean.

MG: You mentioned that you worked on a project recently; can you tell us more about that?

TW: I just sent you a paper which is not yet published. It is supposed to be published during a
conference in South Korea this fall. The reason I sent it to you is that it describes a lot of things
concerning the research question that you are writing about. Did you receive it?

MG: Yes, we are looking at it now.

TW: It’s based on one of the companies we worked with. They chose to follow a strategy
concerning the implementation of lean, where the use a pilot first approach. They choose a
project and decides to try these integration events, based on the illustration I showed you
earlier, showing the stage-gate on the bottom and the lean process above, then the standard on
the top. We try to implement the lean process with integration events and so on, on our
business system, but only on one project, what was the company said. What we did then was to
follow the process to some extent, we do not have enormous results on this, but the paper
describes the research question which was the starting point. We have some results but not big
ones. But you may find interest in it because it describes quite a lot of your research question.
That company has chosen to look at their process, how they work, how they define learning
cycles where they do rapid learning based on the challenges related to a specific project, and
then combine this with a so called ‘war room’. In the war room they have all the relevant
information, timetables, technical challenges, resources, commitments between stand-up
meetings and so on. Two to three times a week they conducted 15 minute meetings where they
review, discuss status and provide feedback, for example. How they are working on solving the
problems they have identified, and how the learning cycles has been. Another important part of
lean is visualization. Visualize plans, visualize responsibility, visualize problems through
knowledge briefs, for example, when we are talking about tools. A3 documentation where you
compress problem areas down to one sheet of paper, where you systematically describe the
background, the problem, how you approached it, what you have discovered and how you can
utilize this in the future. What you have solved, in a way. When talking about A3
documentation, there is simply a sheet of A3 paper, where the complete problem is compressed
into one page. Which, of course, is thought through, with illustration and so on to show
connections and stuff that needs to be solved. That’s how this company has worked when
implementing lean. Obeia room, or war room. We test the implementation on one project,
change the way we work on that project, and see how it goes. That’s basically what the paper is
about.

Another company I worked with chose a different approach. They where also focused on
creating a process located in the middle of the illustration I provided, within their stage-gate
process. You do not remove the stage-gate process, neither did the other company, but they
integrate this way of working into what the framework they already have. They, however, do it
in another way. They implement it over several projects simultaneously through the business
system, but maintain a pilot site, as a figure of speech, they work in a lot of different countries.
It’s based on a lot of the same stuff, they use war rooms, visualization as a tool, plans. They use
a lot of knowledge briefs and A3’s in order to solve problems. They do much of the same stuff,
but test it out broadly and maintain a full anchoring, which is a prerequisite because you change
the entire way of working throughout the company. There is a full integration all the way up to
senior management. In that case I’m observing how the team absorb this way of working. How
these integration events are happening. They answer questions, fifteen questions regarding the
process, results from the meeting, and how they experienced the entire setting. We ask
everyone, and every project has several integration events, and the idea is to follow the
development and how this is absorbed in the organization. If it’s a success or failure.

MG: Could you elaborate more on how they manage the development teams in PD?

TW: In the latter company they use typical development processes that last for three years.
They use cross-functional teams which is established in the very beginning. The company in
question deliver to the final link in the value-chain, within the car industry. They deliver to a
company that makes cars. Those development processes are defined, so you have to follow
plans and timetables. If they develop something faster than others, it won’t matter because they
can’t launch it and earn money. They have to follow a project plan made in advance. They put
together cross-functional teams which is quite market and sales oriented, together with
engineering. When you get an order, you involve production, logistics and so on. They have a
team consisting of 7-8 people on each project, which works on several kinds of problems
simultaneously. It’s very dominated by design and product development in the beginning, but
becomes more dominated by production and technical problems as the PD process moves
forward. There are always cross-functional teams that work on different problems with regard
to the present position within the PD process. Did that answer your question?

MG: Can you tell us more about the dynamics of the team throughout the process?

TW: One important aspect of lean in relation to modern PD processes, previously you had
concurrent engineering where you develop things in parallel, which represented communication
problems. The more communication points you have, the more people involved, the bigger the
problem. The more handovers you have throughout a PD process, the greater risk. In the latter
company they use one project leader from the project is defined, which represents the
continuity in the project. The idea is to reduce the amount of handovers. Of course, you still
need to maintain communication internally in the team, and make sure that production
understands the design people, for example. They need to talk the same language. Logistics
need to understand production and so on. Quality may have a generic overview of both design
and production and so on. Communication is an important part of this.

MG: Could you elaborate on how they integrated customers into this process?

