Improving Project Management with Lean Thinking?

Author
Basit Aziz

Supervisor
Nicolette Lakemond

Department of Management and Engineering (IEI)
Institute of Technology, Linköping University, Sweden
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Abstract

In the new business economy, project management has become a central way for undertaking several of the business activities. One of the increasing and most significant concerns with projects is that, projects are behind schedule, over budget and show unsatisfactory performance in terms quality and customer satisfaction. In the last few decades the manufacturing industry successfully improved quality and productivity, by using the concepts of lean thinking. The thesis explores the relevance of lean concepts in project management and how lean concepts can improve project productivity.

The qualitative method is used in this study. Further, a systematic approach was used to identify the relevance of lean concepts in project management. The qualitative data was collected using an interview with a project consultant.

The results of the study reveal that all concepts of lean thinking are relevant to project management in specific kinds of projects. However, a greater degree of understanding and interpretation of each concept is needed when applying lean thinking in project management. Furthermore, some of the concepts have to be interpreted with caution when they are used in innovative projects.

In general, it is found that, lean project management can improve project productivity. The findings suggest that the lean concepts can reduce cost and time which are two key measures of project success. The results of this study can be seen as a tentative framework intended to stimulate further discussion about integrating lean thinking in project and program management.

Keywords: Lean, Lean Project Management, Project Productivity.
Dedication

This thesis would be incomplete without a mention of the support given me by my Father and Mother, to whom this thesis is dedicated.
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**List of Abbreviations**

LPM  Lean Project Management

NPD  New Product Development

PM  Project Management

PMI  Project Management Institute

PMBOK®  Project Management Body of Knowledge

R&D  Research and Development

TPS  Toyota Production System

TQC  Total Quality Control

TQM  Total Quality Management

VSM  Value Stream Mapping
1 Chapter: Introduction

The introduction offers the reader a background of the topic together with the problem and aspects it includes. The research background and the problem analysis then lead to purpose and research questions.

1.1 Introduction

Today organizations face challenges in the form of intense international competition, rapid technology evolution, maturing customer expectations and quality demands (King, 1987). In such circumstances, effective and efficient management is among the primary ways in which organizations adapt for their existence. In recent years, project management has become a central way for undertaking business activities in an effective way (Whittington, et al., 1999). The activities that are often undertaken in form of projects belong to different industries, such as services, construction, administration, management, product development, and etc. However, several of these projects are condemned to be delayed and overrun cost, which is often considered as normal. This passive acceptance that projects may not deliver on time or within allocated budget has great effects on the overall business of organizations. Delay in projects fairly means a delay in product introduction, certainly missing market opportunity and forefront of technology, which seriously affects company’s superiority in market. Further, it is also identified that projects often show unsatisfactory performance with respect to productivity and quality (Atkinson, 1999; Winch 1996).

In order to address the problems above, a new perspective to project management may lead to new insights that can improve project performance. In the field of manufacturing, for instance, tremendous improvements in productivity and quality have been made by the implementation of lean. It could be interesting to investigate to what extent (part of) the practices connected to lean could be useful in project management. However, project management is a field which is relatively different from manufacturing management. Projects are temporary and unique, and are performed by teams with clearly defined individual roles (Tonnquist, 2008). In contrast, manufacturing is based on ongoing and repetitive activities conducted by production personnel. It is also a common practice to initiate project for unique and creative tasks, in for example, product development activities. Product development projects are based on a high degree of ambiguity, uncertainty and are also complex in nature, especially regarding radical endeavors (O’Connor, 2008; Trott, 2008). Generally, for these activities a higher degree of creativity is required, which is connected to more slack and freedom in work activities (Millson, et al., 1992). However, there are also some common characteristics between manufacturing and
projects as both are performed by people, are constrained by limited resources, both are planned, executed and controlled, but maybe to different degrees.

In the last few decades the manufacturing industry successfully improved productivity, by developing new methods and ways of working. Especially lean manufacturing became popular and is recognized as a main reason of success, efficiency and high productivity (Mohanty, et al., 2006; Cusumano, 1992). The principles of lean manufacturing are now well established and are widely used not only in automotive industry, but also in other industries, and in different contexts, like services. The aim of this paper is to examine to what extent the ideas related to lean are relevant and useful in project management.

1.2 Problem description

In project driven organizations: the project is the primary way to undertake activities. Even in non project driven organizations several departments e.g., administration, finance, marketing and human resource departments also undertake work activities in the form of projects. The focus on organizing activities in projects has increased over the past few decades (Whittington, et. al., 1999). Recently, researchers evolving interest in projects is also documented in research on the organization of construction, product development and of companies in a number of other industrial sectors (Midler, 1995; Ekstedt, et. al., 1999).

Although projects have several similarities as they are focused on temporary, rather unique tasks, projects are also different from each other, for example regarding the size of the task, budget, etc. However, in recent years, there has been an increasing amount of literature consistently showing that Projects often fail. In that they go into frequent cost overruns, delays, and show unsatisfactory performance in terms of quality and customer satisfaction (e.g., Atkinson, 1999; Ewusi-Mensah & Przasnyski, 1997; Flyvbjerg, et al. 2003; Flyvbjerg, et al. 2002; Morris & Hugh, 1987; Winch, 1996; Standish Group, 1995; Williams, 1999). Cicmil and Hodgson (2006) reported that nearly 30% of product development projects never live up to business objectives. According to Winch (1996) U.K. government procured construction projects ranging from hospitals to roads, suffer from, on average, 14% cost overrun and 11% time overrun. The three common problems described above, were already recorded by the Project Management Institute (PMI) in 1969. Still today, project management faces the same challenges.

