Can lean be mean?

- A study of negative consequences of lean in supply chains

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Abstract

Today's world is characterized by volatility and uncertainty. Cooperation is needed to survive in this harsh business climate. Cooperation in supply chains are practiced and well known but in today's tough and volatile environment it is simply not enough. Wastes and unnecessary processes have to be eliminated to secure a competitive advantage. Incorporating lean in supply chains get more and more attention and embrace in the modern literature and media. Lean implemented in supply chains is praised to create a proactive supply chain that successfully eliminate waste and create efficiency.

In the thesis the negative aspects, the angle that is very seldom described in the literature, of incorporating lean in supply chain is researched. I will view lean from the management perspective and research the negative aspects, their cause and impact on the entire supply chain. Being aware of the criticism of lean from the employee and society perspective this research serves to find if lean from the management perspective is a flawless story. To achieve the aim of this thesis I conducted a survey research where 100 supply chain executives from different countries, different industries and of different designations within supply chain management were asked to share their lean experience.

The summary of my research show that lean incorporated in supply chains is not only a sunshine story. I can conclude problems, even a mismatch, with the lean concept incorporated in supply chains- the time sensibility lean brings. In my research it became obvious that lean supply chains are very sensitive to delays and that the consequences of the delays will strike very hard - hence the lean supply chain can also be seen as more vulnerable and fragile compared to ordinary supply chains.

There is no question about the fact that any company, any network of companies or a supply chain for that matter, are better off without delays. A delay will always be negative. In a lean environment, where time aspects such as Just-In-Time and a pull scenario are present, a delay will immediately ruin the entire execution and the consequences will naturally spread in the supply chain. In today's volatile and ever changing world I believe that leaness in supply chains are indeed needed but to an extent where the time factors are viewed realistically in order to avoid drastic consequences.

My conclusion is that supply chains should be realistically lean, bearing the time factors of lean in mind, to avoid being mean. I encourage every supply chain to identify their lean level in order to avoid a mean result.

Key words: Lean, Supply chain, Lean supply chain, Supply chain management
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I Introduction

This introduction chapter is dedicated to the background, problem definition, aim and delimitation of the topic for which this master thesis is dedicated.

1.1 Background and problem discussion

Today's world is characterized by change and uncertainty. Sharpness and cost efficiency are two key elements in achieving competitiveness on today’s market (Tompkins 2010). The pressure to increase efficiency has led to that many companies push cost efficiency demands to their suppliers in inter-organizational cost management systems (Cooper and Slagmulder 1999). The wind of change erases the hope for many businesses already at an early stage in the market while the same wind boost business success for others. In the literature it is pointed out that how changes and uncertainty will affect companies and businesses is not about luck or destiny, it is about decisions and actions. In today's business environment staying idle is not an option. Today only one thing can be predicted - that uncertainty and change is here to stay.

To be able to cope with market volatility it is important to be "lean". There is no room for unnecessary spend, non-valueadding processes or to turn customers down. To fulfil customers demands in an effective and cost-efficient manner it is impossible to act alone. Being very effective and efficient as one stand alone business does not do the trick. Even a successful business that has a "best in practice" organization is still dependent on the performance of business partners. Co-operation is imperative to achieve competitive advantages and success! (Cooper and Slagmulder1999)

Working together in supply chains has been known for long as a structured and organized way to enhance cooperation with customers and suppliers. However, the next level of effective cooperation must be achieved. Today every process and function has to be effective and efficient, within your business as well as cross company processes- waste has to be eliminated at all stages of the competitive supply chain. This is where lean enters the spotlight as a model to cut waste and improve efficiency. The implementation of lean in a supply chain context means implementing a customer focused approach in the supply chain management strategy along with adopting the five lean cornerstones and applying them in the supply chain (Godsell 2009).

The lean model, founded by Mr Taiichi Ohno, was from the beginning created for the production environment at Toyota, Toyota Production System (TPS), after World War II. During the last decade the concept behind lean has grown more and more popular and the model has been adopted in many different settings to improve effectiveness, efficiency and to remove waste. "To become lean" or "become leaner" are today common phrases in many fields of businesses, supply chain management being one of them.

Bruce Tompkins, Principal at Tompkins Associates, a well reputed supply chain management consultancy in USA, describes lean as a cooperative process for success and survival and that supply chains wanting to prosper and improve shall adopt lean. Further Tompkins promotingly describes the lean supply chain as a proactive supply chain that plan for the unknown by dedicating all resources to effectiveness. Tompkins summarizes that all parties in the supply chain
need to speak the same language for a fruitful cooperation and that lean is meant for every party to achieve higher levels of efficiency and effectiveness.

The material of lean in supply chains is new, modern and created to be relevant in our international business climate. Professor Peter Hines and the chairman of the Lean Academy, Daniel T. Jones, are among the most active contributors to lean in a business context today. I will in my thesis carefully define the lean supply chain and review its characteristics.

Having studied lean in general and lean production/manufacturing I have read a lot about lean and over the last years seen the model spread to many different industries and new areas of application. The benefits of lean alone are widely focused on and discussed and the benefits of adopting lean in different settings are embraced. More rare is to come across data covering potential disadvantages of the concept.

Seldom you come across negative publications or even negative comments about lean from a management perspective. I have never spotted any of the authors promoting lean mentioning any potential drawbacks. However, in 2003, I came across an article, "Is lean mean?" written by James Womack, that made me interested in potential negative consequences of lean. In the article the author describes a meeting with a professor and old colleague at Massachusetts Institute of Technology (MIT) in USA that concluded lean to be mean from the standpoint that lean improve efficiencies but hence destroy jobs and that the world need more jobs today, not improved productivity. This input reflects on the consequences of lean from another angle, highlighting some negative aspects, in the perspective of society.

Further Sharon Parker (2003) in her article, "Longitudinal Effects of Lean Production on Employee Outcomes and the Mediating Role of Work Characteristic", criticises lean from the employee perspective. Parker highlights descriptions of lean as intensified mass production and points out lean production to be mean production or management by stress jeopardizing the wellbeing and motivation and the employees.

According to Niepce and Molleman (1998), production principles according to lean production, for example the continuous production and tightly connected processes, generate increased stress for workers and decrease autonomy. Criticism of this kind, along with studies of lean from the employee perspective with negative aspects highlighted, are common in the modern literature.

Given the criticism from the employee and society perspective on lean, does the lean model apply without problems in the supply chain setting, from the management perspective? Looking at the affect lean is claimed to have on employees from the employee perspective according to above authors, can it be true that lean will only bring positive aspects to the management perspective?

I would like to use the more critical spectacles while viewing lean in the management perspective, in supply chains. The lean supply chain is described as:

- Producing just what is needed
- Producing just the amount that is needed
- Producing just (Just-In-Time) when it is needed,
- Producing just where it is needed. (Tompkins 2010)
The lean supply chain focuses on delivering value to the customers and fulfilling their demand with no waste- in time and with no errors in a hasslefree and problemfree manner where no firefighting manoeuvres exist. The author Daniel T Jonas (2007) describes the lean supply chain as reconfiguring the use of the assets and relationships throughout the entire supply chain to enable delivery of added value to the customers.

Is this streamlined approach with no wasteful activities, being ultra efficient and effective, foolproof? Does it always deliver lean or can it sometimes also deliver mean, to the entire supply chain or in parts of the chain? If so, what is causing lean to be mean in the supply chain context?

Since the lean way is more and more commonly applied and also embraced in the literature for application in a supply chain setting I would like to dedicate this thesis to investigate:

*Being aware of the criticism of lean from the employee and society perspective; Are there any negative consequences from the management perspective, incorporating lean in supply chains, if so, what kind of problems are present and what's causing them?*

### 1.2 Problem definition

The problem that serves as a foundation of this research is:

*Being aware of the criticism of lean from the employee and society perspective; Are there any negative consequences from the management perspective, incorporating lean in supply chains, if so, what kind of problems are present and what's causing them?*

### 1.3 Aim

Knowing the criticism to lean from other perspectives than management the aim of this master thesis is to investigate if lean from the management perspective, in the supply chain environment, comes without negative consequences. Through a survey answered by 100 supply chain executives I will research if there is any negative impact of lean incorporated in supply chains.

The motivation for choosing the critical angle in my research is to counterbalance the available literature on lean from the management perspective. The literature covering lean incorporated in supply chains is promoting with benefits and advantages highlighted. Very seldom lean in supply chains is written about with a negative pen. In this thesis the aim is to challenge and test if the combination of lean and supply chains is flawless.

This thesis will also contribute to create a wider understanding of the lean model from the management perspective, supply chains and the combination of the two- lean supply chains.
1.4 Delimitation

This thesis is dedicated to research negative consequences of lean in the supply chain environment. Hence the lean model will in this study be examined from the management perspective only. I would also like to highlight that this is not a study of lean in general but a study of lean in the supply chain context.

The findings of this research and the conclusion of this thesis is therefore not applicable or relevant to lean in general.
2 Method

This method chapter will describe the methodologies used to achieve the aim of this master thesis. Apart from a review of relevant literature I conducted a survey research to get the view from 100 supply chain executives on negative aspects of lean incorporated in supply chains. When a survey answer required further elaboration I followed up with a telephone interview.