In the development process, yes it is the specific firm they are a tier 1 supplier and delivers to
those who produce part to cars and they typically deal with the customers because they come in
with the requirements and say ok this product is suppose to weight this much and do this etc
and then you develop this and get it best possibly and then it should not cost more than this.
That is how they do it and in the first phase before they make their offerings and get an order,
they have to be clever and alternative, think about what is strengths in relation to those
materials they have so they can solve the problems in terms of the initial spec. In some
instances they work long-term because they have an advantage, they are an integrated supplier,
which entails benefits compared to other suppliers through their close work with the
development department at the factory. Based on this you could take part in the establishment
of specifications so that they favor ones own products, thereby maximizing the chance of
getting the order if they are put out on quoting among other sub-suppliers. That’s the first part,
then they work closely with the factory and deliver prototypes and design, design solutions,
prototypes on different levels along the whole development process which takes about two to
three years. Then they work with systems ensuring quality, earlier called QS 9000. Now it is
called TS but I don’t recall the number, but it’s kind of a StageGate, however it is a quality
measurement system. To make sure the suppliers do the right things in terms of making products
with the right quality at different occasions and that it is possible to monitor for the car
producer. That was one of the company’s then it was another who delivered to end customers
and taking part in a lean PD project, they make speed boats. They involve customers more
directly in the development and gets feedback directly from lead-users concerning how new
concepts will be received in the market. So they are working actively with the involvement of
experts or lead-user in order to identify the demand for smart solutions and so on. They also
involve existing customers and get feedback on the boats that are already in the market, what
the problems are, what is good, what is bad and etc., and use this information when they
develop new products. Lean PD can be summed up in six. It is about customer focus,
standardization, management and infrastructure that enables quality ensurment within PD an
examples is that you don’t have people involved in 10 projects simultaneously, resource
planning etc, a infrastructure that makes it possible to work in a proper way. That people don’t
work with the to much, that the people that needs time to think get the opportunity to do that, a
way to work that constitutes stability. Then you got the fourth which is about lean culture, that
is think lean among people, that people think lean all the time in what they do and prioritize
tasks grounded in lean principles. I take the most important first, it may sound obvious, but it is
not all who do it. Then it is continuous improvement, all the time improve how you work, that
is the fifth. The sixth is by what I just talked about with knowledge based things, that
knowledge and the generating has its own value chain just as important as the short term value
chain with making money on a project short term. That is the six things related to lean. You can
say that the two examples jeg used, they implemented integration events and worked like that
and that entails standardizing and how you work, but the other firm that made boats they
focused all their activities in lean towards the customers.

When you say standardizing what do you mean?
Then you can standardize the way you are working, i.e. the process and then you can
standardize with regards to solutions that you develop. For example a company that makes
installations on the seabed, the lean focus they have in their projects entails the development of
product platforms, because they have customers like Esso and Statoil which requires different
spec’s, but there are actually several construction elements which are the same. The lean
activity we have going with them regards the standardization up to a certain level, you want to
standardize as much as possible and then you customize towards certain customers as far in the
value-chain as possible so that you have some basic elements to use. That is an important part
of lean. Further, standardizing knowledge in relation to how you make sure, if you take the
example of the bending radius if you standardize knowledge you make a graph with function of
each material, or type of cross-section or something else about how your profile looks like
before you bend it, then you can look, okay last time we did it like this then we managed to
bend to this radius for that cross-section profile and then we probably can do it now too. With
standardized knowledge you don’t need to create learning cycles to find it out, because you
already solved it and that save time. Standardization can be used at several levels in a process,
in products, with people, like the competence of the engineers you want to bring in, that is a
standardization you are saying they should know this and that.

When you then standardize and use knowledge from previous projects then it can creates a
tendency to only get minor improvements, how should you solve the balance between having
radical innovations and incremental innovations?

If you look at lean manufacturing you notice it’s highly waste oriented, why? That’s because
lean manufacturing is about making a product which is going to manufactured, and if you make
the product good enough, i.e. the quality the customer want, the value potential for that product
is fixed. The only thing you can achieve with manufacturing a product is to make it good
enough so that the customer wants to buy it and that you’re covering the quality specs on your
product. So in lean manufacturing value generating potential is given and it is given that
making a product that is good enough. Value is in relation to what the customer get relative to
the cost of making it. The cost underneath the fraction line is where lean manufacturing work in
order to remove waste and make the cost as low as possible because you cannot do anything
about the value. When the product is good enough, then you reached that potential where you
get paid for what it is. If you think about PD it is not like this, there the value potential is not a
given. If you manage to make a product which is even better than the one your competition is
able to offer, and the customer perceive this to have greater benefits, then you might sell three
times as many products. Or maybe like Apple selling iPhones can charge a certain amount
more than a competitor – at least in a period – because the customer perceive the product
provides more benefits even though you pay 5000 NOK for a product that is so-so in terms of
quality. Lean PD is very value oriented and if you take that further and look at manufacturing, what generates value in manufacturing? Well, consistency. If you manage to make something which is identical every time that represents value because then it’s quality and that quality is good enough. However, if you look at PD what is value creation? Well, it’s variability. If you spend time on developing a product which has already been developed in the past, then you have not created any value.