Although a lot of research has been performed on project management, it seems that the research has not been able to provide remarkable solutions. This may have
to do with the nature of project work which involves ambiguity and uncertainty, but it is also interesting to explore the possibilities for implementing new approaches focused on improving project management performance. In a figure published by PMI companies spend an average of $177,000 per year to improve project management in their organizations (Morris, 2008). This is also reflected in the attention paid to project management maturity models, which assesses project management capabilities at different levels. Mullalay (2006) found that improvements in project management performance can be associated with increases in project management maturity. This indicates the relevance of actively seeking for new ideas to improve project management performance. In a tentative study it has been shown that lean thinking can be applied to knowledge work that is characterized by task uncertainty and ambiguity with positive results (Staats, et al., 2011). The relevance of lean thinking for project management will be explored in this thesis.

1.3 Purpose of research
The purpose of this study is to explore the possibilities to integrate lean thinking in project management for improving project productivity.

1.4 Research questions
Question 1: What concepts of lean thinking are relevant for PM?
Question 2: How can concepts of lean thinking improve project productivity?

1.5 Delimitations
First, lean is a broad topic and due to the limitations in time and resources to conduct the study, it was not possible to analyze all the concepts of lean. Therefore, the focus of study remained limited to the five principles of lean thinking. Second, study is mainly conceptual and only based on a limited empirical basis, consisting of one interview. This, of course, restricts the ability to generalize the results to a broader level, but because of the fact that the interviewee provided perspectives considering different companies, it is believed that the results can be generalized up to some extent. Third, there are not many projects that run on the basis of lean thinking. Therefore, a case study was not possible.

1.6 Disposition of the thesis
Chapter one provides an overall introduction and aspects of the problem area; purpose of research and research questions. Chapter two provides insight into the research methodology and how research is conducted. Chapter three is based on literature review of lean: it provides an insight into the history and evolution of lean thinking, contemporary views on lean production and critical aspects and problems
associated with lean. Chapter four is based on a literature review on project management; it provides insight into the nature of project work; past research on project management and how work is articulated in projects; it also highlights the past research on using lean in projects. Chapter five presents the empirical data. Chapter six is based on analysis of concepts in lean thinking, project management and state of the art practices in project management, it provides a concept wise view of how the concepts of PM are connected with lean in different ways. Chapter seven is based on discussing the results and findings. Chapter eight provides a shorter summary of main areas covered in the thesis and managerial implications and future research suggestions.
2 Chapter: Methodology

The purpose of the methodology chapter is to provide the reader with a deeper understanding of how the research is carried out.

2.1 Overall research design

This study is mainly conceptual and exploratory based on a limited empirical basis, consisting one interview. It was identified that the best method to adopt in this study was to review the literature on both: 1) lean thinking and 2) project management and thereafter, investigate the state of the art practices in project management. Thus, it can be classified as conceptual and exploratory research which tries to find appropriate answers to research questions. Accordingly, an overview of the research design is shown in figure 2-1.

An alternative research design would have been to perform a more in-depth case study method, for instance of a firm applying lean thinking in project management. This would have provided a greater insight into the actual lean practices that are used in project management, their advantages and disadvantages. However, as mentioned earlier in the limitations it was difficult to find any company that can be used as case for this study. Further, the thesis aims to answer on both ‘what’ and ‘how’ related to lean thinking in project management. In order to accomplish the aim, it was decided that a literature review coupled with an interview would be an appropriate research design for this study.

Figure 2-1: Overview of research design
The literature search and empirical data collection is precisely explained in the forthcoming sections. Once, the literature review was completed and desired empirical data was gathered, a systematic analysis was done.

2.2 Research strategy
This research has dual purposes, exploratory and descriptive. It is exploratory as, so far, there has been little research on integrating lean thinking in project management. This research is aimed at developing ideas that can be used further for a more systematic study and will hopefully provide a direction for future research in this area. Furthermore, this thesis provides concepts of Lean Project Management (LPM), referring to different areas related to lean thinking, which establishes an understanding of applying lean in project management. In terms of this, research is descriptive as well. However, the exploratory purpose dominates the study.

2.3 Research approach
This thesis is based on qualitative approach. It was considered that qualitative measures would be more useful for analytical reasoning in order to arrive at the results. Furthermore, the qualitative approach was chosen because research is based on evaluating, comparing and linking the concepts of lean thinking and project management (Figure 2-1) to develop a new methodology i.e. LPM.

![Figure 2-2: Research approach](image)

Science is fundamentally a rational activity and is based on logical reasoning. There are two distinct logical systems which are considered important to scientific search, inductive logic and deductive logic. Beveridge (1951) explains them as, “Logicians distinguish between inductive reasoning (from particular instances to general principles, from facts to theories) and deductive reasoning (from the general to the particular, applying a theory to a particular case). In induction one starts from
observed data and develops a generalization which explains the relationships between the objects observed. On the other hand, in deductive reasoning one starts from some general theory and applies it to a particular instance”. This thesis is based on deductive reasoning, i.e. starting from concepts of lean and then applying those concepts to project management.

2.4 Systematic exploration
This thesis is inspired by Dubin’s (1978) methodology for theory building, which provides a methodology for theory building that is particularly relevant for applied fields such as management, marketing, and organization theory. Although the claim to build theory cannot be made in this thesis, Dubin’s (1978) eight phases have served as an inspiration for using a systematic approach in the thesis. The eight phases of Dubin’s theory building are: (1) units (i.e. concepts) of theory, (2) laws of interaction (among the concepts), (3) boundaries of the theory (boundaries within which the theory is expected), (4) system states of the theory (conditions under which the theory in operative), (5) propositions of the theory (logical deductions about theory in operation), (6) empirical indicators (empirical measures used to make the propositions testable), (7) hypothesis (statements about predicted values and relationships among units), (8) research (empirical test of the predicted values and relationships). Especially the last three phases, which focuses on empirical validation have only been focused on to a limited extent. The features of Dubin’s (1978) methodology has however been guiding the research. The analysis was done according to the concept and state based procedure of Dubin. The objective with discussing concepts and states is that a lean concept that works in one state [type of project] may or may not work in other states. The selection of Dubin’s concept based methodology to adopt for this investigation was further motivated by suggestions of Barens, (2002) and Koskela and Howell, (2002) who argue for a theory based approach for research on PM.