The methods for the review of literature, survey, interview and analysis of survey along with reliability and validity are presented in this chapter.

2.1 Literature review

In the literature review I critically examined the existing publications significant to my area of research. I realise that a literature review is not just a summary of available academical research. The literature is used as a theoretical foundation for my research and the review of the supply chain concept, lean and the lean supply chain are connected and referred back to in my research, analysis and conclusion.

In the literature review I worked with literature and articles. I also used Internet and different databases to search for information.

2.2 Survey

With the literature as a foundation a questionnaire/survey were developed to research and answer the problem; "Being aware of the criticism of lean from the employee and society perspective; Are there any negative consequences from the management perspective, incorporating lean in supply chains, if so, what kind of problems are present and what's causing them?". My survey is of primary data and it is processed, sent out, analyzed and documented in the months of May and June 2010.

There are two main types of data, quantitative and qualitative. Research methods to collect quantitative data relate to the natural sciences and were developed to study natural phenomena. Examples of methods to gain quantitative data that are widely accepted in the social sciences today are for example, laboratory experiments and numerical methods such as mathematical modeling (Merriam 1994).

Merriam (1994) presents that research methods for collecting qualitative data were developed in the social sciences to enable studies of social and cultural phenomena. Examples of methods to gain qualitative data are action research, case study research and ethnography. The collection techniques behind qualitative data range from observation and fieldwork, interviews and questionnaires to documents and texts.
Quantitative data can be used when the object of study can be measured or presented numerically from where statistical analysis can be conducted. Qualitative data are instead used when studying phenomena with a combination of unique qualities and characteristics not possible to measure (Andersen 1994). This research is of qualitative art based on qualitative data.

The survey was sent by e-mail to 150 supply chain executives globally and from that I aimed to get replies from 100. I had a good initial response rate on my survey and 92 executives replied before the deadline (June 17:th). As I aimed at 100 replies I sent a reminder to all the executives that I had not received a reply from. From the reminder I got further response and I closed the survey activity when I reached 100 received surveys, I closed at survey 100 no matter whom it came from or the contents. This means that I collected the remaining 8 surveys by no other priority than receipt date. The actual deadline for receiving the 100 surveys resulted in a delay of four days. Surveys coming in after receiving 100 answers where not read and are hence not included in this research.

The survey/questionnaire was e-mailed to the chosen, lean-experienced, executives along with a presentation of my research and myself. I also made efforts in representing the supply chain cooperation, where possible, when distributing the survey. I wanted to ensure confidentiality for the participants in my research, hence no names and/or companies are disclosed. I instead used industry, country and position as parameters when analysing and discussing the result of the data collection. Kelley et al. (2003) point out the importance of clearly presenting the research and the researcher to the participants in the survey along with a recommendation of a confidentiality guarantee, this is to secure a high response rate as well as to meet the requirements of informed consent.

I chose to work with a survey sent electronically to reach supply chain executives in different parts of the world in an effective and cost-efficient manner. The survey was created with the actual problem; "Being aware of the criticism of lean from the employee and society perspective; Are there any negative consequences from the management perspective, incorporating lean in supply chains, if so, what kind of problems are present and what's causing them?", in focus and also directly pointing at the core of my problem definition to generate qualitative data.

In the survey I used "levels" of questions to effectively drill down to a deeper level to get quality data in the answers. The questions were open-ended to avoid asking leading questions. When an answer required further elaboration/information I followed up with a telephone interview. The telephone interview was used in cases where the elaboration was low, which meant that the participant only provided keywords or when an answer was unclear to me.

Bell (2005) highlights surveys/questionnaires as cost-efficient and fast methods of getting answers to questions of the art; what? when? where? and how? Bryman and Burgess (1999) present three types of data collection in a qualitative manner; open ended interviews with depth, direct observations and written documents. The written documentation includes analysis of questionnaires/surveys. The research technique in collecting and analysing data adopted in this master thesis will be based on written documents (surveys) and interviews.
2.3 Interview

Modell (1996) states that there are different types or interviews with various aims. An interview can be held with the purpose of familiarization, gathering of facts, verification of information gathered elsewhere, confirmation of information and with the purpose to follow-up, amplify and clarify gathered information. I conducted the interviews to follow-up on answers given in the survey, to amplify the level of elaboration in the answers and/or to clarify information given by the participant in the survey.

To secure qualitative data from the distributed survey I followed up with a phone interview where needed. I felt the need for a phone interview when elaboration was very low, in cases where participants only provided keywords and also in cases where the answer was not clear to me. The interviews were a follow up on the answers given in the survey and this enabled a depth to the given answers and further elaboration. I conducted the follow up interviews in close connection to the actual survey deadline to ensure that the participants still had the survey and its questions fresh in mind and also to ensure that I had completed the data collection and closed the survey before I started to process the survey answers.

The interviews were held in a semi-structured manner in order to have the flexibility to ask questioned outside the structure, if applicable. As described by Denscombe (2000) the semi-structured design does not restrict the interviewed person but give room for a dialogue where needed.

2.4 Processing of survey result

I gathered primary data from a survey, answered by 100 supply chain executives. Wright (2003) point out that the aim and core of analysis is to summarize data so that it is easy to understand and returns the answers to our questions. It is important to ensure having all data and the correct data.

After the actual survey deadline I started the analysis work by first going through all answers to the survey. This first contact with the survey answers served to identify if I had all data I needed. From a first study of the answers I identified that follow-up interviews were needed in some cases. I conducted the follow up interview as soon as possible after the need was identified. Doing the interviews right after the survey deadline was important to get all the answers in and to close the survey. I could not start any deeper analysis of the answers before all data was in hand.

When all the data was in hand and the survey closed, I started to summarize the data, this is according to Wright (2003) the core step in data processing. I summarized the result of the survey to see if there were any obvious patterns, leads or deviations. I also investigated if the identification parameters; country, industry and designation indicated any trend, view, pattern etcetera. Oppenheim (1992) point out the importance of analysing patterns, deviations and similarities in data.

The identification parameters present the participants, prove the spread of the survey and enable studies of patterns within the identification groups. I used the parameters to be able to discuss, analyse and quote specific answers in the empirical chapter and analysis. However, these
parameters are not used to "follow" a certain person or to connect the parameters to one another. The three parameters stand alone and are not connected. The small sample sizes of groups in the identification parameters were taken into account when processing and analyzing the answers. To get relevance, representing the supply chain, some groups were in some cases merged. The designation parameter was for example merged into groups that were divided into only non-managers and managers instead of all designations. Where a merge is done it will be commented clearly in the text.

I analyzed and summarized the survey answers in below manner. I first looked at;

• Are there any negative experiences encountered with lean incorporated in supply chains?

Since there were negative experiences mentioned in 100% of the answers these experiences were studied on a deeper level, looking at;

• What kind of negative experience?
• Where in the supply chain are the problems experienced?
• How will the encountered problems affect the entire supply chain?
• What the participants of the survey identified as the cause of the problems.
• If the participants managed to solve encountered problems and how they did this.

Since negative experiences were found they were analysed according to above parameters and in the analysis chapter I connected the result of the survey to the theory in order to identify why lean has lead to a negative impact incorporated in supply chains. There I also related back to the identification parameters and presented possible correlations. Further I related back to the theories to conclude pattern-like mismatches between lean and supply chain management. Where there were no obvious patterns or mismatch to follow I looked at the causes of the negative consequences.

2.5 Reliability and validity

Reliability describes to what extent a research of a concept would generate exactly the same result regardless of the number of research occasions (Merriam 1994). The reliability of the result is a cornerstone in every research. In my research I used written secondary data in the literature review (literature and articles). To secure the reliability I based this thesis on well known academic sources only. The authors, professors and researchers referred to are well known and accepted within their field of expertise.

In the empirical chapter I used primary data collected in a survey to research; Being aware of the criticism of lean from the employee and society perspective; Are there any negative consequences from the management perspective, incorporating lean in supply chains, if so, what kind of problems are present and what's causing them? To ensure reliability in the data collection I asked supply chain executives active in different industries, in different countries and different positions within supply chain management to take part. If an answer required further elaboration/information I followed up with a telephone interview. I worked with open ended
questions to avoid steering the answers. This approach to the survey along with the confidentiality guarantee of answers is a good foundation for reliability.

Validity reflects the accuracy in reflection and assessment of the area of research. There are two types of validity:

1. External validity: The extent to which the results of a research are generalizable or transferable.
2. Internal Validity: Errors or problems in the research, for example difficulties in data collection. (Merriam 1994)

Already when drafting this thesis I wanted to produce a material as general as it can be useful and of interest to any business in any industry. This study is not tied to any industry, company or person. The result of my research will generalize as a first observation that future empirical studies can be compared to. The internal validity of this thesis is high as I did not encounter any problems in data collection, finding literature, contradictory data etcetera during my research.
3 Theoretical framework

This chapter is dedicated to the theories creating the foundation for this master thesis. In this chapter the theories and definitions related to supply chain, lean and the lean supply chain are presented.

