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Reviewing how Customers benefit from IT-Companies using Lean

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REVIEWING HOW CUSTOMERS BENEFIT FROM IT-COMPANIES USING LEAN

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Abstract—

In this research, we aim to show the customer advantages of Lean applied in IT. This is done by analyzing what literature and research proposes as general advantages of Lean with focus on the IT industry, which are then being dissected from a customer perspective. Furthermore, we collect information about actual examples in form of case studies, publicly available information from companies as well as interviews and show how these customer advantages are applicable in practice.

The goal is to offer a broad selection of advantages of Lean from a customer perspective that are applicable in IT by collecting and discussing relevant information, while the discussion is aiming to evaluate these advantages according to what research states as applicable.

Index Terms—

Lean, Agile, Customer, Customer Benefits, Lean Principles

1. INTRODUCTION

Today, most big companies and even several governmental agencies have an organization somehow oriented on the principles of Lean which has its roots in Lean Manufacturing. There are several aspects of Lean Manufacturing that are tailored to the manufacturing industry, however while some principles are more universally applicable, there has also been an effort in trying to translate Lean Manufacturing principles into other industrial branches, IT being one of them. However, a different industry has different conditions, for software development, raw materials are a non-issue and transportation and storage of semi-finished products are of much smaller relevance. Yet there are not only aspects that can be applied to the organization of immaterial development.

At the beginning of the 20th century, Henry Ford revolutionized the manufacturing industry with the large scale application of the assembly line. The ability to set up production lines and produce big quantities of one particular product in relative short time was such a powerful force that on the one hand, it made it possible for a much broader public to be able to afford a car due to the much cheaper prices, on the other hand forcing most competing manufacturers to change their production process to adapt an assembly line system as well (Georgano 1985).

While the customer advantage of cheaper prices is obvious, assembly lines also pretty much predefined the whole product and made individualization much harder. Henry Ford is often quoted for saying “Any customer can have a car painted any colour that he wants so long as it is black”. The truth behind that quote according to Ford’s autobiography is that there

actually were Model Ts, the only car that Ford manufactured at that point and eventually had a market share of 50% of all cars in the U.S., which were at one point available in different colors than black. However, when the production of the Model T was switched to the assembly line, black became the mandatory color because it was the only dye that dried fast enough, which was crucial in the step of the assembly line where the dye was applied (Ford & Crowther 1922).

This example illustrates the short-comings of such a production system when it comes to what is offered for customers. Back in the 1920s, this might have been an acceptable compromise for customers, judging by the fact that most people were not even able to afford buying an own car before the Model T. However, nowadays it would most likely be quite disgracing for any reputed car manufacturer to show the inability to provide a car model without some color selection, even the comparatively extremely cheap Tata Nano (Oconnor 2008) is available in 6 different color sets (Tata 2010). It has become common for car manufacturers to offer customers a much wider range of customizable features beyond choosing a particular color.

Taiichi Ohno, the inventor of the Toyota Production System (Swamidass 2000), in the beginning of the 1950s faced a world where variety was on higher demand by customers and it wasn’t suitable to rely on one single car model to compete in the market of mainstream car manufacturers. While Ford’s books were an important inspiration to Ohno (Strategos 2004), he realized the lack of individualization and flexibility of the real car factories of Ford at that time are less than ideal (LEI 2010). The resulting Toyota Production System contained such principles as to using a pulling

system where customer demand pulls the product rather than producing in advance (Liker 2003). In terms of waste reduction, this can be translated to software development as to only develop software that the customer actually needs rather than spending money to develop features that are never turned into value.

The purpose of this research is to find advantages of Lean in the IT field for customers. While Lean principles are established in a lot of industry branches, it is still in an emerging state in the IT sector (Waterhouse 2008). There are a lot of companies in the IT sector that consider their practices as Lean, but this is also due to the fact that there is only a vague definition of what has to be fulfilled in order to be lean, much more is it an individual approach (Kinnander 2010). The reason why they call their processes Lean are because they are in some way oriented to some of Ohno's originally described principles at Toyota. However, since the original description of the Toyota Model was drafted, extensive research about Lean has been conducted in all kind of industry fields, including IT, as well as the fact that the conditions in these fields have changed dramatically. One of the most crucial subjects for research with Lean within IT is trying to find analogies and idiosyncrasies of both IT in general and individual companies to other business fields. An example for differences of IT to other fields is often found by the sheer proportions of waste, for example servers are on average used at a capacity of a mere 25% (Waterhouse 2008). In both manufacturing as well as servicing, such a number seems awfully low, but due to the different nature of how computers are used today, it could still be advantageous if a method is found how the unused 75% capacity can be used as good as possible.

The customer perspective: There are obvious advantages of customers from companies using Lean, for example a more efficient production cycle leads to more competitive production prices, which can be passed on to customers. But besides cost, there are potentially rather characteristic customer advantages of Lean, consultants in that field use to advertise customer benefits among the most beneficial aspects of Lean (Sörqvist & Nielsen 2010). External integrity as stated by Clark and Fujimoto, oriented on the Toyota Model (Clark & Fujimoto 1991) is an aspect directly related to customer benefits, which has been caught up by Mary Poppendieck's adaption of Lean to the IT world (Poppendieck & Poppendieck 2003).

The contributions of this document is an evaluation of customer advantages of Lean in software development. This is done in the discussion of the theoretical advantages and the case studies, and to some extend in the conclusion.

The structure of this document is to introduce the topic, explaining relevant background knowledge, explaining our research methodology and approach, explaining case studies as well as gathered information through interviews, then discussing theoretical advantages, case studies and interviews

and finally a conclusion about this research.

2. BACKGROUND

The theoretical background section of the paper will cover the definitions and concepts, which will be used to support our study. Agile software development will be presented and also, in more detail, Lean software development. The different interpretations of Lean will also be covered. Furthermore, there will be focus on the concepts and findings in the existent literature, which are of greater interest for this paper, i.e. the customer perspective in Agile and Lean development.

2.1. AGILE DEVELOPMENT

2.1.1. SHORT HISTORY

In the beginning of the seventies, Winston W. Royce described a sequential software development model, which was later named *waterfall model*. Royce, however, mentions that this approach may be risky and could result in failure (Royce 1970). Royce also presents a solution to the addressed problems of this approach by introducing iterations between the steps of the waterfall model. The waterfall model soon became the standard development model used by software developing companies.