2.5 Literature search and empirical data
A systematic review of contemporary literature was conducted. In this regard literature was searched from, within the areas of, 1) lean, 2) project management, and 3) lean project management. Published studies were identified using a search strategy. The literature search and selection technique is explained further in forthcoming sections. Thereafter, in order to, analyze the current project management practices in project organizations empirical data is collected through one interview. The selection of interviewee and interview method is also explained in forthcoming section.
**Literature search and selection technique**

In this research the data came from past research, i.e. concepts, principles, theories, etc. These are selected from journal articles, conference papers and books. In order to find enough relevant material a detailed search was conducted. At the start scholarly journal databases: Web of Science, Scopus, Business source premier, were used for finding articles while using the key words and phrases “Lean”, “Lean project management”, and “project management”, after which the papers were reviewed. After the first search it was found that there are very few publications and past research combining “lean” and “project management”. A second search was conducted using Google scholar. Google scholar was used as it searches papers in all databases and internet sources with articles and patents. The search at Google scholar was conducted using the exact keyword of “Lean project management” by this search only 159 results were found which consist of journal articles and references to books. Many of these results had nothing on LPM but were just related to project management only.

After the second search, a final search was done, in which article references were searched for additional relevant publications. A backward search was important to figure out the past research on this topic. The intention was to avoid revision of similar research and to expand on already established knowledge.

The results of the literature review included many papers on lean as well as project management, but only a few that explicitly combined these two fields.

After these literature searches all papers and books were sorted in three categories 1) lean, 2) lean project management, 3) project management. From within the sorted literature, a final selection was done by using decision criteria (See Figure 2-2) where preference was given to literature that was highly cited and/ or explaining the underlying concepts, principles, and theories.
Some of the highly cited researches found on lean are published in the form of books, instead of papers in Journals. Three of them are considered as central and are used extensively in this thesis. They are as following:


**Empirical Data**

**Selection of Interviewee**

The empirical data is used for examining the state of the art in project management and the possibilities to link this to the concepts of lean thinking. The interview was conducted with Carina Höyheim, a project expert who runs a project consultancy company. The interview with Carina provided dual benefits. First, she has been
working with projects since 15 years. Thus, she holds comprehensive experience and
knowledge in this field. Second, consultancy companies work with several
organizations in managing their projects which keep them updated with practices
at several companies. Therefore, although the empirical basis is limited with
respect to the number of interviews, the interviewee was carefully chosen in order
to be able to reflect a broad experience in project management in several different
companies. Thus, considering the experience of Carina, this interview can be
defined as respondent interview rather than informant-interview, meaning that the
information person herself participated in the phenomenon (several different
projects) that is studied instead of being just an outside observer.

**Interview Method**

The interview was arranged as semi-structured, the author personally asked the
interviewee about all the predetermined questions. The complete interview guide
with carefully planned and arranged questions was developed in advance. Prior to
commencing the actual interview, a pilot interview was conducted informally with
Kourosh Zahedian, a project manager with 15 years of experience. The pilot
interview was intended to test if some questions are confusing and how much time
will be required to finish the interview. After the interview, the insights from the
pilot interviewee provided a new understanding about ambiguous and confusing
questions. Thereafter, the interview questions were reviewed and clarified for
actual interview.

The underlying objective with choosing a semi-structured interview was to maintain
the liberty to explain things the respondent does not understand or finds confusing.
The interview questions can be seen in appendix (10.0). The interview was
completed in one hour.

**Empirical Data Analysis**

A Transcript of notes was produced directly following the interview. The interview
was recorded as well as noted down. An initial processing of transcript of notes was
done by re-checking notes with recorded audio of interview to make sure that the
interpretations are credible, dependable and confirmable. The transcript of notes
was further used to identify core categories – which were found in original notes. A
concept based coding technique was used for the coding of data into categories and
sub categories identified in the data collected.
2.6 Research quality

The nature of the qualitative research method increases the importance of producing valid and reliable results compared to a quantitative research where validity and reliability can be established beforehand. The quality of a qualitative research can be determined by using a number of tests. The quality is typically assessed by considering the validity and reliability of the study. A discussion of the internal and external validity and reliability of this study is further discussed in the forthcoming sections.

**Internal Validity:** Internal validity is concerned with, the extent to which the results of the study correspond to reality. According to Yin (2003), internal validity is concerned with establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships. Hence, although qualitative study is not of a causal nature (Golafshani, 2003), the degree of internal validity should still be considered. In this thesis it is considered by recording the interviews. Thus, information collected could be reviewed several times in order to ensure that a correct presentation of the findings is given. This is believed to increase the internal validity of the results.

**External Validity:** External validity is concerned with the extent to which the results from a research can be generalized, meaning that degree to which the results are applicable to situations other than the situation studied. In some studies the aim is to be able to generalize the results to a broader theory (Yin, 2003). Generalization of results can be more easily done when several situations have been studied and similar results have been obtained. This research was limited by time and resources. Hence, study was focused on only one interview. However, external validity was still considered by collecting data from a source (project consultant). The source provided perspective from several different project organizations. Thus, the results to some extent could be generalized to organizations carrying out tasks in the form of projects. However, at the same time it is difficult to establish a high external validity without increasing the study to include a greater number of researched organizations managing different kinds of projects.

**Reliability:** Reliability is concerned with the extent to which the research study can be repeated and arrive at the same results. In qualitative research it is almost impossible to conduct a social research in the exactly the same way twice, thus reliability of a qualitative study cannot always be determined by reproducing the investigation. To ensure reliability in qualitative research, establishing trustworthiness is crucial. Trustworthiness of a research report lies at the heart of issues conventionally discussed as internal validity, “a demonstration of internal...
validity is sufficient to establish reliability” (Golafshani, 2003). Thus, in-order to establish the trustworthiness in qualitative research data must be auditable through checking that the interpretations are credible, transferable, dependable and confirmable. In the methodology chapter and in the chapters explaining the theoretical perspectives for this study; the underlying theories, and the selection and background of interviewee are thoroughly explained. Hence, researcher’s position with regard to trustworthiness has been identified, which increases the reliability of the study.
Chapter: Literature review Lean

This chapter is based on review of literature on lean. It establishes better understanding and will provide the reader with information on principles of lean production, principles of lean thinking, critical aspects of lean and practices that are linked with these principles.