3.1 What is a Supply Chain?

All companies are unique, they have their own unique operations and their prerequisites and conditions are situation based. The way you manage and organize your business hence always has to be adjusted to fit the current situation. There is not one solution that works in all situations. However, in some aspects all manufacturing and distributing companies are alike- they are all doing business in a market/markets where they in competition sell their products and/or services. They all have customers and suppliers that they have a relationship and dependency on- they are involved in one or several supply chains (Mattsson 2001).

Mattsson further describes the supply chain as a chain of actors. Below is an example of a simple, single, supply chain;

Starting with: Raw material producer
↓
Refining of raw materials
↓
Product manufacturing company
↓
Regional Distributor
↓
Local Distributor
↓
Ending at: Customer

To be able to see all activities of the supply chain clearly Tompkins (2010) illustrates the components of the supply chain;
Martin Christopher (1998) describes how supply chains can appear in clusters or networks, where supply chains are integrated and connected together. Below figure (Figure 1) illustrates a supply chain network. The network is created from interacting supply chains.

3.1.2 Definition of the supply chain concept

There are many definitions of the supply chain concept. Although the majority of definitions available in the literature are similar there are different ways to define a supply chain. Some authors and researchers define the supply chain as a chain of activities while some prefer to view the supply chain more as an integrated network of more than one chain rather than one "isolated" chain.

I would like to adopt the below definition of a supply chain throughout this Masters thesis:
“... a connected series of activities which is concerned with planning, coordinating and controlling materials, parts, and finished goods from supplier to customer. It is concerned with two distinct flows (material and information) through the organization.” (Stevens 1989 p. 39)

A more extended view of supply chains are highlighted in some sources of literature. Martin Christopher (1998) for example, argues that a supply chain should be considered as a network instead of a chain. Christopher presents the following definition of supply chain network:

“A network of connected and interdependent organizations mutually and co-operatively working together to control, manage, and improve the flow of materials and information from supplier to end user.” (Christopher 1998 p. 19)

Some authors prefer to define the supply chain from a more simplified view, Stig-Arne Mattsson defines a supply chains as:

“Chains of companies from rawmaterial manufacturers, via different refining and distributing companies to customers as final consumers of the products or services.” (Mattsson 2001 p.7)

Above definitions all touch the same areas and the same activities, the differences appear in the extension of the supply chain. Some authors view the supply chain more as a single chain and some authors describe many chains connected together in networks/clusters. The definition presented by Steven (1989), that I chose to base this thesis on, defines the supply chain from a connected series of activities in the areas of; planning, coordination and control of materials, parts and finished goods from suppliers to end customers. These activities are mentioned in all above definitions. Stevens also highlights the flow of material and information. The material flow is touched upon in all definitions while information is more rarely mentioned.

3.1.3 Supply Chain Management

In the academic literature many authors agree that supply chain and supply chain management originates from logistics and its management; Bowersox and Closs, (1997), Cooper and Ellram, (1993), Kent and Flint, (1997), Ganeshan et al., (1998) and Mattsson (2001). The evolution from logistics into supply chain management is described by Masters and Pohlen (1994). They present an evolution of three phases:

1. (1960-1970) Functional management: Functions related to the filed (shipping, procurement etcetera) are managed as separate divisions.
2. (1980) Internal integration: Management of supply chain functions within an enterprise are unified.
3. (1990) External integration: Management of functions throughout the chain, internal and external actors are unified. Cooperation and coordination between the different parties are required within the chain.

In supply chain management the tasks related to planning, developing, coordination, organization, management and control of the flow of resources in supply chains are focused on- supply chain management is the management of supply chains (Mattsson 2001).
Mattsson highlights that supply chain management can be defined in different ways. Therefore I would like to present different definitions of supply chain management. Mattsson himself defines supply chain management as:

“Supply chain management means planning, development, coordination, organisation, management and control of intra- and inter-organizational processes from a holistic perspective and regarding exchange of material, information, payments, product development activities and marketing activities in supply chains from original raw material supplier to final consumer.” (Mattsson 2001 p. 56)

Martin Christopher (1998) adopts a more summarized definition with focus on cost efficiency:

“The management of upstream and downstream relationships with suppliers and customers to deliver a superior customer value at less cost to supply chain as a whole.” (Christopher 1998 p. 18)

Harrison and van Hoek (2002) present a similar definition with cost efficiency highlighted along with a focus on alignment of partners:

“The alignment of upstream and downstream capabilities of supply chain partners to deliver superior value to the end customer at less cost to the supply chain as a whole.” (Harrison and van Hoek 2002 p.7)

Otto and Kotzab emphasis the integration of organizational units in their definition:

“Supply chain management is the task of integrating organizational units along a supply chain and coordinating materials, information and financial flows in order to fulfill customer demands with the aim of improving competitiveness of the SC as a whole” (Otto and Kotzab 1999 in the “Supply chain management and advanced planning—basics, overview and challenges” by Stadtler).

Above definitions are similar, but there are some minor differences. The differences are related to how the supply chain is described. As presented in the definition of the supply chain there are slightly different views published in the academic literature on the complexity of the supply chain – hence definitions will be narrow or wide. In defining supply chain management these differences in viewing the supply chain become apparent. However, the purpose that is communicated from all authors above is that supply chain management is a theory of managing supply chains.
3.2 Lean

Lean has its roots in Japan. The engineer Taiichi Ohno (1912-1990) is known as the father of the concept. The lean concept started to develop in Toyotas manufacturing plant, within the Toyota Production System (TPS), after World War II (Womack & Jones 1996).

3.2.1 Toyota Production System

The integration of a production process date from the early 1900's and was first done by Henry Ford in the car manufacturing business, Ford. In Michigan in the USA Ford created the first production flow with parts in a moving production line.

Ford managed his production in sequences using special purpose machines wherever applicable. This was a revolution in America where the other productions where build around general purpose machines grouped by processes. The production flow made it possible for Ford to have a very high inventory turnover, having the production managed this way he turned the inventory of the company around every other day. The problem Ford faced was instead the problem to produce a variety of his products, cars. In his production he could only produce one model, the T-Ford, which was produced in one design only.

In the area where Henry Ford failed the other car manufacturers on the market were able to meet the customers demand on variety. Ford's competitors were able to provide customers with different designs and choices but they instead faced problems with long throughput times with increased inventories as a result.

When Taiichi Ohno and his fellow co-workers at Toyota looked in to the Ford example in 1930 they found it possible to offer the customers a variety of products and at the same time keep the continuity in production flow through a number of simple innovations. From Henry Ford's initial idea, through simple innovations, the Toyota Production System (TPS) was created. The main innovations that Taiichi Ohno and his colleagues at Toyota introduced to Ford's way of production was a shift in focus. Ohno et al moved the focus from machines and the utilization of them to the product flow in the total production process. At Toyota the actual purpose and utilization of machines were put into focus. The machines in the Toyota Production Systems were:

- Self-monitoring to control quality.
- Quick to setup and change to provide flexibility and to enable small batch sizes.
- Sized to match production volume.
- Located in a sequence to support the production flow.

Further Toyota focused on descriptions of each step in the production flow and having each production step notifying the previous workstation on material needs. This generated a flexibility, fast throughput times, the possibility to provide a varied product portfolio in a high quality and at a low cost. (www.lean.org)
3.2.2 The lean principals

The lean way is about banishing waste or *muda* which is the Japanese word for waste. Muda is the centre of the lean model. Waste is any human activity that allocates resources but generates no value. For example, production of products that are not in demand, processing activities that are not needed and unnecessary transportation of goods. (Womack and Jones 2003)

Taiichi Ohno and his colleagues at Toyota identified and described seven different types of muda, waste:

1. Defects or reworking scrap.
2. Idle time or waiting time in production or for staff.
3. Unnecessary transportation, handling or moving of material or staff.
4. Unnecessary movement of equipment or staff.
5. Over-processing or unnecessary processing.
6. Unnecessary inventory, applies to all levels of inventory serving a production. (Raw material store, work in progress and inventory of finished product).
7. Overproduction or too early production. (Ohno 1988)

Further I would like to define lean:

"*Lean thinking can be summarized in five principles: precisely specify value by specific product, identify the value stream for each product, make value flow without interruptions, let the customer pull value from the producer and pursue perfection.*" (Womack and Jones in Redefining the lean principles, Hines Peter (2009).

In this definition the five cornerstones of lean are presented:

1. Value
2. Value stream
3. Flow
4. Pull
5. Perfection

The starting point of lean is value. What value is can only be defined by the customer. Value is only meaningful when its expressed in relation to a specific product or service which meets the customers demand at a certain price at a certain time.

The value stream is a set of actions needed to bring a specific product or service through the problem solving task from concept to engineering/design to product launch. To bring the product or service through the information management task, from order management via scheduling to delivery and through the transformation task, from raw arteries to a finished product or service in the hands of final consumer. When the value is specified, the value stream known with all wasteful elements removed it is time for the remaining, valueadding activities, to flow.

Pull represents the fact that nothing shall be produced upstream unless the product/service is required downstream. For example, raw material shall not be processed and pushed downstream until it is needed in a later station in the production process. This describes the Just-In-Time-concept.
When organizations start to specify and acknowledge value, identify their value streams, enable products or services to continuously flow and let customers pull value from the organization and work with continuous improvement, perfection is suddenly not far fetched. (Womack and Jones in *Redefining the lean principles*, Hines Peter (2009). Figure 2 below illustrates the five lean principals.