Not long after the description of the waterfall model, an adaptive software development process is described, which is similar to the modern agile (Edmonds 1974). In the years to follow, different methods appeared: Scrum, Adaptive Software Development, Feature Driven Development, Dynamic Systems Development Method, Crystal Clear, Extreme Programming, Lean Software Development and so on (Larman 2003).

In the year 2001, the agile manifesto was created by the Agile Alliance. The manifesto states twelve principles, which reinforce Agile software development (Beck et al. 2001).

2.1.2. AGILE PRINCIPLES

The benefits of agile development don't come from working faster - but working differently (Shore & Warden 2007). The agile approach is created to offer an answer to the eager business community asking for lightweight and faster software development processes (Abrahamsson et al. 2002). As mentioned in the previous section, the agile manifesto was created, and it sets the base for understanding what agile software development stands for. The four principles of the manifesto are:

- **Individuals and interactions** over processes and tools
- **Working software** over comprehensive documentation
- **Customer collaboration** over contract negotiation
- **Responding to change** over following a plan

The manifesto states that the values on the left are of greater importance compared to those on the right.

2.1.3. CUSTOMER INVOLVEMENT

Compared to the traditional way of working, agile software development establishes stronger relations with the client, dedicating one of the four principles to the collaboration between the organization and the customer. The principle is "Customer collaboration over contract negotiation" and it changes the customer's role in the development, making it part of the process and encouraging frequent contact with it (Hazzan & Dubinsky 2008). By involving the customer in the ongoing development, an invaluable feedback is received, and thus the possibility for misunderstanding of the requirements significantly reduced.

There are several studies about the customer involvement in the agile development process. The studies mainly focus on the customer satisfaction, customer's role and the collaboration between the organization and the customer (Dybå & Dingsøyr 2008).

2.2. LEAN DEVELOPMENT

While there is no standardized and widely accepted framework for working Lean in software or IT organizations, there are few attempts to bring this principles and practices to them. The main names that figure in the literature and researches are Lean IT and Lean Software Development (LSD). In this section, the main aspects of Lean manufacturing will be covered, followed by the key interpretations of Lean adapted for the software and IT domain.

2.2.1. LEAN MANUFACTURING

Lean manufacturing is a multidimensional approach that encompasses a wide variety of management practices, including just-in-time, quality systems, work teams, supplier management, etc. in an integrated system (Shah & Ward 2003). One of the main goals of Lean manufacturing is to eliminate waste. Waste is anything that does not add value to a product (Poppendieck & Poppendieck 2003).

Lean manufacturing was born in the Japanese automobile industry, or more precisely the automaker Toyota. Toyota was a small company after the Second World War, and was largely influenced by the American and European automakers.

The key person behind the introduction of what later will become Toyota Production System and Lean was Ohno Tai-ichi. He found two logical flows in the Western production systems, one being the production of components in large batches resulting in large inventories, and second, the inability to accommodate consumer preferences for product diversity (Holweg 2007). To address the issues, Ohno started developing a production system for Toyota with focus on waste elimination. The methods and practices are explained in his book (Ohno 1988). Gradually, Toyota succeeded in producing large quantity of automobiles, at low prices and high quality. In 2008, the Toyota models outsold General Motors, thus becoming biggest automaker by number of cars sold (The Washington Post, 2009).

2.2.2. LEAN SOFTWARE DEVELOPMENT

Lean software development can be classified as one of the agile development methods, and is based on several principles of working in an organization. Despite the fact that LSD is derived from Lean manufacturing, which exists for a long time, only recently the attempt was made to establish it as development method suitable for software organizations. In their book "Lean Software Development: An Agile Toolkit", Mary and Tom Poppendieck give the principles and practices, inspired from Lean manufacturing, adapted to the software domain (Poppendieck & Poppendieck 2003). This book is recognized as one of the most important interpretations of Lean in software development. (Hendrickson 2005)

The book presents seven principles, closely related to those of Lean Manufacturing, with focus on software development and agile thinking. The principles, as elaborated in the book, are:

- **Eliminate Waste** is a principle which is one of the key aspects of Lean thinking. Everything that does not add value for the customer, or if there is a way to do it without it, is waste. In a software organization, this can be partially done work, defects, extra features etc. However, before action can be undertaken in order to eliminate waste, it needs to be discovered and recognized as such.
- **Amplify Learning**, a principle where the role of the customer can be of crucial importance. In the nature of agile working is receiving frequent feedback from the customer, as well as almost daily collaboration. By doing frequent tests, the possibility for defects is significantly reduced. To address the issues in complex project, creating less documentation and more code is recommended, also studying the tools and choosing the best one, instead of making early decision.
- **Decide as Late as Possible** is about possibilities, options and decisions. Making mistake in the beginning of the process can be very expensive, if it has to be solved later. All options should be analyzed and all possibilities open until the end of the decision making process. This also gives an opportunity to the customer to make late changes without affecting the already started process, and it is quite common in practice for customers to change their mind after the development has already started.
- **Deliver as Fast as Possible** and get customer feedback immediately. This is related to the previous principle "Decide as Late as Possible" when it comes to customer involvement. This principle is based on the customer demands and customers always value fast delivery a lot. One of the main concepts used to support this principle are Pull Systems. The key of this concept is to allow the customers to pull work, and not to be pushed by the schedule like in the traditional way of working.
- **Empower the Team** so most of the decisions can be taken by the people who work on the tasks. This improves the development pace. In a traditional organization, the decision is taken based on the hierarchy.
- **Build Integrity In** giving the customer the feeling that

the product works as a whole. There are two types of integrity: perceived and conceptual. Perceived integrity is about the balance of the product's functions, usability, reliability etc. Conceptual integrity is achieved when the central concept of the product works as a cohesive whole.

- **See the Whole** principle is targeting mainly the managers, who need to ensure good integration and coordination of activities.

2.2.3. LEAN IT

Lean IT is yet another translation of the Lean manufacturing principles to the IT domain. Compared to Lean Software Development, which focuses on the actual development process, Lean IT tries to introduce the Lean Manufacturing principles to a more business and management level, with focus on services for the customers.