3.1 History of lean
The ideas behind lean production originate from Toyota Production System (TPS) originally developed by Taiichi Ohno, an engineer at Toyota Motor Corporation. In the late 1940’s and early 1950’s Toyota’s sales fell dramatically, at that point Toyota decided to study car industry in other countries. Womack, et al. (1990) mentioned that everything started when Eiji Toyoda and Taiichi Ohno went to U.S in 1950’s in order to study world’s largest and most efficient manufacturing plant, Ford’s mass production factory in Detroit. Toyota’s intentions with studying Ford’s plant were to learn and improve their own production in order to become more competitive in the car industry. During their stay in the U.S., Ohno realized that Toyota did not own enough resources and production capacity to mass produce like Ford. Instead, they have to develop an efficient system that produces smaller volumes. Furthermore, what fascinated Ohno in U.S was how food stores were built. The customer assumes that the store has what he/she wants, and when the customer takes it; the inventory was replenished using kanban in stores. Ohno took this idea back to Toyota and later developed the Just in Time philosophy based on this idea (Womack et, al., 1990). After coming back to Japan, Ohno tried to implement new methods for improving production processes. Although, his suggested methods were beneficial. Those methods were not completely practiced until Kiichiro Toyoda resigned and Ohno began to experiment new ideas (Womack, et al., 1990). With the passage of time Toyota radically succeeded in increasing production quantities, but was also confronted with a serious crisis when Toyota’s new brand was rejected in American market. There were several underlying reasons for rejection: lack of safety, less engine power and heavy mass of the cars. This set back again developed an interest to improve quality for survival. Thereafter, Toyota’s management finally agreed to adopt Ohno’s, Total Quality Control (TQC) system (Womack et, al., 1990). The new system was successful and Toyota finally achieved both quality and productivity. This new system became a solid reason for increasing Toyota’s market shares worldwide. From different learning experiences they developed a new way of production, a way today we know as lean production.

3.2 Contemporary views on lean production
The Machine that changed the world published in 1990 by Womack, Ross & Jones, three members of the MIT International motor vehicle program (IMVP), changed
the way that world was thinking about automotive industry. The term ‘Lean Production’ was first coined by John Kraficik, a member of the IMVP team.

**[Lean Production]** uses less of everything compared with mass production – half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time. Also it requires keeping far less than half the needed inventory on site, results in many fewer defects, and produces a greater and ever growing variety of products’ (Womack et al. 1990, p.13).

To date there has been little agreement among researchers for the definition of lean or lean production (Pettersen, 2009; Karlsson and Åhlstrom, 1996a). Despite an abundant amount of studies, the field has struggled with lack of clarity. Debate continues about what lean production is and what it is not. Several features and principles that characterize the concept of lean production as identified by authors in the studied literature are discussed in the forthcoming sections.

**Elimination of waste**

Waste reduction is the fundamental and probably the most focused principle in lean organizations (Chen, et al., 2010; Hines, et al., 2004; Karlsson & Åhlstrom, 1996; Shingo, 1981). The whole purpose of the TPS is to lower cost; this is done through elimination of waste. Waste is defined as any activity that consumes resources but create no value for customer (Shingo, 1981; Womack, el al., 1990), such activities should be eliminated. Potential sources of waste identified by Taiichi Ohno in physical production include: Over-production arises when an organization produces more than demand, unnecessarily early or ‘just-in-case’ and it is particularly known to be the most harmful source of waste as it is the root cause to other types of wastes, such as inventory (Liker, 2004). Extra inventory hinders problems from being solved (Hayes, 1981). Other sources of waste include unnecessary transport of materials, inappropriate or over processing of parts, unnecessary movement of employees during work and production of defective parts (Liker, 2004; Womack and Jones, 1997).

**Continuous Improvement**

Continuous improvement is the second fundamental principle of lean production, after the principle of elimination of waste (Karlsson and Åhlstrom, 1996). Waste is
the main subject of continuous improvement (Cusumano, 1992). Continuous improvement focuses on two directions, *first*, to eliminate waste in-order to reduce cost, *second*, to improve products and processes in-order to increase customer satisfaction (Chen, et al., 2010). The practice behind the principle of continuous improvement is that employees at every level of organization are looking and experimenting to improve their own work (Mohantay, et al., 2006; Schonberger, 2006). The aim is to constantly improve the whole system, it is a never ending process. Therefore, continuous improvement should not be seen as a state, but as a direction (Karlsson and Åhlstrom, 1996). Some researchers mentioned that there are huge benefits coupled with the principle of continuous improvement. According to Proctor, et al. (2004) it is the principle of continuous improvement that assisted Toyota for many years to produce cars in one third of the time in comparison to car manufacturers in western countries. One element of continuous improvement is to improve the process, which is further explained under the heading of perfection in the principles of lean thinking.

**Zero Defects**

The concept of zero defects is another important component of lean organizations (Hayes, 1981). In order to maintain a continuous flow of production process all products have to be defect free and remain so throughout the process at the production line, so that the line remain running (Hayes and Clark, 1985). The flow of production line determine the productivity of organization, in order to attain high productivity it is essential that all parts and products are fault free from the very beginning (Karlsson and Åhlstrom, 1996). In order to maintain both quality and productivity, all units are inspected using inexpensive means like *poka yoke* to ensure zero defects. The intention is that errors should be prevented before they occur, the underlying objective with such inspection is not to find defects but to preventing them (Shingo, 1981).

**Pull instead of Push**

The pull system – is a customer use as a signal to produce is the basic principle at TPS (Schonberger, 2006). Pull can be better understood by focusing on fundamental concept of Make to stock (push) vs. Make to order (pull) approach. This principle is further explained with the principles of lean thinking.