![Figure 2. Principles of lean thinking (Womack and Jones in Harrison and van Hoek 2002)](image)

The lean way is developed from 14 principles:

1. Always base your management decisions on a long-term philosophy, even if that means sacrificing short-term goals.
2. Bring problems to the surface through a continuous process flow.
3. Use "pull" systems instead of "push" to avoid overproduction.
4. Level the workload.
5. Build a culture and understanding on getting the right quality from the beginning to avoid mistakes that have to be fixed.
6. Standardize the tasks, this is the foundation of continuous improvement and empowerment of employees.
7. Do not hide problems, use visual control.
8. Use technology that serve people and processes.
9. Develop leaders who understand the tasks, whom live the philosophy and let them teach others.
10. Grow exceptional teams and people whom adopt the philosophies of your company.
11. Respect your network of external partners and suppliers, challenge them and help them to improve.
12. Go and see the situation with your own eyes to understand.
13. Make decisions carefully and by consensus, considering all available options. Once decision is taken, implement what's decided rapidly.
14. Be a learning organization through reflections and continuous improvement, known as Kaizen. (Liker 2006 on www.lean.org)

3.3 The lean supply chain

3.3.1 What is a lean supply chain?

Although lean is traditionally known and applied in a manufacturing/production setting, lean principles are adoptable where there are processes to improve. Lean is therefore applicable to the entire supply chain. A lean supply chain is a supply chain that:

- Produces just what is needed.
- Produces just the amount that is needed.
- Produces just (Just-In-Time) when it is needed.
- Produces just where it is needed. (Tompkins 2010)

The lean supply chain is about delivering value to the customers and fulfilling their demand with no waste in time and with no errors in a hasslefree, problemfree manner where no firefighting manoeuvres exist. It is about reconfiguring the use of the assets and relationships throughout the entire supply chain to enable delivery of added value to the customers. (Daniel T Jones 2007)

Thomas Craig (2004) describes the lean supply chain process as streamlined to remove and reduce non-valueadding activities and waste to the entire flow of the supply chain and to the goods moving within the chain. Waste shall be measured in unnecessary costs, time and inventory and the valueadding activities shall be defined as contributors, that will in an efficient manner bring the product to its end customer. There has to be a flow in the chain and inventories, anything stopping or interrupting this flow or relating to inventory has to be a valueadding activity. The lean supply chain is demand driven, customers pull goods instead of suppliers pushing goods down the chain. This pull flow of the lean supply chain has to always flow, anything delaying or interrupting the flow shall be analyzed as a potential wasteful activity.

How to manage waste reduction in the supply chain relates back to the seven identified wastes in the lean model:

- Defects or reworking scrap.
  - Stop defects at their source.

- Idle time or waiting time in production or for staff.
  - Eliminate idle time.

- Unnecessary transportation, handling or moving of material or staff.
  - Eliminate excess transportation and handling.

- Unnecessary movement of equipment or staff.
- Eliminate excess movements.

- Over-processing or unnecessary processing.
  - Eliminate unnecessary production processes/production steps.

- Unnecessary inventory, applies to all levels of inventory serving a production. (Raw material store, work in progress and inventory of finished product).
  - Let processes flow together/relate the components to the process.

- Overproduction or too early production.
  - Eliminate overproduction, produce Just-In-Time.

From the above steps the idea of what can be improved and how to do it are born. Waste can be identified and removed, or at least reduced to a high degree. In a production environment, removing the above wastes generate:

- Shorter cycle times.
- Reduced labour time.
- Improved quality.
- Space savings.
- Reduced inventory.
- Quicker response to the customer.

The benefits in removing these wastes to the entire supply chain, creating a *lean supply chain* consist of:

- Reduction of overall cycle time.
- Reduction of labour costs along the entire chain.
- Improved quality of products/services.
- Improved delivery precision.
- Reduced inventory.
- Overall shorter lead-times along the chain resulting in ultimately shorter lead-times to end customer.

The summarized effect is a *lean supply chain* more efficient and responsive to customer needs. (Tompkins 2010)

The lean supply chain is further exemplified by Daniel T Jones (2005) where the lean supply chain for vegetables of British retailer Tesco is used as an example; Tesco's supplier of the particular vegetable is using a software module to carefully follow and control the planting process, the growth and harvesting of the vegetables to make sure to match the trends in demand. The crops are harvested every day according to weekly plans they have agreed with Tesco. The picked quantities are exactly matched to the actual orders received and are moved to the packing unit in the field right away- in real time. The vegetables are packed and dispatched with no delays and sold to the customer at one Tesco store the day after.
McKee and Dr. Ross (2008) describe lean supply chain management from an Internet oriented perspective in their report "Lean Supply Chain: A Foundation for Change" p. 7-8:

"Lean SCM is a supply chain operational and strategic management philosophy that utilizes Internet-enabling technologies to effect the continuous regeneration of supplier and service partner networks. A lean supply chain network is empowered to execute superlative, unique customer-winning value at the lowest cost through the collaborative, real-time synchronization of product/service transfer, demand priorities, vital marketplace information and logistics delivery capabilities..."

From the description by Tompkins (2010) of the supply chain activities (suppliers/supply, procurement, manufacturing, warehousing/storage, transportation and customer) the lean supply chain characteristics can be illustrated as:

**Lean suppliers/supply:** To be a lean supplier you have to be able to respond to changes. The purchasing prices of a lean supplier are in general lower due to efficiencies of lean production processes. Their quality is at a level that inspections at the next link in the chain can be reduced. Lean suppliers work with continuous improvements and deliver Just-In-Time.

**Lean procurement:** Some of the lean procurement processes are e-procurement based and system automated procurement. The foundation of lean procurement is visibility, the suppliers must see their customers activities and vice versa. The companies need to identify the current value stream and together create a future strategic value stream serving the procurement process. There must be a mutual flow of information and a pull set-up for both information and products.

**Lean Manufacturing:** In a lean manufacturing the production is focused on only producing according to customer demand; to produce the quantity and quality demanded, when the customer wants it (Just-In-Time) with minimum resources. Initiatives of being lean normally start in the manufacturing part because applying lean here is known to free up capacities for continuous improvement and to create a pull scenario. Lean adopted in manufacturing typically represents the greatest opportunity for cutting costs and to improve quality.

**Lean warehousing/storage:** The typical operation of warehousing/storage are:

- Receiving goods.
- Storing goods.
- Replenishment of goods.
- Picking of goods.
- Packing of goods.
- Shipping goods.

In lean warehousing all non-value added activities and waste shall be removed. Wastes in a warehouse environment, relating back to the seven wastes identified in the lean model, that shall be removed can be:

- Defective goods sent out generating returns.
- Overproduction or over shipping of goods.
- Unnecessary inventories kept.
• Unnecessary motion of staff and excess handling of goods.
• Unnecessary processing.
• Unnecessary transportation.
• Idle time- waiting for goods and information.

**Lean transportation:** To create a lean transportation the value stream has to be carefully mapped, there has to be a flow created for the transportation activities, and all non-value adds and waste has to be removed. A lean transportation is characterized by:

- Programmes with core carriers.
- Top notch administrative processes and automated functions supporting transportation.
- Grouping of orders.
- Combined truckloads with multi-stops.
- Cross docking.
- Equipment being right sized.
- Pre-defined processes for import/export transportation.
- Backhauls and inbound transports.

**Lean customers:** A lean customers has identified and know its need and can hence clearly communicate requirements. The lean customers value flexibility, short lead-times, expect high delivery performance and quality. They further want to shape effective partnerships in which continuous improvement is focused on in the entire supply chain to reduce the total costs. Lean customers expect value from the products they purchase to be able to provide the very same to their customers.

In the lean supply chain the five principals of lean are embraced and applied:

1. Value: The lean supply chain starts with the customers and to understand what they value.
2. Value stream.
3. Flow.
4. Pull.
5. Perfection. (Tompkins 2010)

### 3.3.2 Implementation of lean in supply chains

The implementation of lean requires a strategy, the implementation will require a change and a new approach to remove waste and to add value. It also has to be recognized that implementing lean in a supply chain is a cross company matter and that the lean principles has to act as a basis for the lean supply chain.

Implementing lean in supply chains is not a quick fix. Adding on to the normal and usual implementation problems in one company, the supply chain involves many actors and these cross company relationships and processes has to be supported. The first step in the implementation is to map and assess the present supply chain from a value stream perspective. This is to identify waste and to state from where the continuous improvements will start. When thinking about the
future lean supply chain it is important to remember the supporting infrastructure- training, policies and IT etcetera. (Thomas Craig 2004)

Ronald L. Turkett (1999) highlights the following steps in the implementation of the lean supply chain:

1. Partner and engage with the best suppliers early in the process.
2. Work with key suppliers that can ensure high capability for processes and supply.
3. To avoid long lead-times your suppliers should be located in the country where your product is manufactured.
4. Strive for a short supply chain by having suppliers close by, frequent deliveries along with leveled production plans.
5. Develop and ensure a pull systems with suppliers.
6. Know the production capacity.