It is the novel, the innovation that constitutes value in PD. It is the extreme. If you think about a graph, if you say the sum of activities for a firm is given by two things, how oriented they are towards process and how oriented they are towards a project. And in a project the value is based on the uniqueness that comes out, but in the process it is the consistency. So there are two opposing forces that pull in the opposite direction and when it comes to innovation and incremental and radical innovation then you are in radical innovation you are a lot more in the direction of the project-driven, unique piece of development. And lean tools and lean in PD have traditionally operated to something closer to process-oriented. I have an PhD student at Stanford who works with early stage and innovation and ideation and how this is compatible with lean thinking. So if you consider all possible crazy stuff you're doing to develop techniques that you use to influence how many ideas you come up with, how to work broadly instead of taper and standardize it goes in the opposite direction of what we talked about with standardization of the process, but it is still an interesting issue to ask. I can not answer your question, it is not possible to answer that for radical innovation is not something you can plan, if you make way for a business strategy that only involves standardization and say that everything is processes then it would be no other outcome than incremental improvements so you have to balance it and that is why it is so important to make your own lean model. If you say that lean is the outcome of a process that means whatever techniques you use to create that outcome tis of minor importance you using several and does adaptations. A construction firm with three employees who only have one project, no knowledge base and is taking a product or idea to the market they will surely have a different lean model than a firm who designs profiles with different geometries which is the same from time to time, they are completely different. The latter will be very process-oriented and the first project oriented. And I know where innovation will come from. So it is an interesting question and it's a field of research, no one can answer that question I think.

I wondered I you could answer in terms of cost to such a process, is there any differences before and after you started to work lean?
That is a very difficult question to answer because in the literature there are some who say they have been twice as effective and some who say they have been 30%, etc. But it is not documented in any way, it is very difficult to document it and why? Because it is very difficult to measure the impact of product development. You can do things quickly, but wrong and get things quickly through and then products is launched at the other end which is not good and that you neither manage to sell or has the requested quality. Or it may be that you are doing product development rather poor way, like Apple and then get the products out in the market and it's the marketing organization and a business strategy around the system that built up a gimmick around things that make it sell. So you say oh look at the financial results they are really good, then we have to be good at PD. So it is very difficult to measure it for what is effective PD and how much it costs? how much you will get back in ROI?, it is almost impossible to measure. But having said that, we have done some research, for example if you look at the value-added time that people spend on value-added work in the organization it could be an indicator, and in manufacturing it's like 80-90% which is productive time when the equipment is producing. But on average PD engineers uses no more than 30% of their time on value-added work, the rest are administrative tasks and not so much waste, but meetings and things that are not directly creating value. Neither to generate knowledge - that is one of the value streams - or for generating knowledge used directly for reducing the risk in a given project - the second value stream - as the criterion of value. It is difficult to measure it and I have not seen anyone who managed it.

What about people in the team?

Well you can measure it, but if you work in a firm and I get my Christmas bonus based on the profit for this year and my bonus is tied to the performance of the company the last year. If I then run a whole bunch of processes using two years to develop, I terminate the PD staff and I say that now I cut the cost, then I get one good result this year, but the result in 2 or 3 years when you do not have any products on the market because you did not have a long term strategy that is impossible to answer. So to answer the question it must be seen in the short-term perspective of the long-term strategy. So it is no problem to make money in the short term, but it's supposed to be sustainable, a company must be something that exist for a long time and it means that you have to invest some in the short term and some in the long-term development and then you have to try to balance from the perspective of what is right.

There are no good ways to measure this presently?
Productivity in PD?

Yes, or perhaps success in PD?