**Multifunctional Teams**

Another salient feature of lean production is the extensive use of multifunctional teams (Karlsson and Åhlstrom, 1996). A multifunctional team is a group of those
employees that can perform several different tasks, such as regulating, organizing, controlling and improving the work (Sexton, 1994; Wheelwright, 1985). Perhaps the purpose of multifunctional teams is to decrease the job classification. Therefore, each employee can perform a variety of tasks. Thereafter, there is not, much dependence on a single person and tasks can be easily rotated between team members leading to an increased flexibility and a lower dependency on individual employees. This in turn reduces vulnerability of production system (Karlsson & Åhlstrom, 1996).

**Decentralized Responsibilities**

Another important characteristic of lean organizations is that responsibilities are decentralized onto the multifunctional teams. There is no supervisory level in the hierarchy. Instead, the supervisory role is performed by multifunctional teams (Delbridge, et al., 2000). In its most elaborate form this is done by rotating team leadership among employees trained for task. In contrast to the traditional leadership role of managers, team leaders take on more supervisory role in the form of coaches. As a result, the number of hierarchical levels can be reduced (Karlsson and Ahlstrom, 1996).

**Vertical Information System**

The final principle of lean production as stated by Karlsson and Åhlstrom (1996) is vertical information system. The vertical information system is an essential requirement for multifunctional teams to be able to perform according to goals of organization (Karlsson and Åhlstrom, 1996). In order to, utilize the workforce for problem solving. It requires a very different kind of information system, one that works in real time and encourage employees for problem identification and problem-solving (Wheelwright, 1985). The presence of vertical information system enhances prompt action and feedback (Cole, 1985). According to Mo (2009) it also supports flow of information in hierarchies. In the view of Karlsson and Åhlstrom, (1996) this flow of information can be divided into two types: Strategic or Operational. The strategic type of information concerns the overall performance and intentions of the company. The operational type concerns information about the performance of the teams.

3.3 **Evolution of lean**

As mentioned in earlier sections, originally lean was developed as a production philosophy and quality system, with elements of both craft production and mass production. Since its introduction, the understanding of lean has changed
considerably. Hines, et al., (2004) use the stages of organizational learning to demonstrate the evolution (Table 3.1).

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Focus</td>
<td>JIT techniques, cost</td>
<td>Cost, training and promotion, TQM, process reengineering</td>
<td>Cost, process based to support flow</td>
<td>Value and cost, tactical to strategic, integrated to supply chain processes, such order fulfillment and new product development</td>
</tr>
<tr>
<td>Key business process</td>
<td>Manufacturing, shop floor only</td>
<td>Manufacturing and materials management</td>
<td>Order fulfillment</td>
<td></td>
</tr>
<tr>
<td>Industry sector</td>
<td>Automotive vehicle assembly</td>
<td>Automotive vehicle and component assembly</td>
<td>Manufacturing in general1 often focused on repetitive manufacturing</td>
<td>High and low volume manufacturing, extension into service sectors</td>
</tr>
</tbody>
</table>

Table 3-1: The evolution of lean (adapted from, Hines, et al., 2004)

First, lean diffused to other automotive manufacturers (first stage) and later to other manufacturing industries (second stage) because these manufacturers were relatively similar to Toyota. There was limited need to adopt the original instruments to these new environments, after then extended to other sectors like services (Joostein, et al., 2009). Over the years lean thinking evolved beyond applying Toyota’s shop floor tools. This evolution was accelerated by promotion of successful western case emulation by business in diverse sectors based upon 'lean principles' with a more focus on eliminating waste, at that point in time Womack and Jones introduced lean thinking (Hines, et al., 2004), which is, in their opinion, a powerful antidote to Waste (Womack & Jones, 2003, p.15). Lean thinking and its principles are further explained in the forthcoming sections.

3.4 Lean Thinking

Lean Thinking is a result of narrowing lean production concepts to a set of five principles that focus on elimination of waste, the principles of lean thinking are briefly specify value, identify the value stream, create flow, pull, and pursue perfection. According to some authors these principles could be applied across a wide range of industrial settings (Sausa and Voss, 2001). The principles of lean thinking are further elaborated in the upcoming sections.

3.5 Principles of Lean Thinking

Specify Value

The first principle in lean thinking is to understand the customer needs and what customer is willing to pay for. Once customer requirements are identified, define value in terms of product, its functions and capabilities offered at specific price. In
fact, value can only be defined by the ultimate customer. And it is only meaningful when expressed in terms of specific product (a good or a service, or often both at once) which meets the customer’s needs at a specific price and time (Womack & Jones, 2003, p.16).

This goal can be accomplished by ignoring the existing assets and technologies and to rethink firms on a product line basis with strong and dedicated product teams. Value is often hindered because of the needs of shareholders and mindset of senior management. Another issue is the strong technical functions and technical experts. Which consequently result in products with complex designs with sophisticated underlying technologies but the customers weren’t sophisticated enough to grasp the merits of such products (Womack & Jones, 2003, p.17). It is unrealistic for any company or manager to successfully implement Lean Thinking instantly, but of course they can form a clear view of what is really of value to customer. This rule can also be applied to an in-house customer; in situations where product tasks are divided in teams and every next team play the role of customer for receiving the work from previous team.