McKee and Dr. Ross (2008) present the infrastructure needed for a lean supply chain:

- E-Information: The Internet based information flow of the supply chain.
- Supply chain synchronization: Real-time information available to all supply chain actors at the same time. All actors will work in partnerships to optimize resources and cut costs. The keys of a synchronized lean supply chain are a unified business strategy, common agenda for product and performance excellence and a common selection of technologies.
- Supply chain collaboration: The actors engaging in and constantly widening collaborative partnerships.
- Optimization: The continuous optimization of productive resources through process management and technology.
- Operations excellence: Collaborative operations excellence throughout the supply chain.
- Connectivity and networking: The technical infrastructure that serves as a link between IT, people and businesses.
3.4 Criticism to lean and the lean supply chain

In the literature lean is not too seldom criticised from the society and employee perspective. The critical voices from the society perspective point out that improved productivity destroy jobs and hence lead to unemployment. Womack (2003) Sharon Parker (2003) has further given her critical input from the employee perspective where she highlights that the monotonous, hyper effective, mass production according to lean principles are causing stress, puts down the motivation and jeopardized the wellbeing for the workers.

Lean from a management perspective however is seldom criticized. The criticism available is recently published and the majority of the material exist as articles, editorials and in online forums.

Lean manufacturing and The Toyota Production System (TPS) has been in the critical spotlight during 2010. The media attention is referring to the recalls made by Toyota. The most recent one was announced by Toyota August 26:th, 2010. This particular recall, involving approximately 1.13 million 2005-2008 model year Toyota Corolla and Corolla Matrix, was regarding Engine Control Modules (ECM) that Toyota state may have been improperly manufactured. (www.toyota.com)

The Toyota recalls were discussed in an editorial "Supply Chain News: Is “Lean” to Blame for Toyota’s Recall Issues?” on the popular supply chain news site supplychaindigest.com. Here Robert Martichenko, CEO of consulting company LeanCor By concluded the high need of perfection required in a lean production; "If you move to the point of just-in-time, almost radically low inventory levels, it means the quality of parts has to be nearly perfect, because there is no buffer inventory to protect against a quality issue."

Toyota is not the only automotive manufacturer under review regarding its lean performance. In the article "Nissan- dangers of a lean supply chain" (2010) Professor Michel Roberto critically comments on Nissan's lean supply chain in connection to a production stop in six production units of the company due to supply chain disturbance. According to Roberto this illustrates what happens in the super effective lean supply chain with no backups if there is a minor problem somewhere in the chain. At Nissan the problem started with a problem in one of their production units rapidly escalating throughout the chain.

Another article "How Lean is Too Lean in the High-Tech Supply Chain?" written by Chris Cookson (2010), available on the popular supply chain forum supplychainbrain.com, criticises lean for being too lean and also point out the problems with implementation. The author uses inventory as an example to where lean can be too lean since lean view inventory as necessary evil. Cookson state that in reality no company can cut their inventory without risk unless the supply chain is absolutely perfect. Cookson continues to highlight that most implementations of lean are done in a suboptimal manner where factory layouts, visual controls, fool proofing assembly processes etcetera are focused on but the second step of the implementation; analyzing, taking control and improving processes, are forgotten. Further the author point out that lean is
many times implemented in some parts of a company only, where as reality require a throughout implementation spanning over all functions.

The lean supply chain get criticism from Steven A. Melnyk in his article "lean to fault?" (2007). Melnyk point out the benefits of applying lean in a different context but Melnyk also criticizes the lean system as not being a perfect solution and not applicable in every environment. The author further highlight that lean, under certain conditions, can be bad for companies and supply chains. According to Malnyk the lean supply chain can be fragile, without buffers in the areas of capacity, lead time, or inventory and that the lean supply chain can not handle the unplanned. Unplanned events are in this article exemplified by the author as nature catastrophes and epidemical diseases. The example of the earthquake in Taiwan in September 1999 and its direct impact on companies such as Apple, IBM and Compaq is used as an example.
4 Empirical result

This chapter will be based on my survey. I will here present the result of my primary data collection, the survey.

4.1 Background of survey and the participants

I sent the survey to 150 supply chain executives from different industries, in different countries and of different designations within supply chain management. I had already targeted to receive 100 answers and I'm pleased that I managed to hit this magic number. I'm pleased to have gotten the amount of answers I aimed for but I'm even more pleased with the quality of answers and elaboration. The interest, energy and effort the survey answers brought me is impressive!

Before distributing the survey I aimed to get a good spread of industries, countries and to get answers from executives of different designations. I also tried to represent the supply chain, where possible, when distributing the survey. I have for example managed to get answers from automotive raw material suppliers, automotive manufacturers and automotive dealers- these actors will all be in a natural connection to each other and are connected in a supply chain.

I ensured the anonymity of my survey participant and will therefore only relate to the identification parameters chosen; country, industry and designation.

I want to highlight that I chose to work with identification parameters to be able to present the participants, to prove the spread of the survey, to be able to see patterns within the identification groups and to be able to discuss, analyse and quote specific answers in the empirical chapter and analysis. I did not chose to work with identification parameters to "follow" a certain person or to connect the parameters to one another. The only time the parameters will be connected are when I will reproduce an answer from the survey, then I will use the parameters in a combination to "identify" the source of statement. Apart from this the three parameters will stand alone and will not be treated in connection with each other.

Please find a presentation of the participants from the country perspective:

![Participants from country perspective](image)

Figure 3. Participants from country perspective
Above diagram show the spread and participant from a country perspective where the Y-axis show number of answered surveys. It is an interesting spread covering many continents and developed as well as developing countries. I'm not surprised in the spread of answers since I got response from all countries I sent the survey to. The number of answered surveys span from 3-9 which is a manageable spread where the "lost answers" belong to the countries with less number of surveys answered.

Please find below presentation of the participants from the industry perspective:

![Industry Participants](image)

Figure 4. Participants from Industry perspective

From the industry perspective I got answer from 17 different industries. The Y-axis show the number of answers. The answers/industry range from 4-12. The reason for the retail industry's high participation number is that I have chosen not to divide retail into sub groups- hence the retail industry consists of retailers holding everything from fresh foods to clothes to more specialized retailers stocking only fashion items for example.

I managed to get the supply chain connections represented in the industry parameter. From above diagram you can point out obvious and close supply chain relationships with the following actors:

- Chemical raw material producers, chemical manufacturing, chemical trader and paint manufacturer as chemicals is a main raw material in production of paints. There is also a connection to retail.
- Automotive raw material manufacturer, automotive manufacturer and automotive dealer. There is no retailer connected to this industry, the retailing is done through the dealer.
- Textile producer, fashion manufacturer and retail.
- Food manufacturer and retail.
- Homeware manufacturer and retail.
The remaining industries can of course belong in above supply chains, transportation for example can be applicable to any industry. However these actors do not necessarily connect in this case. Since I wanted a good spread of my research I wanted to study both the supply chain affect to search for patterns but I also wanted to combine this with "stand alone" industries.

Please find below presentation of the participants from the designation perspective:

![Designation](image.png)

The Y-axis show the number of answers received. The spread of number of answers/designation range from 4-9 and I asked people from 17 designations to take part.

To fulfil the aim with this thesis I wanted to get the opinion from people across the supply chain, holding different designations. I wanted to make sure the view of lean in supply chain was given from different levels in the companies and from an end to end in the supply chain. Hence I have not prioritized seniority in distributing my surveys.

### 4.2 Result of the survey

In this section I will present the summarized result from the survey. I have chosen to present the summarized answers per question following the order of the survey (available in Appendix 1).

**Question 1:**
The first question in the survey served to find out whether the participants have had any negative experiences with lean in supply chains:

**Question:** "According to your experience with lean incorporated in supply chains, have you encountered any negative experiences? Yes or no?"

**Survey result:** All 100 supply chain executives answered yes to above question. This means 100% of the participants had experienced negative aspects of lean in supply chains.
Since all participants indicated negative experiences I could from this question not investigate any patterns etcetera from the identification parameters.

**Question 2:**
The second question was asked to find out what negatives the participants had experienced.

**Question:** "If, yes, please elaborate around the negative experience you have had."

**Survey result:** Since all participant indicated negative experiences all participants answered above question.

As 100% of the participants answered this question I looked at patterns, trends etcetera from all identification parameters. I also used the opportunity with a follow up telephone interview to elaborate further around this important question. I identified the need for this additional discussion in 12 cases.

The summarized result of this question show a clear pattern. This pattern was very obvious from the industry parameter as well as from the designation point of view.

The most active contributors in answering this question were the downstream actors. In 87% of the cases the participants active downstream the supply chain (all the manufacturers, traders, dealers and retail from the industry perspective) indicated problems with late deliveries or cancelled deliveries from suppliers as a main problem. This was pointed out to generate loss of sales/customers, a loss of money and production stops along with the need to hold extra stock for safety reasons. The delay was also said to be pushed down the chain as the actors in this field have customers that they have made a promise to. I was given examples of stock outs in stores due to late deliveries, summer collection arriving at wintertime and production at manufacturers that had to be stopped.

The transportation/shipping/freight/logistics matter was also highlighted by 30% of the total participants as a cause of late deliveries. Due to strikes, nature catastrophes, letdowns from a haulier or bad planning the goods from the supplier did not reach in time. The recent ash cloud from the volcano incident on Iceland and recent airline strikes were in almost all cases mentioned as a delaying factor.