The core philosophy of Lean IT is: maximize value and minimize waste (Hurwitz & Demacopoulos 2009). The waste reduction is the core of the Lean IT. Hurwitz and Demacopoulos give eight elements of waste in enterprise IT and their business outcome, shown in simplified form in Table I on page 6.

2.2.4. LEAN INTERPRETATIONS

Lean software development is still not widely used by simply following all of the principles and practices. Many big organizations have recognized its benefits, but they have created their own development processes based on Lean manufacturing. For example, one of the largest IT and telecommunication providers, Ericsson AB, has created a process based on Lean, which they call Streamline Development (Tomaszewski et al. 2008). Fujitsu, one of the biggest IT service providers in the world, is also one of the leading companies to implement Lean way of working, address the problems from customer perspective, and solving them at the source (Womack & Jones 2005). These interpretations of lean may have different names, but the idea is the same - to provide the customers what they want, creating value for them and for the company.

3. RESEARCH APPROACH

In this section the research method will be elaborated, the reason for the choice and the data collection and analysis strategies that will be undertaken.

3.1. METHOD

This research does not focus on finding solutions to a precisely defined problem, but rather analysis of the existent data and drawing certain conclusions which can help in further improvement of the Lean software development and IT service providers using it. As our aim is to explore a new subject and we do not have a concrete hypothesis for which quantitative data could be collected, we are conducting a qualitative research using an exploratory research method. This type of research is especially good for gaining deep knowledge and understanding of some area. It should be

approached from two orientations: flexibility and open-mindedness (Stebbins 2001).

Another reason for choosing this research type is the availability of data for this topic. Unfortunately, there is not much written literature about Lean software development. However, the Lean manufacturing is more expounded. By trying to focus the topic by adding the customer perspective and its influence on the Lean and on the organization which uses it, we limit the sources and possible data even further.

3.2. DATA COLLECTION STRATEGIES

3.2.1. RESEARCH BOUNDARIES

One of the main obstacles that could limit the possibility to study and explore this topic and problems which could appear between the customer and a company using Lean is the lack of sources and case studies. There are not many companies using Lean in its full potential so it could be difficult to obtain relevant interviews. However, an attempt will be made to get as much as possible relevant information and eventually create a base for further research on this topic.

3.2.2. DATA SOURCES

This research will be based on different types of data sources. Written documents will be used during the study, such as journal and web articles. Written literature, i.e. books, will also be used to support the theory behind our study. Many articles today are available in web form, as part of web pages. We will try to use only quality sources providing reliable information and data.

Another source of data will be E-mail interviews. The interviews are conducted with company which have experience in Lean. In this case, we conducted two interview with two respondents from the telecommunication company, Ericsson. Ericsson uses Streamline process, which is directly based on Lean and the Lean principles. The interviews are included in form of appendixes (See Interview I and Interview II), to which will be referred throughout the analysis. We decided to keep the interviews short and used few open-ended questions.

3.3. DATA ANALYSIS STRATEGIES

The analysis of this research will be in form of narrative text. The analysis will be an ongoing process together with the data collection. However, the text will be finalized after the interviews are conducted and answers received. During the analysis, the data related to our topic will be marked and classified. The main ideas that appear will be analyzed more carefully.

4. DESCRIPTION OF CASE STUDIES

In this section the description of the case studies we have found will be given. The cases will be analyzed in the section 5.2.

Waste element	Business outcome
Defects	Poor customer service, increased costs.
Overproduction	IT misalignment, increased costs, misuse of resources.
Waiting	Lost revenue, poor customer service, lower productivity.
Non-Value added processing	Miscommunication
Transportation	Higher capital and operational expenses.
Inventory (Excess)	Increased costs, lost productivity.
Motion (Excess)	Lost productivity.
Employee Knowledge (Unused)	Talent leakage, low job satisfaction, increased support and maintenance costs.

TABLE I
EIGHT ELEMENTS OF WASTE (HURWITZ & DEMACPOULOS 2009)

4.1. CASE: CUSTOMER ENABLED BRITISH AIRWAYS

By applying Lean Manufacturing principles, British Airways was able to increase annual profits by more than £100M and at the same time improved customer service and operating efficiency with a new customer system they internally called Customer Enabled British Airways (Watson 2005, Goodwin 2006). According to British Airways CIO Paul Coby, they tried to make IT the center of the business.

John Mornamente who joined BA in 2000 and became the head of IT and Business Change functions of British Airways's Information Management Organization helped Coby restructuring the company according to Lean Manufacturing principles in order to "identify and eliminate wasted steps in servicing customers". But additionally, they also used principles they called 3PI: Proposition, Process, People, and the Single IT Solution (SITS). The "customer proposition" helped the airline combining 3000 fare rules into three fare conditions. An example of the SITS approach was that call center staff would use the same tools as the customer. From the customer perspective, one of the most important changes was the new website as the central customer interaction interface (Orlov 2008).

4.2. CASE: FUJITSU - SENSE AND RESPOND

Fujitsu is one of the biggest IT service providers in the world and among the leading IT service providers in Europe. Fujitsu is one of the main big companies to implement Lean way of working through their award-winning¹ *Sense and Respond* approach.

Ian Cooley, a Service Delivery Manager at Fujitsu, explains *Sense and Respond*:

"Philosophically Sense and Respond takes a lead from the Lean management methodologies developed in the manufacturing industry, especially by Toyota and Unipart, by aligning all the participants in a process to meet the real needs of customers, and eliminating any waste or unnecessary processes." (Cooley 2007)

¹2003 National Business Award for *Best Customer Service Strategy*, among others.

Paul Reynolds, Director ICT Services, explains:

"Instead of simply working to IT objectives, Fujitsu staff give priority to the customer's business objectives. In practice, Sense and Respond makes users happier and more productive, at lower cost." (Reynolds 2009)

Cooley, in his case study, list the benefits for the customer (but also for the company itself) which they have achieved at Fujitsu using Lean operational controls, or in the case their unique *Sense and Respond* approach:

- Enhanced customer service
- Increased staff satisfaction
- Improved resource usage
- Reduced costs
- Enabled continuous improvement

The main focus of Fujitsu's Lean is on providing the customer with faster and better service. The "Sense" phase, as explained by (Parry 2004) starts with includes "viewing the organization from customer perspective". This is an important aspect, since the organization ultimate goal is rarely the same with that of the customer. About the understanding of customers position, Parry adds:

"Understanding the real needs of customers and the multiple uses they make of company products and services provides a rich source of information against which to design new offerings." (Parry 2004)

4.3. CASE: DELL INC.

Dell Inc. is a US based IT corporation. Dell provides multitude of IT services and also develops computers for many different markets. Lean thinking in Dell was introduced in 1999, and "is involving everybody in the creation of Value for our Customers through the elimination of Waste" (Tuite 2003).