No, well it is very difficult to measure it, you can have indicators, I did a survey in the Norwegian industry where we asked about 300 people how they worked in terms of the six main points of lean as I mentioned previously. We had 12 to 15 questions in each and then we looked at how effective PD process subjectively was rated by the individual person. And then it was clear that you can look at different things, you can see how the project comply to plan, if you constantly are late then it suggests that you are either too optimistic or do a worse job one you have planned. If your products always are more expensive than you planned or opposite cheaper than the goal you have done a good job. So you can measure compliance in relation to the original plans and that is a good indicator of why you invest in a project because you have faith that the project is appropriate for the firm. That was where we started the discussions about Stage Gate. If you are able to follow the plan, okay you deliver on time, you deliver on cost and you deliver on sale - ability to innovate - thats why people buy the product as an end user. If you deliver as Tier 1 and you're depending on how many cars GM sells in Germany even though you have made a damn good product it is not certain that GM sell more cars, so it might not be your product that controls whether the customer buys it. If you sell tires it may be the design of the car that is more important for you to buy, again it depends on the setting you are in, but the plans and variances and compliance for plans it's important indicators in considering how well you do PD. Then it is benchmarking against other similar businesses that make the same products, if you can measure how many resources you use to make the products up against competitors and you have comparable financial results, then you can analyze it. Then you can count how many quality problems you have with the products, it's often related to what you did and the decisions you made during the PD process. You can for example take the StageGate process as Cooper suggests, the number of late kills. This means that if you run a project that is stopped late in the process, that entails you've spent a lot of resources in a project before you stop it, then you have taken the wrong decisions and done a poor job along the way, so he uses it on an indicator of how well you do PD. You can also add things to the Gates and measure product performance and your design and look at how you do compared to the plan again it is compliance to plans. Then you can take a macro perspective, you can analyze profits, but that is dependent on the other people in the organization, so it does not matter how good the
PD team you have. So it is difficult to measure. The one I wrote the paper has a PhD in exactly that.

Is there any differences between a project portfolio in PD and one in lean?

No nothing else than lean PD and most of the literature written about it is very related to the process-oriented industries in PD. For example, the automotive industry and Toyota is process-oriented also in PD because every five years or so they present a new model and they do the same, and they can have objectives that it should be 75% reuse of parts and 25% new, the projects look similar, and then there are some varieties that the customers perceive as improvements and variations to what they have seen before. But if you go to another industry that deliver a one of a kind solution, like to find a new way of communicating. Let's take Facebook, if you come up with that kind of ideas it is not process-oriented, you cannot order the next Facebook it was something that came forward probably because there was someone who had a unique belief in the concept and who did not give up. If you took a survey and asked people if they were to spend 5 hours in front of the computer to communicate with former high school friends after been in employment for 30 years most would say no, yet they do it now when the product is launched.

Is a project portfolio smaller in a firm focusing on lean PD?

It doesn’t need to be smaller, but in a lean PD organization it is fewer projects per person. One of the most important reasons to limit productivity in PD is multitasking

Can you say that lean PD focus on limit the projects and the importance of turn down projects you’re not sure about and instead prioritize the most important?

No, that is perhaps too easy to say, but in lean PD you solve the problems based on the primary cause, you solve the problems and then the product and the value is a result of how well we have resolved the issues and generated the knowledge necessary to solve the problems. In English, they call it solve the problems by the root cause, it is no guessing, take the least risk and ensure that the decision making process used in the PD process is based on facts and that is manageable through integration events and learning cycles and the process that I sent you. I have worked in the industry for 12-13 year among others in the automotive industry and my experience is that all the projects that went crap for us was because we had not been able to integrate manufacturing early enough in PD, we didn’t take account for the production, so
when we were going to production it came as a surprise, the problems found us. It happened
every time, the products who went smoothly were the ones we had front-end loaded with
resources, and that’s an important element in lean product development, that you front-end load
resources and solve problems early. The projects were we had the opportunity to do this usually
went well, while the projects where we started narrowly usually went bad, and they went bad
because of things related to the integration of design and production. And that is something you
don’t have in software so it is a little different.

How far was the projects that broke down?

I've experienced losing projects at $70 million that had came into production and actually been
in production for a year and then the customer took the product from us and outsourced it to
someone else because we had not considered the tolerances that we managed to achieve in
terms of the processes that we did. That resulted in the need to implement machining processes
into production and that made the production too expensive and the quality to low. If we had
considered the problems in advance then we might had done it in another way. And it always
happened those times it was poor integration between production and design. And it's clear that
if you make software and service innovations you don’t have that part. But still you have many
elements in standardization, customer focus, continuous improvement, preserve the knowledge
you generate, those things are the same. But using them in slightly different ways adapted to
your business.

You learned a lesson from that project?

Yes you can’t blame the designer or the PD-developer either, it is about how many resources
you get to solve the problems. How do you work with suppliers who make equipment you use
to production, and if you don’t use enough resources to follow up or help them make
appropriate equipment then it is you who has the beard in the mailbox the day you go to
production and deliver to your customers. You can’t say that PD is this and the firm is like this.
Lean PD is an integrated part of the whole business system, so you can’t be lean unless you got
the whole system with you. From management and PD, to integration, manufacturing, quality,
logistics, HR, everything. Lean PD is the whole firm and how it functions together. The
products is a result of how everyone do their job, not only designers and the PD-team. In
manufacturing you can become lean if you do things efficiently, but you can’t be lean in PD
that way, there you need a system perspective.