The problems presented by actors upstream in the supply chain where we find the raw material producers were of more general art, such as bad communication, a lack of cooperation and implementation problems. However 12% of the participants active upstream the supply chain had encountered problems to deliver as promised. The problem to deliver was said to be due to bad production planning (internal problems), unplanned orders from customers not respecting the lead times, production gone wrong which means that the specification of end product was not possible to sell and limited buffer stock levels of ready product.

Bad communication and the lack of cooperation with customers which was highlighted by the raw material producers targeted the need of a closer cooperation. Interface of order systems and a closer dialogue of future needs were pointed out. From the manufacturers perspective nobody mentioned transportation/shipping/freight/logistics issues as causing problems.
From the country parameter I did not discover any pattern or anything indicating a similar view in a certain country or a certain part of the world. I also did not find any deviation from this aspect.

Another central input to this question that I encountered in the majority, 74%, of the answers was general problems with lean due to a poor implementation. There were many different comments connected to this statement and this is where I can see a pattern from the designation point. People in non-managerial positions, 42 executives, felt that the management did not anchor the lean programme before implementing it. Many of the non-managers pointed out that lean was just seen as an added workload as nobody bothered to educate or explain the idea behind the lean implementation or with lean.

From supply chain executives holding managerial positions, 32 executives, the problems due to a poor implementation were given many different reasons. A denial and ignorance from the staff was pointed out in some cases along with many different causes like a lack of time, consultants not doing a good job, bad timing and a different view of lean within the organization.

**Question 3:**
The third question, which sought to identify where in the supply chain problems had been encountered turned out to be somewhat overlapping question number two.

**Question:** "If yes, where in the supply chain have you experienced problems with lean?"

**Survey result:** I got answers from 100% of the participants on this question as well. In this question I could not find anything indicating a pattern, trend or similar from the country perspective. The same result was concluded from the designation parameter. Although there were a pattern from this parameter in the previous question (question number two) there where no such trend available in these answers. One explanation to this can be that the trend in the previous question was noticed in comments regarding problems in the implementation of lean in supply chains. The patterns and correlations were instead obvious while summarizing the answers from the industry perspective. The noticed patter does also correlate back to the trend seen in answers to question number two.

The participants downstream the supply chain (all the manufacturers, traders, dealers and retail from the industry perspective) were the most active contributors in this question. They indicated problems upstream the chain, where we find the raw material producers. The highlighted problem was late deliveries or cancelled deliveries. The upstream supply chain actors (raw material producers) identified the need for an understanding of lean from their partners side. Bad cooperation and a lacking communication was in many cases pointed out as a problem creator at the upstream end of the chain.

60% of the participants, the actors in the shipping and airline industry excluded, also indicated problems, in all cases meaning delays, in transportation/shipping/freight/logistics. The executives from the shipping and airline industry in a few cases commented on the above criticism with the core meaning that the problems/delays are already present when reaching their part of the chain. Apart from this input the executives in the shipping and airline industry only highlighted internal operational problems.

I got many similar comments, in 38 surveys, from different industries all giving the same main message that lean in a way makes the supply chain vulnerable and fragile which was said to
generate problems across the entire chain. The shared message to this input was that a mistake or a problem at one actor transfer to the next actor as lean does not give room for mistakes.

**Question 4:**
Question four serves to get an understanding of how the encountered problems will affect the entire supply chain.

**Question:** "If yes, how will the encountered problems affect the entire supply chain?"

**Survey result:** This question got an response rate of 100%. However the level of elaboration was slightly lower and the answers in many cases referred to the previous question. To secure qualitative data I felt the need to follow up with a telephone interview in 7 cases.

In this question again the country parameter was irrelevant. I could not find any pattern, trend or mismatch from the country perspective. The very same could again be concluded for the designation point of view. The industry parameter delivered a pattern, strongly connected to the result of question number two and three. The majority, 54% of the participants active downstream the supply chain indicated that stock is pushed down the chain. The actors active downstream felt the need of extra buffer stock to keep up with the late deliveries from lean suppliers due to their low or non-existing buffer stocks- hence the stock is said to be pushed downstream along with its cost and administration.

In 25% of the answers higher costs were given as en effect of the lean supply chain: This was motivated by the need to keep buffer stock due to late deliveries and also to stops in production, loss of sales when suppliers can not deliver on time/at all. From the executives in manufacturing industries I got many quotes regarding lean resulting in production stops.

Further 12% of the participants presented that when a problem arises in the lean supply chain it will affect the entire chain downstream. The problem will be passed on to the next actor. It was said that there are limited resources to solve a problem, and hence it is solved to some degree or not at all and simply passed on. The general input to the question, coming from 62% of the participants in total, were indicating delays and an overall fragile/sensitive supply chain. In this question I did not come across any contradictory answers or industries talking "against" each other. I didn't find any answer deviating to the general perception.

**Question 5:**
The fifth question asked the executives to elaborate around what they found to be causing the problems with lean in supply chains.

**Question:** "If yes, please explain what have you identified to be the cause of the problem/problems with lean in supply chains?"

**Survey result:** The response rate on this question was again 100 participants, 100%. The answers to this question were very interesting as all participants gave general input, input not specific to any industry, location in they supply chain (upstream or downstream), country or designation. No pattern or deviation was to be found as all participants gave answers in the same span. In the answers I soon concluded five keywords; implementation, education, communication, delay and fragile. These words represented the underlying causes of problems with lean in supply chains in my research.
Implementation was again given as the most common cause of problems with lean in supply chains. 79% of the executives mentioned poor/non complete implementation as a factor causing problems. Education is in this context not only relating to the initial implementation. Education is said to be needed not only at the very initial implementation. In this question 71 executives mentioned the lack of education as one factor generating problems.

Communication was also mentioned in the majority of answers. In this case communication cover the internal communication as well as the cross company communication. 69% of the participants felt that a lack of communication/faulty communication caused problems.

The above causes were given by the majority of participants. Delays were in 34 % of the cases given as a cause of problem. In this context delays are highlighted to be the factor that will offset problems always, a delay anywhere in the chain equal problems. Fragile is mentioned in 21% of the answers where the lean chain is said to be too fragile which is explained as the lean supply chain has a problem to cope with change and deviations.

Question 6:
This question was asked to understand if the encountered problems were solved and if so, how they were solved.

**Question:** "If **yes**, did you manage to solve the encountered problems? If so, how did you solve them?"

**Survey result:** This question was again answered by the 100 participants. Only 22% managed to solve the problems they had experienced. The interesting pattern here is that these 22 executives that managed to solve their problems with lean in supply chains had experienced problems in implementation only. Hence, any other problem but implementation related remained unsolved.

Relating back and studying the outcome of question two again to find further patterns in this question only the designation parameter turned out to be relevant, correlating to the 74 executives that had encountered problems with implementation. In this question the 22 executives that felt that they managed to solve their problems the majority were managers, 17 participants. The participants that managed to solve their implementation problems indicated that they solved them by training, mentoring, improved communication, improving IT-system infrastructure and an increased understanding of business needs.

Question 7:
The last question was formulated to find out why no negatives had been experienced with lean in supply chain in case participants indicated that no problems had been encountered.

**Question:** "If **no**, please elaborate around why you think no negativities have been experienced."

**Survey result:** Since all participants had experienced negative impact this question was not answered and is therefore not relevant in this research.
5 Analysis

In this chapter I will analyse the result of my survey and connect its finding to the theories presented in the theoretical framework. I will conduct the analysis with my research question as a foundation; Being aware of the criticism of lean from the employee and society perspective; Are there any negative consequences from the management perspective, incorporating lean in supply chains, if so, what kind of problems are present and what's causing them?

I would like to start this chapter by stating that the first part of the research question is already answered. From my research I can conclude that there are negative experiences of lean from the management perspective as well. The answers to my survey show that lean incorporated in supply chains is not a pure sunshine story.

I will further dedicate this chapter to analyse and elaborate around the problems of lean incorporated in supply chains presented by the participants in my research. I will analyse why there are problems with lean in supply chains and discuss potential reasons behind why these problems are present connecting the answers in the survey to the theoretical chapter. I will elaborate around the matter to see if there are any obvious mismatches with lean and supply chain management and try to find causes to why problems arouse referring to the problems presented by the executives in the survey.

I will use the identification parameters to discuss a certain problem from the stand point of country, designation and industry. I will analyse if certain problems apply to certain parameters only and investigate possible causes or if a problem is encountered across the entire chain.

In the empirical chapter where I summarized and presented the result of my research I found that the following problems with lean incorporated in supply chains were apparent:

- Problems due to poor implementation
- Delays
- Lack of communication/cooperation
- Vulnerability/fragility
- Higher costs due to delays
- Problems spreading/pushed down the chain
- Stock pushed down the chain/need for extra buffer stock

I would like to start this analysis analysing the implementation related problems. The majority of the executives, 74% indicated problems connected to implementation. The problems due to implementation can in this case, from the input in the survey, be seen as "general". Implementation problems can be present in any implementation or whenever ways of working are changed. Studying the reasons given in the survey to the problems related to implementation the main problems were of very general art. The non-managers pointed out that lean was seen as an added workload along with a lack of education of the new ways of working. The supply chain executives in managerial positions indicated denial and ignorance from the staff, a lack of time, consultants not doing a good job, bad timing and a different view of lean within the organization.
Looking at the theory available on implementing lean it's clearly stated that it is not a quick fix, in this context it is even more challenging as it involved not only one company but a chain of companies - a supply chain. It is a demanding change that require close partnership within the chain but also a solid infrastructure supporting IT and processes. It is also pointed out that companies in general implement lean to a first stage and in certain areas of a company generating a first stage implementation rather than a full implementation.