Joan Magretta conducted interview with Michael Dell, the founder of Dell Inc. We use many parts of this interview to get first-hand information about the factors that influence the success of Dell, and especially we try to extract those related to the relation with the customer.

One of the first steps of Dell in going Lean was the introduction of the model called "Direct Business Model" (Magretta 1998). What this model mean is reducing the

time from manufacturing to customer. Basically, Dell has eliminated the resellers in the company-customer chain, and they decided to sell the products directly to the customers. Another important factor for the success of Dell, as explained by Michael Dell, is the decision to use computer components already made by specialized companies and provide top performance, rather than manufacturing them themselves as the big players like IBM, Compaq, HP and others used to do during the 1980s. This lowered the price, increased the income of the company and provided the customers with high quality systems. In the continuation of the interview, Mr. Dell explains the collaboration with other companies, the reason why they decided to collaborate with other companies and how this is different than outsourcing:

“Outsourcing, at least in the IT world, is almost always a way to get rid of the problem a company hasn’t been able to solve itself.” And continues: *“That’s not what we’re doing at all. We focus on how we can coordinate our activities to create the most value for customers.”*

The problem of inventory is addressed by Dell also. The optimization of the inventory adds great value. The inventory is mentioned as great risk, especially in the computer industry. Interesting to mention here is the treatment of companies related to the inventory time. Namely, Mr. Dell gives an example of buying monitors (which Dell Inc. is not producing themselves such a component). For a company like Sony, there is not need of inventory, because they have trust in their high quality monitors, so they can simply put the *Dell* logo on it and distribute the whole system.

Last that we would like to cover in this description of this case study is the concept of Pull Systems. In yet another source, this time a video, introduced by Michael Dell, a quick manufacturing tour of one of the Dell Inc. factories is given, and the lean way of working and production is explained (Dell 2008). The highlights are presented next:

- Nothing is built before the customer orders
- All centers use the same systems, processes and measurements
- Sophisticated ordering system, synchronized worldwide
- Customers can monitor the process, even with images of the product
- To ensure complete order, completed computers are staged till the last is done

Despite the fact that this is more of a manufacturing and hardware, we find analogy in the software industry and will try to discuss it in this research (See section 5.2.3).

5. ANALYSIS OF CASE STUDIES

In the, rather comprehensive, theoretical background section (Section 2), most of the benefits and advantages for the customers from organizations which have adapted Lean way of working were covered. In this section, findings and results will be presented. In an effort to cover as many aspects

as possible and not miss any behaviors, the analysis will be approached from two different perspectives.

In the first, the theoretical benefits will be evaluated and how are they present in the reality. We will discuss them using literature, examples from the industry and the especially the interviews we conducted.

The second will be about particular cases and experiences in certain companies which have implemented some interpretation of Lean. We try to evaluate how companies were affected by Lean according to these case studies, using the same concept in analyzing how it worked for them.

5.1. DISCUSSING THEORETICAL CUSTOMER ADVANTAGES

Derived from Poppendieck’s interpretation on how to commit Lean in software development (Poppendieck & Poppendieck 2006), we simplified the principles and will analyze them from customer’s perspective:

- 1) Waste Elimination
- 2) Increased Feedback
- 3) Empowered Improvement
- 4) Perceived Integrity

Asking a developing company, our focus is to find out what steps they undertake in order to achieve particular points. In case they are different from the Poppendieck suggestions or if they are not implemented, it is interesting to learn about the reasoning behind it. From customer viewpoint, it is more interesting to learn about which of these advantages they have experienced, what exactly lead to a particular experience and if they would prefer to actually get some potential advantages of Lean that they might have missed out on.

5.1.1. WASTE ELIMINATION

Waste elimination is one of the main aspects of Lean. In summarized form, waste elimination leads to:

- a) Faster delivery
- b) Decreased cost
- c) Higher product quality

Waste elimination could be considered the main principle among the seven summarized by Poppendieck, but also probably the most important one of Lean IT. Certainly, it is not directly related to the customer, at least when it comes to customer involvement in the realization of it. Rather, this principle is about improvement of the processes in the organization. However, improved processes are hugely beneficial both for the company and the customer. As the case of Fujitsu (Section 4.2) shows, the improvement of the processes in the company led to faster delivery and response to the customer, thus providing better service. One of our respondents, asked about the role of waste elimination, confirmed that the customer benefits a lot, especially from

the fact that the elimination of waste makes the product development shorter, thus leaving more time for improvements and adding new features, thus increasing the functionality also (Interview II).

Our observation about this Lean principle is that it is definitely the one that is most influential to the process. The customers may not be aware that the company is trying to optimize the internal processes, but fact that they get the product in shorter timeframe, higher quality and lower prices is what is win-win combination for both the company and the customer.

5.1.2. INCREASED FEEDBACK

Increased feedback refers both to the feedback that the customer gives to the company, and the other way around. Poppendieck devoted two complementary principles to this aspect of the collaboration, "Decide as Late as Possible" and "Deliver as Fast as Possible" (Poppendieck & Poppendieck 2003). This is an important property of the agile development also, as it is iterative and the customer feedback is crucial in the process of improving during each iteration. The iteration are short, thus allowing the first version of the product to be evaluated by the customer very soon after the project has started. The expense of changing the requirements early are much lower than changing them later.

In a case study about the company Timberline Inc, it is concluded that the customer was very satisfied with the product "due to the continual focus on customer needs combined with the frequent, iterative development cycles" (Middleton et al. 2005). It is very clear that customers want quick delivery, and it is one of the main selling points of products today.

In order a development team to be able to deliver fast and achieve quick iteration, an appropriate agile development methodology should be adopted. Tatum (Tatum 2005) has listed the phrases and methods of coding mapped to the Lean Software Development principles. For the "Deliver as fast as possible" some of the components are: Extreme Programming (XP), queue sizing etc. This demonstrated that the agile methodologies could be used extensively to support the Lean principles.