**Identify the value stream**

The second principle in lean thinking is to identify the value stream, i.e. the whole set of actions required to make a specific product (whether a good, a service or a combination of both) (Womack & Jones, 2003, p. 317; Liker, 2004, p. 202). It is an action that is applied to all three major tasks of a business, 1) **Problem-solving task**: From concept through detailed design and engineering to production launch, 2) **Information management task**: From order taking to detailed scheduling to delivery, 3) **Physical transformation task**: From raw material to a finished product in the hands of the customer

A value stream analysis show three type of actions occurring along the value stream:

- **Value adding activities (VA)**: Assembling engine, tightening a bolt
- **Necessary but not value adding (NNVA)**: Inspecting welds to ensure quality
- **Non value adding (NVA)**: activities that add no value and to be eliminated instantly

The underlying goal with the analysis of value stream is to look at the entire value stream of each product, starting from first supplier toward the ultimate customer of product. The analysis of entire value stream provide a holistic view that goes beyond a single company, it also gives the opportunity to improve the whole rather
than just concentrating at own business, thus removing all the waste. This approach in terms of an organization is often called the lean enterprise (Womack and Jones, 2003). Organizations often avoid this approach, as this is considered as a matter of confidentiality and because of the fear that information regarding internal waste and process could be counter used by upstream or downstream partners for bargaining. Such organizational behavior seriously affect company’s rivals, especially when individual firms are outsourcing more and themselves doing less, which is because products are getting complex and there is not always in-house capacity to develop everything (Womack and Jones, 2003). Thus, the solution is to form a voluntary alliance of all the involved parties to evaluate value creating activities and remove disconnects or non value adding activities from whole value stream. Making the lean enterprise needs new ways of involving partners and suppliers; such coordination is based on simple principles. In order to regulate the behavior between partners and make value stream transparent. Such coordination provide opportunities to remove waste and all partners will be able to verify if other partners are working according to the agreed principles (Womack & Jones, 2003).

**Flow**

The third principle in lean thinking is to create continuous flow of value creating steps. This is an important step in the whole process of implementing lean. This step requires change in thinking, a new way of doing things which is completely different from traditional batch thinking. The goal of flow principle is based on redefining the work of functions, departments, and firms so they can make positive contribution to value creation and to speak to the real needs of employees at every point along the stream so it is actually in their interest to make value flow (Womack & Jones, 2003, p. 24). Effective accomplishment of this goal is possible through focusing on product and further creating a lean enterprise for each product coupled with rethinking conventional boundaries of careers, departments, functions and companies. Once managers learn to see flow thinking, it is possible to apply flow techniques in any activity and the flow principle remains the same in every case (Womack & Jones, 2003, p.64).

The flow principle also seems to have impact on employees and workers, citing to the research of polish psychologist named Mihaly Csikszentmihalyi, University of Chicago (Womack and Jones, 2003). Csikszentmihalyi, has been studying thousands of subjects around the world for 20 years to find out what makes peoples feel good, and concluded that peoples from around the world report activities most rewarding and that feel them good. Involve, a clear objective, a need for concentration so intense that no attention is left over, a lack of interruptions and distraction, clear
and immediate feedback on progress toward the objective, and a sense of challenge – the perception that their own skills are adequate and sufficient enough to deal with on hand task. “Csikszentmihalyi further reported that peoples who are experiencing these conditions are in a highly satisfying psychological state of flow” (Womack & Jones, 2003, p. 65).

In comparison to this, the classic batch-and-queue work hardly contributes to psychological flow, because the worker can see only a small part of the task and often there is no feedback about: 1) whether the task was performed right or wrong, 2) status and progress of system. Batch-and-queue system also requires less concentration and skills, and there are constant interruptions and disturbances to deal with other tasks, the worker is responsible for. Thus, an organization where the value is made to flow continuously also creates the condition of psychological flow. Creating and maintaining continuous flow is of course a continuous challenge and also because of the focus on perfection, which is the last principle of lean and place entire system in a permanent creative tension on behalf of every worker (Womack & Jones, 2003, p. 65-66)

**Pull**

The fourth principle of lean thinking is focused on, not only how to provide customer oriented products, and when to provide it. Toyota follows pull, this means production starts only after an order is placed by customer. Thus, the customer order is pushed backward (using kanban) in the production process until it reaches the first stage from where the production begins (Mo, 2009). In the view of Womack and Jones, the pull principle must be applied at every step of value stream. No one upstream should produce a good or service until the customer downstream demand it. The basic strategy behind pull is that you let the customer pull the product from your company instead of pushing the product toward customer, by doing this the pile of inventories are eliminated. Womack, et al. (1990) during their comparative study of automobile manufacturers, observed that there was no room for inventories at Toyota Takoka and factory hold only an hour’s worth of inventory.

The pull system turns production into a Just-in-time process in which materials are scheduled through pull instead of push (Karlsson and Åhlstrom, 1996). Pull consequently reduces throughput times “half in product development, 75 percent in order processing, and 90 percent in physical production” (Womack & Jones, 2003, p. 24). This creates stability as customers know that, “they can get what they want and whenever they want” (Womack and Jones, 2002, p 24). Thus, the whole system is designed in a way that supplies are immediately ordered from the next level, and
work happen in small batches. Two popular tools that are used to manage pull are Kanban and Just in Time (JIT). According to [Sensei of Toyota], Shingo (1981) Just-in-Time implies that the stock of finished products remain zero, meaning the production must equal orders.

Following this rule in practice is more complicated and take companies time to understand. Having a look at the data on inventories at any given level of economic activity, inventories are not reduced enough in Europe, America and even in Japan the application of Pull is more in Just in Time supply, not in Just in Time production. Thus, seemingly companies have more adopted the principle in supply instead of production. Thus nothing has happened except to push inventories of the same magnitude one step back toward upstream processes and raw materials (Womack & Jones, 2003).

**Perfection**

As organizations begin to accurately specify value, identify the entire value stream, make continuous flow of value creating steps, and let the customer pull the value, these four principles further lead the system toward last principle of lean thinking “Perfection” which is an alert that there is no end to the process of reducing; effort, time, space, cost, and mistakes while offering a product which is ever more nearly what the customer actually wants (Womack & Jones, 2003, p. 25).

The first four principles interact with each other in a virtuous circle, thus improvements in any of these lead toward improvement in the others. For example, strong product teams that are in direct contact with customer always find ways to specify value more accurately and often find better ways to enhance flow and pull as well. New processes and technologies in manufacturing are also among ways that contribute in this context. Thus, increasing value and eliminating waste all together leading toward perfection (Womack & Jones, 2003).