Analyzing the reasons behind the implementation issues nobody mentioned any problem specifically linked to lean, supply chains or anything directly linked to the theory on how to implement lean in supply chains. I got many comments similar to this quote, from a manager in the chemical industry: "We were told to implement lean and we were all exited about it, however, the timing was wrong and there were not sufficient resources given.". From the non-managers I find this quote to represent the common view: "When we were going lean we did it over night, we were told we were now lean but nobody educated us on what it meant and how to manage it".

One interesting pattern found in relation to this was that it was only implementation problems that the executives managed to solve and from the executives solving these problems 77% were managers. This is of course interesting from the employee perspective but I don't see a correlation to lean incorporated in supply chain and will hence not analyze this finding further in this thesis.

As for the implementation problems all the 74 participants were indicating internal problems, related to change management, hence I chose not to analyze this further in this context.

The second most noticed problem, delays, was presented in majority by the industries active downstream the supply chain. The late deliveries had serious consequences for these actors and was also indicated to be passed on to their customers. I got comments from down stream the chain: "We don't dare to be lean having a lean supplier", "When our lean suppliers cant deliver/deliver too late, if there is no buffer stock, we need downsize/stop production", "In our industry we need deliveries on time and in the right specification, if this fail production at our site can not continue" and "Our suppliers are lean or too lean and hence stopping us to be lean".

Looking at the supply chain or the supply chain network and how it is constructed one interruption will naturally be passed on to the next lead. Hence, if there is a problem it will be a problem not only for one business but also for the connected actors. Viewing the input from the critical voices of the lean supply chain the lean chain is said to be more vulnerable to the unexpected, having no backups due to a minimized inventory and the fact that a small disturbance will rapidly escalate in the chain.

Why are the these suppliers not delivering on time? Because they are lean? Is the problem more visible because the is not an excess inventory at all stages of the chain or is a lean supply chain more time sensitive? A part of the answer is given by the raw material suppliers in my survey as they themselves, 12% of them, indicated problems to deliver as a problem. Here production gone wrong, bad production planning (internal problems), unplanned orders from customers not respecting the lead times and limited buffer stock levels of ready product are brought up as reasons.

As I see it there are two sides to this problem. I first reconnect to the theory of lean where there is a clear ban of defects or delaying re-work of production. The question hence has to be raised if the suppliers giving the above explanations are really lean. No buffer stock will in the long run
make up for a faulty production line. The limited buffer stocks of ready made goods as a cause of delivering late can also indicate problems in the production or other departments rather than indicating a too small warehouse.

Further, looking at the theory on what is required to develop a lean supply chain the above signals that we do not have that scenario:

- Partner and engage the best suppliers early in the process.
- Work with key suppliers that can ensure high capability for processes and supply.
- To avoid long lead-times your suppliers should be located in the country where your product is manufactured.
- Strive for a short supply chain by having suppliers close by, frequent deliveries along with leveled production plans.
- Develop and ensure a pull systems with suppliers.
- Know the production capacity.

It is obvious that the infrastructure and the partnership to enable a lean chain is not in place. Hence I believe that parts of this problem can be related back to the issues of implementation.

On the other hand one can argue that it is very hard to live up to the lean supply chain cooperation at all times. Having streamlined processes delivering exactly what is needed when its needed (J-I-T) can make it hard to execute perfect result always. However, even a ordinary supply chain can not make up for continuous problems, bad cooperation and delays.

The downstream executives point out bad consequences when there is a delay. They lost business, money, the producers sometimes had to stop a running production and they felt the need to keep extra stock. These problems have their origin in a time factor, a delay. Looking at the lean supply chain, it is a chain that:

- Produces just what is needed.
- Produces just the amount that is needed.
- Produces just (Just-In-Time) when it is needed.
- Produces just where it is needed.

Looking at today's volatile world I raise the question of the above is realistic. Can a company or a chain of companies, a supply chain, perform according to above with a perfect execution always? If they can't there will be serious consequences in the lean supply chain. In this question I get support from the critical voices commenting on lean supply chains. Melnyk (2007) for instance highlights the fragility the lean approach in supply chains bring.

It is clear that there is a time factor connected to the lean supply chain. The Just-In-Time concept is present as one cornerstone. It leaves no space for wastes such as contaminated production or excess production of goods. Hence, a lean supply chain is sensitive to delays. Critical voices even call the lean supply chain fragile due to its need for perfection and a lack of backup.

The need for high level of correctness for the lean supply chain to work and not generate delays connected with huge consequences can be a mismatch between lean and the supply chain environment. Although all parties do their part there can be, and recently we have had many examples of nature catastrophes, strikes etcetera, breaking the performance needed for a good
execution. One company's efforts are not enough, there has to be correctness throughout the entire chain. Especially in today's global world I find the Just-In-Time to be hard to live up to always.

In some cases transporters/hauliers and freight forwarders were pointed out to cause delays, this quote comes from a raw material producer; "it's hard to be lean all the way down the supply chain if the transportation providers don't live up to the expectations" and "it's impossible to deliver a lean result in today's environment where nature disasters and strikes rule the freight business". The last quote refers back to the recent ashcloud from Iceland. In many of the answers strikes and nature disasters are commented on in regards to delay.

On the contrary I received comments from executives in the freight/logistics/transport industry stating; "We are see as the enabler of lean and are kept accountable for bad planning" and "Our lean mission is at times mission impossible". This indicates that delays are sometimes already present when reaching the logistic actors.

I can relate back to the Just-In-Time concept in lean and conclude that there is no room for the unexpected in a lean supply chain such as an ashcloud. Problems with broken lean supply chain performance due to nature disasters etcetera is not a new phenomenon. Melnyk (2007) highlight the draw backs with the lean supply chain in this context concluding that a lean chain has a problem to handle the unplanned generating huge consequences at the same time as it can be concluded that nature will always life its own life being impossible to control.

Regarding the problems mentioned with a lack of communication/cooperation I do not find lean to be the cause. Lean might put a high demand on communication and cooperation as the theory of implementation states; partnership, collaboration etcetera are core already at the stage of implementing lean in supply chains. Looking at the number of executives indicating a poor implementation and also looking at the reasons behind the problem of delays it is clear that cooperation and communication is not perfect. I got a few similar comments on this from the executives active upstream the chain; "Knowing lean and cooperating lean is needed for us the be able to deliver lean". From the same part of the chain I got this comment; "There has to be a common agenda on lean and realistic expectations on us suppliers, the lead-times has to be accepted and we can not be firefighters to our customers problems"

I find the above problems more related to a lack of communication, poor cooperation and lean not fully implemented rather than lean causing the problems. I would even say that the supply chain cooperation, leaving lean out for a moment, is not in place. This reflect the problems seen by the upstream actors, these are the actors highlighting bad communication and a lacking cooperation as problems. I see this as the supply chain cooperation not working rather than lean creating the issues. Viewing the definition of a supply chain (Stevens 1989 p. 39) makes it clear that not even this level of cooperation is achieved according to the answers to the survey; "... a connected series of activities which is concerned with planning, coordinating and controlling materials, parts, and finished goods from supplier to customer. It is concerned with two distinct flows (material and information) through the organization.".

In the answers to the survey the lean supply chain are in some cases seen to be causing problems being too vulnerable and fragile. It was said that; "The lean supply chain is more vulnerable, we don't have space for mistakes and when there is a mistake it does not come cheap" and "There is no backup in a lean supply chain and therefore it hits hard when a problem occur".
The above correlates well to the critical publications available on lean supply chains. The critical voices state that the lean supply chain is indeed vulnerable and has a problem to cope with the unplanned.

Analysing the answers I can also reconnect to the issues with delays in the lean supply chain and its time factor. The need for a high level of correctness throughout the supply chain to achieve a lean supply chain can be very hard to live up to at times. Although all actors do their part there can be issues impossible to control that will break the performance needed for a good execution. In one company this operation is easier, processes and operations are kept within one organization, in the supply chain there are operations and processes crossing many company boarders and to get a flawless result according to lean can be hard to achieve at all times and in some cases it will be due to things outside the supply chains control. However, when performance is not living up to expectations, no matter the reason, any supply chain will be affected. The lean supply chain, being very streamlined with Just-In-Time and the pull approach etcetera, having no built in back up is indeed more vulnerable and fragile.

The lean model ban defects and unnecessary inventory, hence the theory do not embrace a "backup" scenario. However, necessary and unnecessary is not stated by the theory. Although the level of unnecessary is not stated the lean supply chain is clearly not build around safety if something goes wrong. In the answers I got from the survey in relation to the lean supply chain being vulnerable and more fragile the connection was in some cases made to strikes and nature catastrophes again, just as for the delays. In cases like these no supply chain is safe but the lean chain, streamlined with low buffer stock levels, pull production and Just-In-Time will naturally be more affected. This level of vulnerability and fragility is also one of the most common criticism to the lean supply chain today.