Question that arises when it comes to the customer feedback is how much can one big company can handle it in reasonable time. Big companies are know as being inert, with long procedures and strong bureaucracy. Ericsson, for example, listens to the customer, receiving feedback, but not at the desired level (Interview II). They work with so called CI (Customer Inquires), which the customer issues asking for feature/improvement, and the response time from the company is 21 days. This time could be considered reasonable for big and complex systems, but not really prompt in a very agile way of working, with quick and frequent iterations.

One of the main tools in Lean Software Development are the *Pull Systems* (Poppendieck & Poppendieck 2003). This means that the customer's needs should *pull* the work, compared to the schedule *pushing* it. Dell Inc., a major IT corporation, have created manufacturing process where they do not build anything till the customer orders it, thus giving the customer "*exactly what they need, with the support they need*" (Dell 2009). Ericsson with their Streamline also uses pull systems, but they have also integrated push in their process in form of roadmap based development. This is an example of successful integration of the right method for the right purpose (Interview II).

5.1.3. EMPOWERED IMPROVEMENT

When the success of Toyota and other Japanese car manufacturers that followed the ways of Toyota became apparent, car manufacturers around the world started to try to adapt to a similar model in order to imitate its success. (Pilkington 1998) addresses the issue that while the success of the Japanese model was undeniable, the best practice approach, which suggests to make employees striving for adapting a working practice which was deemed to be ideal by experts in a particular field, has proven to be problematic to be simply imitated. He analyzes the impact the Japanese model had on the U.K. automobile industry, which is described as "disappointing" and concludes to avoid simply adapting best practices but rather put effort on strategic competencies and bringing the manufacturing process in line with a companies strategy rather than seeing these two as individual aspects of a company. For adapting Lean in software development, (Poppendieck & Poppendieck 2006) promotes that "There is no such thing as best practice" and suggests to "Embody the current best known practice in standards that everyone follows, while actively encouraging everyone to challenge and change the standards.". Instead of just giving employees the opportunity to adapt to known best practices, it enables them to build working practices upon their own expertise, thus freeing the way for not only achieving some standard but also improving above it. A crucial reason that Poppendieck gives is that best practice is often decided from experts that have competence in their corresponding field, however the resulting practice lacks the individualism required in actual application.

A regular customer can greatly benefit from employees that are able to adapt their working practices according to the customer needs. In reality, customer specific expertise of employees is something that happens unavoidably, however the Poppendieck proposition empowers this factor rather than reducing it by trying to bring employees to follow a common standard rather than an individualized approach suited for the customer needs.

5.1.4. PERCEIVED INTEGRITY

The concept of perceived integrity according to (Poppendieck & Poppendieck 2003) is leaned on the model of external integrity according to (Clark & Fujimoto 1991).

Perceived integrity is integrity as in product value that is achieved by developers knowing what the customers want without customers explicitly stating everything as required/appreciated. This is a different direction towards dealing with the problem of handling specifications and requirements, as opposed to trying to write down requirements as explicit as possible. While these two approaches are not mutually exclusive, the argument for perceived integrity is that customers can only assume what they want according to their own knowledge about their own demands and wishes, however as they are customers rather than developers, they might not be aware of the technical possibilities, both under- as well as overestimating them, that are available for getting what they want. While being able to supply products that exactly fit stated specifications is a great feat, a lot of successful innovations would never have seen the market if only things according to stated wishes would have been developed. Inventions like video games, e-mail, the google search engine, the iPhone, YouTube, etc., the common user perception is to see it and out of those who adapted it liked what they have seen, quite likely without having spent thoughts about finding exactly such a product. The theory of perceived integrity says that a developer who knows the customers is much better in developing things according to what the customer appreciates, as he has the ability to put himself into the customer position. This not only leads to better products but also helps removing waste, counteracting the development of unneeded features as well as achieving more positive customer test results.

Andréasson sees it as a pity that customer involvement could be much higher at Ericsson (Interview II). Product Management, which has the closest ties to customers, acts as closely in the development integrated unit as customer representatives. The Poppendieck recommendation, adapted from the Japanese car manufacturing industry practice is to have lead engineers for each development unit that spend much time with customers and are supervising their subordinated engineers, trying to make sure that they are developing according to customer tastes.

5.2. CASE STUDIES

5.2.1. CUSTOMER ENABLED BRITISH AIRWAYS

The customer of an airline, or British Airways in this case, is any individual or a company who is buying tickets from them and uses them to fly with them. Customers are not directly aware of the Lean concept behind the airline's interaction with them and we found no evidence that British Airways is using Lean to advertise themselves to customers. One can make the assumption that anyone who ever consciously encountered common pricing rules of airlines will likely appreciate a simpler pricing system. Effectively, BA managed to cut costs while improving customer satisfaction (Nicolini & Salini 2006). It is an archetypical example of Lean practice to organize a company according to its working structures in order to streamline the workflow and thus eliminating waste. In this particular case, British Airways applied this

customer-pull practice to their company oriented on their IT system.

The voluntary online booking system was generally perceived well by customers as being more performant and transparent. The concept of the new IT system extended beyond normal online booking systems remotely over the web site and also included self check in counters at airports, obviously an approach from the airline to save money, however also helping customers as these self check-in counters mean shorter queues for them.

Asked about the experiences with the new IT system, British Airways CIO Paul Coby repeatedly stresses the importance of simplification of the process and puts it as a key criteria of the success of the program. This was achieved by tracing data from sources that are involved in the process, the example of call centers is given, and then analyzed according to the needs of the process, streamlining the data flow (Goodwin 2006).

What led to the beforementioned savings was a remarkable customer acceptance of the new system, according to numbers from 2006, 80% of the ticket sales world wide were conducted over the new online booking system. Coby mentions that one of the goals of the new systems was to not getting customers to only use the new system by more or less forcing them to by removing other options but making it good enough to making them wanting to use the new system. However, the new system is not only used for online booking but as a unified system, call center operations are done on "the same set of data" (Goodwin 2006).

A parallel to Poppendieck's concept of perceived integrity is indicated by what Cody states as the "key differentiator", that the whole system has been designed and managed internally (Goodwin 2006). While there were no further indications about the reasoning behind this statement, it can be assumed that not having to rely on external contractors with a lower level of familiarization with not only the system but British Airways business practices as a whole led to this conclusion.