However, it is impossible to envision perfection, but of course “it provides inspiration and direction essential to making progress in right direction” (Womack & Jones, 2003, p.94). The most important stimulus to perfection is transparency – making entire value stream visible to everyone: subcontractors, suppliers, assemblers, distributors, customers, and employees, all of them can see everything; making value stream visible in such a way, make it easier to discover ways to create value and prevent waste. In lean organizations visual control boards are often used in production and near the assembly lines which provide instant feedback to the workers about made improvements, and it develop further motivation among workers to continue with further possible improvements (Womack & Jones, 2003).
3.6 **Source criticism on lean**
In its development over time, critics either from within or outside the lean movement have pointed to various shortcomings and pitfalls of lean thinking. Most of these shortcomings surfaced as organizations progressed on their learning curve as well as the extension of lean thinking into new sectors with different settings and constraints, in particular this happen more often when applied to sectors outside the high-volume repetitive manufacturing environment (Hines, et al., 2004). Key aspects of criticism found in literature are discussed in forthcoming sections.

**Lack of consideration of human aspects**

It is recorded by authors that lean production systems put higher pressure to the shop floor workers (Hines, et al., 2004), the speed of belt is very high, which makes it difficult for workers to detach themselves from the repetitive work, these difficulties have been aggravated because of a higher pressure for quality (zero defects) and efficiency in modern Japanese lines, which demand a high degree of mental concentration on work (Berggren, 1992) similarly also Mehri (2006) that the higher speed of belt also contribute greatly to accidents and health problems. Following the similar line of arguments Williams, et al., (1992) mentioned that lean production is de-humanizing and exploitative in its physical nature.

**Lack of creativity**

Slack on human resource side mean unused work time and excess workers. In lean organizations slack is identified as waste and often removed, increasing worker utilization and reducing the size of the workforce usually lead to reduced manufacturing cost. Tight deadlines and schedules may derive creative tensions that may stimulate employee's creativity. However it is also recorded by authors that too much stress is more likely to stifle employees’ creative thinking (Chen, et al., 2010). As mentioned by Silverthrone (2002) most people cannot work effectively in tight schedules, this makes things worse rather than better and may eventually lead to situation that workers will not be able to innovate for long period of time. Research has shown that slack is a key source of innovation and creativity (Millson, et al., 1992), slack time provides workers with the opportunity to review their work and learn to perform activities in more creatively way to obtain higher quality results. This notion highlights potential tradeoffs between creativity needed to improve product quality and the speed of production.
**Incrementalism**

The Japanese depend on continuous improvement and do not believe in sudden change like westerners. According to (Proctor, et al., 2004) extensive dependence on incremental improvements eventually mean Japanese are not good at coming up with brand new ideas. Other authors argue the same; it is very rare in Toyota that new ideas emerge from within the company. In order to substitute this lack of creativity Toyota relies on outside expertise by purchasing innovation from smaller companies (Mehri, 2006). Furthermore, in product development setting, continuous improvement has limitations, particularly when coupled with a workplace culture that does not allow free flow of ideas, open discussion and extensive intelligence (Mehri, 2006).

**Coping with variability**

Another aspect of criticism in literature is the ability of lean production to cope with variability. Variability is the degree of difference in the same process when repeated, some variation is natural as process not often remain the same, and some variability is artificial. This artificial variability is related to controllable factors in the design and management of systems. On an operational level the lean approach focuses on only removing artificial variability and natural variability remains the same (Joostein, et al., 2009). Therefore, in situations of demand variability (natural variability) lean approaches has sought to flatten to control demand, as the Japanese automotive industries work in fairly stable demand environments. This stable high-volume and repetitive demand character suits the application of level scheduling (heijunka) and pulls (kanban) approach. However in other industrial settings, demand variability is a main inhibitor to the implementation of lean in general. In order to solve the variability issues authors introduced alternatives like, agile flexible assemble to order system for dealing with customer demand variability (Hines, et al., 2004). Furthermore, many authors have also mentioned that lean production has reached its limitations and a range of other approaches to counter variability, volatility and variety are suggested, some authors suggested for a lean-agile approach as more applicable, discussing whether an agile or lean strategy, or even a hybrid approach might be the most suitable one (Hines, et al., 2004).

**Other Aspects**

Authors have also raised questions on the credibility of reports on lean related applications and improvements that have led some to conclude that the lean
message is 100 percent positive. Lean can improve productivity and reduce costs; such claims are critically questioned by researchers. Furthermore, such an overly positive conclusion fails to take into account the variety of issues related to the application of lean thinking (Joosteim, et al., 2009).

Linking back to the discussion in past sections it is clear that lean is highly interpretive as there is no one definition of what is meant by lean production or what constitutes lean production. Moreover not all aspects of lean are though positive. Several authors (Chen, et al., 2010; Joosteim, et al., 2009; Mehri, 2006; Proctor, et al., 2004; Hines, et al., 2004; Silverthrone, 2002; Williams, et al., 1992; Berggren, 1992) have also discussed problems and issues related to lean.

Although some authors believe that the principles of lean thinking could be applied across a wide range of industrial settings (Womack and Jones, 1997), first it cannot be ignored that the universal applicability of these principles is critically questioned, second, basically these principles are originated from repetitive manufacturing processes and their use in other industrial settings may not be viable especially in innovative NPD projects as they are completely unique and very different from repetitive manufacturing tasks.

In such different settings organizations can face difficulties in directly transferring the principles used in production to non manufacturing processes, a detailed and deep understanding and interpretation is necessary in order to identify the concepts and principles that are relevant to project management.
Chapter: Literature review Project Management

This chapter provides readers with information on past research on project management and integration of lean concepts in project management.

Origin of Project Management

The researchers in the field of PM trace the roots of project management research and knowledge to various types of planning techniques, such as CPM, PERT (Packendorff, 1995). Others say that the father of project management is Henry Gantt, who invented the Gantt charts, which later became a standard in project management. Following similar lines indicate that project management is based on a sort of problem solving methods, optimizing theory and mathematics.