In connection to vulnerability, fragility and delays we do have the problems mentioned by the executives related to added cost due to delays. These added cost relate to the consequences the delays caused hence I find this problem directly connected to the delays and as a consequence of the delays. In a chain build upon Just-In-Time and pull consequences from delays will of course be costly, and at least the impact of these problems will be greater in a lean chain where the chain is built around goods arriving just when they are needed and where there is no production until needed and so on- hence there is no back-up built in. As discussed earlier I think that the level of correctness and the streamlined approach with lean can at some degree mismatch with a supply chain.

Another problem highlighted by the executives answering the survey was that problems spread or are pushed down the lean supply chain. These problems are of course sometimes directly connected to the issues with delays that have been discussed earlier but other problems are said to also be passed on. I got comments such as "My suppliers problem become my problem" and "No problem is ever solved in the chain but only passed on the next actor". Apart from the time perspective, the delays, I find it hard to see that lean incorporated in the supply chain are causing these issues. I find it more to be the nature of the supply chain, the way its build, that will generate a natural chain effect for both good and bad.

Reconnecting the theory and definition of a supply chain it is natural that my suppliers problem will become my problem due to the close cooperation up and down and also across the chain. I find the way of cooperation in chains to be the cause of problems spreading.
Not only problems are said to be pushed down the chain but also the safety stock along with the need of additional buffer stock downstream the chain. The majority, 54%, of the downstream actors felt the need of extra buffer stock to keep up with the late deliveries from lean suppliers and hence the stock is said to be pushed downstream.

I got comments from executives downstream the chain such as; "Since our suppliers don't stock we have to do it at our end" and "We don't dare to have a lean warehouse". In this case again the problems is connected to the time factor, the delay. The downstream actors build in safety to be able to cope with delays and to reduce the consequences of the delays. Is this a lean supply chain? As discussed earlier, connecting to the theories, this scenario does not describe a lean supply chain. However, one might wonder if a lean chain from the Just-In-Time and pull production aspect is possible today. The above answers describe a scenario where a supply chain is trying to compensate for delays introducing a backup.

The problem with a lack of safety and backup is highlighted by the critical voices commenting on the lean supply chain as being vulnerable and at risk due to slimmed inventories. This relates back to the time factor again and the comments from the survey show that the lean execution is not always reliable hence there is a need to create safety and backup. It is clear that there is a need to try to secure bad performance or lean performance not being perfect to the level is needs to be to execute on time.
6 Conclusion

In this chapter I will summarize and conclude the result of my research in connection to the research problem of the thesis; "Being aware of the criticism of lean from the employee and society perspective; Are there any negative consequences from the management perspective, incorporating lean in supply chains, if so, what kind of problems are present and what's causing them?".

The first part of the research problem is already answered as stated already in the analysis. Summarizing the result of the survey it became apparent that there are negative consequences of lean from the management perspective as well. To fulfil the aim of this research I will further conclude the present problems, their cause and potential mismatches between lean and supply chain management.

In the analysis chapter the below problems with lean incorporated in supply chains, as per the result of the survey, were analysed and discussed:

- Problems due to poor implementation
- Delays
- Lack of communication/cooperation
- Vulnerability/fragility
- Higher costs due to delays
- Problems spreading/pushed down the chain
- Stock pushed down the chain/need for extra buffer stock

From the above problems I would like to conclude the problems due to poor implementation as general. This means that I don't find any link between the problems presented in this context to lean in supply chains. The problems in this field were instead related to change management and general changes in way of working. I can not find any indication that it is the implementation of lean as a tool creating the problem.

Further I can not see that the problems with lack of communication/cooperation and problems that spread/are pushed down the chain are linked to the incorporation of lean. A good communication and cooperation is of course needed in all business relationships, not the least in a supply chain but a poor quality of these aspects can hardly occur or get worse due to a change in ways of working. It can become more important, but I don't find any link to the lean model causing these problems.

I can also conclude that there has been no evidence in this research that lean is creating or increasing the spreading affect of problems down the chain. From the theoretical definition of a supply chain I can conclude that there will be a chain effect due to the nature of cooperation, in chains and in networks.

For the remaining problems; delays, vulnerability/fragility, higher costs due to delays and stock pushed down the chain/need for extra buffer stock I can conclude a problem, mismatch, with the lean concept incorporated in the supply chain environment. What I find to be the common factor in all these problems is the time factor connected to lean. In the lean supply chain there is a Just-In-Time concept and a pull scenario that has to work flawlessly for the lean chain to perform, if
this performance is not in place there will be delays and these delays will cost. The lean supply chain is vulnerable/fragile to the unplanned and hence there can be a need for downstream actors to take on stock to parry the consequences.

It is obvious that the lean supply chain is very sensitive to delays and that the consequences of the delays strike hard - hence the lean supply chain can also be seen as more vulnerable and fragile compared to an ordinary supply chain.

From the input to the survey it becomes evident that today's world is volatile and many times run by the unexpected. A flawless supply chain performance can unfortunately be torn down by things outside our human control, nature catastrophes for example. The recent ashcloud from Iceland was highlighted in many survey answers and given as a cause to major delays and terrible consequences within the supply chain. As discussed in the analysis I think all supply chains suffered from the Icelandic cloud but looking at the time concepts of the lean supply chain it is obvious that lean is not build around a back up scenario or created for the unexpected, instead a lean and flawless chain of actions is required within a lean supply chain.

I would like to end this chapter by clearly concluding that I have found the time factor of the lean concept to be a mismatch between lean and supply chain management creating a more fragile/vulnerable supply chain.

My final conclusion is that there are negative consequences of lean incorporated in supply chains and hence also negatives of lean from the management perspective. I have identified the problems to source from the time factors in the lean model. Being aware of this supply chains should be realistically lean, bearing the time factors of lean in mind, to avoid being mean. I recommend every supply chain to identify their lean level in order to avoid a mean result.

6.1 Implications and interpretation of result

I would like to start to once again highlight that this research of lean is made in the supply chain environment and from the management perspective. Hence the result will not be applicable to lean in general or to lean from other perspectives.

The study is conducted across different industries, different countries and the input is given by supply chain executives holding different designations within supply chain management, hence the study will not be more specific than specific to lean in supply chains. This should of course be taken into account while interpreting the result.

Worth to mention is also that the wide scope of diversity in my research was planned from the very beginning. I wanted to avoid connecting this research to any specific industry, designation level, supply chain or country. Instead I wanted to research from diverse sources to be able to work with a more general supply chain picture.
6.2 Recommendations for future research

This research is focused around problems with lean incorporated in supply chains, studying lean in the management context. During my research I have of course carefully studied lean from a holistic view and from other perspectives than management and hence I would like to make the below recommendation on interesting areas for future research.

In my research I come across that there are different perceptions of lean from the employees point of view. There is a difference in how managers and non-managers perceive the work with lean. In my research this became apparent from an implementation point of view. There is a clear difference in encountered problems and it also became clear that the problem encountered was seen to be solved mainly by managers. It would be interesting to research lean from this standpoint.

I can also recommend further studies of the implementation of lean, in supply chains and in stand alone organization as 74% of the executives encountered problems due to implementation.
Appendix 1

Survey- Being aware of the criticism of lean from the employee and society perspective; Are there any negative consequences from the management perspective, incorporating lean in supply chains, if so, what kind of problems are present and what's causing them?

This survey is created to identify negative consequences of lean incorporated in supply chains. If negative aspects are found I would like to get a deeper understanding of their causes and their impact on the entire supply chain.

Seldom you come across negative publications or even negative comments about lean from the management perspective. We have all seen lean being criticised from other angles and perspectives, for example lean bringing mean to workers increasing efficiency and hence increasing unemployment along with more general critique to lean production from the employee perspective.

I would like to use these more critical spectacles while viewing lean in the management perspective, in supply chains. Since this is an electronically distributed survey I kindly ask you to be as elaborative as possible and don't hesitate to give examples. I would also like to have the opportunity to follow up on answers via a telephone interview if needed.

You answers will be kept strictly confidential! I will only use country, industry and designation as identification parameters. If you are interested you are of course more than welcome to take part of the findings of my research.

If you have any questions regarding the research or the survey please contact me on XXX@gmail.com or mobile: 00 46 704XXXXXXX. I would appreciate to have your contribution as soon as possible, the deadline for the survey is June 17 2010.

I need Your help and Your expertise! Please share Your lean supply chain experience with me!

Country:

Industry:

Designation:

1. According to your experience with lean incorporated in supply chains, have you encountered any negative experiences? Yes or no?

2. If, yes, please elaborate around the negative experience you have had.
3. If yes, where in the supply chain have you experienced problems with lean?

4. If yes, how will the encountered problems affect the entire supply chain?

5. If yes, please explain what have you identified to be the cause of the problem/problems with lean in supply chains?

6. If yes, did you manage to solve the encountered problems? If so, how did you solve them?

7. If no, please elaborate around why you think no negativities have been experienced.

Many thanks for Your kind contribution and help!
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