5.2.2. FUJITSU - LEAN IT SERVICE PROVIDER

Fujitsu has focus on providing better and faster services for their customer. By implementing some of the Lean principles and ways of working and thinking, especially eliminating waste, they have achieved to create leaner processes and give their customer what they want. They also focus on meeting the real needs of the customers.

Based on the few case studies, from which some highlights were presented in section 4.2, it is clear that Fujitsu uses the principles of Lean to improve the internal processes, eliminate unneeded ones (waste elimination), and thus giving their clients better service. This is an example that shows the interrelation between two or more principles from the Poppendieck's Lean interpretation - Lean Software Development. Namely, the elimination of unneeded processes

(Eliminate waste) contributed to shorter waiting time (Deliver as fast as possible) and more satisfied customers.

Another principle which we found exposed by Fujitsu, is the integrity of the products. Poppendieck suggest to *build integrity in*, understand the real needs of the customer and improve the overall feel of the product or the system. Using their *Sense and Respond* approach, Fujitsu tries to *sense* the customer demands and real wishes, putting themselves in the role of customer, increasing the functionality of the product for the particular customer.

Fujitsu is not strictly a software development organization, when it comes to their IT-business units. Their IT services are broad and mainly they provide different kind IT solutions and consultancy. However, Fujitsu also develops software, in the traditional sense, especially customized software. We found only some evidence of their development methodologies, for example using agile practices and similar. This is an important to mention, considering the fact that the customer involvement in the development (in form of giving feedback after each iteration and thus resolving requirements problems) is one of the keys to customer satisfaction at the end. Specifically, Fujitsu Software Technologies has taken actions to improve the process based on the Toyota Production System (TPS) (Furugaki et al. 2007). Furugaki et al. focus on explaining the use of agile development practices, pair programming and iterative development, among others. Interesting to note here is the usage of agile as a tool to realize the principles of TPS. Two of the principles we found most interesting for our study are:

- Pull System
- Just-In-Time

The first is already elaborated throughout this research. The second, as explained by the authors of the article, is about prioritizing customers needs and implementing the prioritized features sequentially.

The general conclusion about Fujitsu is that their efforts of implementing Lean is definitely exemplary, and they are among the leading organizations to take this to a new level. From the *Sense and Respond* model, to the development units, there are many examples of focusing of the customers needs and providing benefits to the customers by adapting to the Lean principles.

5.2.3. DELL INC.

Dell Inc. started as small company in a time when the big computer giants were undisputed rulers of the hardware and software industry. In a very short time, however, Dell managed to grow, and today it is one of the major player and suppliers of computers and IT services of different kind. One of the factors for this success is the close relation with the customer, fortified with the Lean way of working, eliminating waste and inventory time and creating value for the customers.

What we learned to be the key of the initial success of Dell, is simply the fast delivery to the customer, not only

anything, but the top technology present. When it comes to hardware and software, the improvements are so fast, the time till the product gets to the customer is enough for new version to be completed. Dell Inc. solved the problem in a smart way, assembling the computers using latest components from different renowned manufacturers. In a software development industry, it is not too different. The software, especially the complex systems, use many already done components and libraries. Depending on the demands of the customer, the development teams can use updated versions of the components from trusted suppliers, thus without any effort and longer times providing better products, accompanied with new features and stability.

What deserves to be especially mentioned here, is the Dell's focus on customer demands for features, helped by Pull and Order Systems. In a mass production business, customization is reduced to minimum and only for special orders. However, Dell, via their investments in the ordering processes, helped by the latest IT solutions and internet, have created an opportunity for much wider range of customers to customize their computers and get exactly what they need. This would not be possible just by deciding to do so, but takes a great deal of optimization inside the company, and that is where Lean principles are used. The inventory is optimized and the unneeded processes, for example resellers, eliminated.

Our conclusion for Dell's case is positive. Dell has succeeded to take advantage of the good ideas, mainly inspired by Lean manufacturing, and created a base for future improvements. This company is prove that in this industry of huge competition, the customer comes first. Another very interesting aspect that appeared studying this case, is the collaboration between the companies. Even though this belong to another topic and it definitely can be an interesting study in the future. The aspect that we would like to underline is the advantages of the Lean way of working, not only for the company using Lean, but also for their contractors. Michael Dell, in the interview, mentions that the customers had impression that the service technicians are employed by Dell, which is not true. This is a perfect example of very good collaboration, and providing the right product, service or component to the customer.

6. CONCLUSIONS

Out of the four cases that we looked at here more closely, namely Fujitsu, Ericsson, British Airways and Dell, Fujitsu was the only one that directly promotes Lean as an advantage of why potential customers should pick them over others. British Airways and Dell both deal with not only companies but end-users as customers, for whose the more direct advantages of Lean are easier to advertise. Ericsson roams exclusively in a business to business realm, customer contacts might likely have an idea about advantages of Lean. While we were not able to get conclusive data on that matter, it was however assumed that the advertisement from Ericsson is not promoting Lean directly (Interview I).

While it was easy to show how some of the more generic advantages of Lean like cost and development time reduction are directly benefiting customers in selected cases, there still seems to be potential for more sophisticated advantages like actively pursuing a closer relation between developers and customers.

As pointed out by both Timmerås (Interview I) and Andréasson (Interview II), Streamline was designed with customer interests as a primary element. As pointed out by various people, Lean is a management philosophy or a set of principles resulting from this philosophy rather than a process. However, companies following Lean principles can implement a Lean process. Such implementations can be found in Fujitsu's *Sense and Respond* or Ericsson's *Streamline*, but there is no such thing as *the* Lean process. While Mary Poppendieck, renowned in the agile community for having adapted Lean into software development (Hendrickson 2005) directly contradicts guidelines from the Toyota Way like the discussed "Best Practice" paradigm. As (Hendrickson 2005) points out, software is different than manufacturing and that is why a new interpretation is more helpful than simply trying to apply guidelines one by one in order to become Lean. The individual application of the Lean philosophy is a necessity in order to gain the full advantage. As Fujitsu has shown, a top-down reorganization was conducted in order to apply Lean reforms, changing to Lean means a lot of changes for the organizational structure of a company. One of the most central principles of Lean, waste elimination on its own is nothing more than a buzz word, but with keeping it in mind when conducting a reorganization, in any competitive market situation, it easily translates into direct customer advantages in form of lower prices and faster product deliveries, which as explained by (Poppendieck & Poppendieck 2003) often translates into better product quality as well, as requirements change over time and the faster a product gets delivered, the more it matches its requirements. While Ericsson advertises itself mainly with pointing out its experience and market dominance (Interview I), Fujitsu basically tries to sell themselves by stating that they use Lean, they are good at it and then promising all the typical advantages of Lean (cost, quality, service, time...) explicitly pointing them out as direct customer advantages (Fujitsu 2010).

But as for any customer, while Lean has huge potential for them, if the implementation does not match their needs (one might argue here that such a mismatch would be un-Lean to begin with), they most likely do not get what they are looking for. However, Poppendieck has demonstrated that advantages of Lean applied the right way can greatly benefit a customer, and most of the required changes, even the ones that are not directly concerned with waste elimination like perceived integrity, do not come with high operating cost and it does raise the question, why such an approach should not be chosen.

This research, while putting a focus on customers, has addressed the issue of advantages of Lean in a quite general way. Future research about particular potential advantages,

especially about the implement-ability and maybe some quantitative cost/benefit analysis would be interesting, however such research would require much closer interaction with companies conducting Lean than we had. The limitation of our contact was not only that we had relatively few interviews, but also that one always has to be able to talk to the right person for the right questions, in our case, questions about advertisement were not as fruitful when asked to a process improvement engineer as opposed to how it most likely would have been with someone in the marketing department, but as pointed out by Timmerås, it becomes unavoidable in bigger companies that there is no one who is an expert on every subject about the companies functionality.

LIMITATIONS

As it is now, several sources are based on what companies say about themselves, be it through interviews or advertisement. As the goal of this research was to focus on potential advantages of lean, we didn't have the potential to critically investigate the truthfulness of all claims made by companies.

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REFERENCES

- Abrahamsson, P., Salo, O., Ronkainen, J. & Warsta, J. (2002), *Agile Software Development Methods: Review and Analysis*, VTT.
- Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R. C., Mellor, S., Schwaber, K., Sutherland, J. & Thomas, D. (2001), 'Manifesto for agile software development'.
- Clark, K. & Fujimoto, T. (1991), *Product Development Performance: Strategy, Organization, and Management in the World Auto Industry*, Harvard Business School Press.
- Cooley, I. (2007), 'Lean creates a solid platform for growth'. <http://www.fujitsu.com/downloads/SVC/fs/casestudies/fujitsu-lean.pdf> [Online: 2010-05-27].
- Dell (2008), 'Lean enterprise case study dell example'. <http://www.youtube.com/watch?v=c dg9rpg6Dt8> [Online: 2010-05-31].
- Dell, M. (2009), 'Lean enterprise case study: Dell', Video. <http://learnsigma.com/lean-enterprise-case-study-dell-example> [Online: 2010-05-24].
- Dybå, T. & Dingsøyr, T. (2008), 'Empirical studies of agile software development: A systematic review', *Inf. Softw. Technol.* **50**(9-10), 833-859.
- Edmonds, E. (1974), 'A process for the development of software for non-technical users as an adaptive system', *General Systems* **19**, 215-218.
- Ford, H. & Crowther, S. (1922), *My Life and Work*, Doubleday.
- Fujitsu (2010), 'Pamphlet'.
- Furugaki, K., Takagi, T., Sakata, A. & Okayama, D. (2007), 'Innovation in software development process by introducing toyota production system', *FUJITSU Scientific & Technical Journal* **43**(1), 139-150.
- Georgano, G. N. (1985), *Cars: Early and Vintage (1886-1930)*, London: Grange-Universal.
- Goodwin, B. (2006), 'British airways cites it investment as key factor in 20% profit increase'. <http://www.computerweekly.com/Articles/2006/05/30/216183/British-Airways-cites-IT-investment-as-key-factor-in-20-profit.htm> [Online: 2010-05-31].
- Hazzan, O. & Dubinsky, Y. (2008), *Agile Software Engineering*, Springer Publishing Company, Incorporated.
- Hendrickson, E. (2005), 'Agile testing'.

- Holweg, M. (2007), 'The genealogy of lean production', Journal of Operations Management **25**(2), 420–437.
- Hurwitz, D. & Demacopoulos, K. (2009), 'The case for lean it', White paper, CA.
- Kinnander, A. (2010), 'Lean', Media Planet (5). In Swedish.
- Larman, C. (2003), Agile and Iterative Development: A Manager's Guide, Pearson Education.
- LEI (2010), 'A brief history of lean'. <http://www.lean.org/whatslean/History.cfm> [Online: 2010-05-29].
- Liker, J. (2003), The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer, McGraw-Hill.
- Magretta, J. (1998), 'The power of virtual integration: an interview with dell computer's michael dell'.
- Middleton, P., Flaxel, A. & Cookson, A. (2005), Lean software management case study: Timberline inc., in H. Baumeister, M. Marchesi & M. Holcombe, eds, 'Extreme programming and agile processes in software engineering', Springer-Verlag Berlin Heidelberg, pp. 1–9.
- Nicolini, G. & Salini, S. (2006), 'Customer satisfaction in the airline industry: the case of british airways', Quality and Reliability Engineering International **22**(5), 581–589.
- Oconnor, A. (2008), 'Tata nano - world's cheapest new car is unveiled in india'. <http://driving.timesonline.co.uk> [Online: 2010-05-29].
- Ohno, T. (1988), Toyota Production System: Beyond Large-Scale Production, Productivity Press.
- Orlov, L. (2008), 'British airways: A case study in 'lean' it', Web Article. <http://www.cioupdate.com/insights/article.php/3767846/British-Airways-A-Case-Study-in-Lean-IT.htm> [Online: 2010-05-31].
- Parry, S. (2004), 'Managing for value (case study extract)'.
- Pilkington, A. (1998), 'Manufacturing strategy regained: Evidence for the demise of best-practice', California Management Review **41**(1), 31–42.
- Poppendieck, M. & Poppendieck, T. (2003), Lean Software Development: An Agile Toolkit, Addison-Wesley Longman Publishing Co., Inc., Boston, MA, USA.
- Poppendieck, M. & Poppendieck, T. (2006), Implementing Lean Software Development: From Concept to Cash, Addison-Wesley Professional.
- Reynolds, P. (2009), 'Case study at department for business innovation & skills'. <http://www.fujitsu.com/downloads/SVC/fs/casestudies/bis-sense-and-respond.pdf> [Online: 2010-05-27].
- Royce, W. (1970), Managing the development of large software systems, in 'Proc. IEEE Wescon', pp. 1–9.
- Shah, R. & Ward, P. (2003), 'Lean manufacturing: context, practice bundles, and performance', Journal of Operations Management (21), 129–149.
- Shore, J. & Warden, S. (2007), The art of agile development, O'Reilly.
- Sörqvist, L. & Nielsen, K. A. (2010), 'Lean', Media Planet (5). In Swedish.
- Stebbins, R. A. (2001), Exploratory research in the social sciences, Sage Publications.
- Strategos (2004), 'Pioneers of lean manufacturing - taiichi ohno & shigeo shingo; interview with norman bodek'.
- Swamidass, P. M. (2000), Encyclopedia of Production and Manufacturing Management, Springer.
- Tata, M. L. (2010), 'Tata nano'. <http://tatanano.inservices.tatamotors.com> [Online: 2010-05-29].
- Tatum, R. (2005), 'Applying lean thinking principles to software development', Report.
- Tomaszewski, P., Berander, P. & Damm, L.-O. (2008), 'From traditional to streamline development — opportunities and challenges', Softw. Process **13**(2), 195–212.
- Tuite, N. (2003), 'Dell's lean experience'. http://www.engineersireland.ie/sector_papers/dellexperience.pdf [Online: 2010-05-24].
- Waterhouse, P. (2008), 'Improving it economics: Thinking lean', White paper, CA.
- Watson, J. (2005), 'It strategy propels ba profits sky-high'. <http://www.computing.co.uk/computing/news/2135359/strategy-propels-profits-sky> [Online: 2010-05-31].
- Womack, J. & Jones, D. (2005), 'Lean consumption', Harvard Business Review **83**(3).

APPENDIX I

INTERVIEW 1

The respondent is Software Process Engineer at Ericsson AB, Göteborg.

Question 1: *Do you think that there are some characteristics of Ericsson why new customers chose you over the competition?*

Answer: Yes. But I'm afraid that I'm working too far away from the customer to be able to specify this. That's a common thing in large companies. Furthermore, it's a bit difficult to go into details, since some of these things may be regarded as company secrets. What our marketing and sales people tells the customers about this, I don't know. In very general terms, Ericsson points out the facts that we are a global company with a firm position on all markets, we offer whole solutions and not just single pieces of equipment, and we are market leaders in many areas. You can probably get a more extensive answer by looking at the official Ericsson material on the web.

Question 2: *How has the change to Streamline changed what customers get from Ericsson?*

Answer: The goal of Streamline Development is to shorten the lead-time from decision to delivery. That has been achieved. Another impact of SD is that we spend less time investigating things that eventually turn out not to be developed. That saves time that can be spent on developing the valuable things instead.

Question 3: *Are there Streamline features that Ericsson uses to advertise to customers?*

Answer: I don't know. Probably not, since the customers mainly make an interest in our internal methods if there are big problems. But it may have been mentioned in conversation.

Question 4: *What role did the customer perspective play in the creation of Streamline?*

Answer: Since the goal of Streamline is to shorten lead-time to customer, the customer perspective is very important. The Product Management took part in the creation of SD, and from our (Product Development Unit) perspective, Product Management acts as the customer's representative in this.

APPENDIX II

INTERVIEW 2

The respondent is Manager of development unit at Ericsson AB, Göteborg.

Question 1: *One of the main principles of Lean is eliminating waste and unneeded processes. Do you see any benefits for the customer, or does it only provide benefits for*

the company internally?

Answer: Definitely a benefit for customer, for example:

- reduced waste → shorter lead times in development → shorter time to market (TTM)
- reduced waste → reduced cost for development → cheaper products
- reduced waste → releases time for improvements → increased quality on the products
- reduced waste → releases time for develop more features in the product → increased functionality in the products

Question 2: *Lean is related to agile. Increasing the delivery time, usually by using iterative development and agile methods (XP, Scrum...) is also an important aspect of the collaboration between the customer and the company. How much does Ericsson collaborate with the customer, i.e. does customers give feedback often and the developers use the feedback to improve the system?*

Answer: I don't think we collaborate enough with our customer but of course we listen to our customers feedback and try act on that, we have both formal feedback processes and informal.

Example of formal processes:

- CI: Our customer could issue a customer inquire (CI) of a feature or improvement they would like to see. Ericsson shall respond on this CI within 21 days, i.e answer the customer whether we will develop this feature/improvement and if this will be included in a planned release of the product or if we will handle it as a specific feature/improvement just for that customer or if this will be included in a future release
- FST: Fault slip through analysis (FST) is a analysis done on the first 80 customers trouble reports we get on a specific release, this analysis might lead to improvements in the product or changes in our way-of-working
- MFA: Market feedback analysis where we collect feedback from customers regarding a release based on the support requests we got from the customers

Example of informal processes:

- When management has meet the customers (often management meet management)
- When technician have supporting the customer at the customer site (could be installation of a new release, helping with a specific problem, ...)

Question 3: *Ericsson uses Streamline process, based on Lean. However, how much does this Lean implementation focuses on the customer needs, how are the customer wishes handled so to customer gets exactly what it needs?*

Answer: We no/very little directly customer involvement, which is a pity, however we try to involve the customer representatives instead, for example:

- When developing features/improvements based on customer inquire (CI) we normally have some kind of dialog with the customer of what the really wants

- When developing features from the road map we try have a startup meeting with the product line at (the product line have regularly communication with the customers)
- When correcting a Trouble reports the developer normally have a conversation with the first line support about what the problem really is

Question 4: *Another aspect of the Lean way of working are the Pull Systems. This means that the work is pulled by the customer instead of pushed by the schedule. How is this in Ericsson, especially the units that work under the Streamline process?*

Answer: Yes we both pull and push, I have explained the process of customer inquire (CI) in the answer to question 2 which is pull and we also have the road map based development which is the push way. Both these way are integrated in the streamline process.