Although we have publications from well known management journals that date back to 1960, and talk about projects as organizational form, even in recent publications several writers criticize and claim project management as new concept. For example, Shenhar and Dvir (1996) argue that, as an organizational concept project management is quite new and not well understood. Lindkvist, et al. (1998) argue that traditional project management literature reviews projects as analytical processes, and is not able to explain the logical character inherent in projects. Consequently there are different thoughts about the history of project management.

4.1 Nature of project work

Concept, Definitions and Characteristics of Projects

Several definitions exist ranging from long and complex to short and easy, all depending on its creator and its purpose. Some of them are:

(Gaddis, 1959, p 89): A Project is an organization unit dedicated to the attainment of a goal—generally the successful completion of a development product on time, within budget, and in conformance with predetermined performance specifications.

(Archibald, 1992): Project: A complex effort, usually less than three years in duration, made up of interrelated tasks, performed by various organizations, with a well defined objective, schedule, and budget.

(ISO: 10006, 2003): Project: unique process, consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources.
(PMI, 2008): Project: A temporary endeavor undertaken to create a unique product, service, or result.

Projects are usually organized around activities that have to be performed with limited amount of recourses to achieve specific objectives, in a specific time, and in a specific locality (Kerzner, 2006, p3). Projects consume resources for creating assets that gives benefits for long period of time. Projects are unique, complex, and are undertaken to achieve an objective within the constraints of time, cost and resources.

**Characteristics of a project:** Based on the work of Gareis (1995), a project is a task that includes the following characteristics:

- Temporary organization - an explicit organizational design and a definite start and ending time.
- Complex - socially and technically (involves many parties and some inexperience with technology)
- Important - it is set to perform an important task.
- Risky - involves an amount of uncertainty and a chance that loss occurs.
- Dynamic/flexible - adjusts when the project situation changes.
- Unique (relatively) - it is unique, including a unique context and output (product or service). If a project is repeated the uniqueness is relatively reduced.
- Goal determined - it has well defined goal(s) and directs its efforts against this goal.
- Social system - with distinct structure and culture, differentiating itself from its environment.

**Operations and Projects**

In order to clarify the characteristics of projects, projects can be compared to operations.

**Operations** are ongoing and repetitive activities conducted by the staff. Some of these include: financial management and control; continuous manufacturing; product distribution. In contrast **Projects** are temporary and unique, and are performed by teams that have: clearly defined team and individual roles; use open and effective communication systems; visible rewards for good performance, and have constant pressure to improve performance. However, also some common
characteristics exist between operations and projects: they both are performed by peoples; they are constrained by limited resources; both are planned, executed and controlled (Tonnquist, 2008).

**Categories of projects**

Although projects generally show some similar characteristics they are also different from each other and it is essential to classify them into groups, Archibald (1992) classified projects into the following six categories.

- Commercial projects under contract for products or services
- Research product development and engineering
- Capital facilities design and construction
- Information systems
- Management projects
- Major maintenance projects (process, utilities and other industries)

The six categories of projects very often illustrate different ways and culture of performing project management. For example the commercial projects are undertaken to provide services to owners, developers and businesses for constructing a buildings, roads, etc. Several activities within commercial projects are often repeated. This is similar to operation. In contrast research and development projects are based on creative work undertaken on systematic basis in order to develop a particular technology and are often carried out as corporate or governmental activity. R&D projects are unique and not repeated. However, the categories do often overlap.

**Division of Project Work**

Westhagen (1994) divides project work into two parts, product related work and project administration, as shown in Figure 3.1.
Separating project work into project administration part and product related part is important in order to create the holistic view (focusing on whole instead of parts). For example, one of the new practices introduced in project organizations in the last decade is to have a project office or project management support office. The purpose of establishing a project office is to facilitate better coordination of resources, a standardization of the review process, reporting and further developing the quality of the project work (Tonnquist, 2008, p 327). This eventually means that companies using a project office also spend resources on activities performed by employees working with administrative side of project. The purpose of focusing on the whole is to focus on both product related and administrative activities as they both consume resources.

**Concept, Definitions of Project Management**

Project management is planning, organizing, directing, and controlling of company resources for relatively short term objective that has been established to complete specific goals and objectives. There are several definitions of project management.

*(ISO 10006, 2003):* Project management includes the planning, organizing, monitoring, controlling and reporting of all aspects of the project and the motivation of all those involved in it to achieve the project objectives.

*(PMBOK, 2008):* Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements.

Project management is accomplished through the appropriate application and integration of project management processes. PMBOK (2008) logically gathers these project processes under 5 process groups, which are, Initiating, Planning, Executing, Monitoring, Controlling, and Closing.

The **project manager** is the person who has the responsibility to plan and accomplish the project objectives, normally a professional in the field of project management. The importance and power of project leader is widely discussed by authors. It is believed that projects that involve similar tasks can run smoothly even without a powerful leader. In contrast, in complex projects like NPD and R&D projects which are highly iterative, such complex projects can lose its focus if the project team loses sight of the “big picture”, conflicts and confusions can occur.
among project team members which consequently lead to project failure, for example, Engwall (2003) argues that little authority of project manager is one of the reasons of project failure.

The Triple Constraint of Project Management

Meeting stake holder's needs, expectations and quality demands involves balancing competing demands among cost, quality, scope and time.

\[ Q = f(T, C, S) \]

- Where Q is for Quality, S is Scope and T is Time and C is Cost
- Project quality is affected by balancing these three factors

Figure 4.2 is an overview of project management which shows that project management is designed to manage or control company resources on given activity, within time, within cost, and within performance. Time, cost and performance are the constraints on the project.

![Figure 4-2: Overview of project management](image)

Project Productivity

Management in any project is concerned with productivity. The concept of productivity has been available for over two centuries (Tangen, 2002). This can be explained as follows:

**Productivity**

The concept of productivity is generally defined as the relation between output and input. Productivity is one of the basic variables governing economic activities (Singh, et al., 2002) and most vital factor affecting organizations competitiveness. However this factor is often neglected or ignored especially by those who influence processes (Singh, et al., 2002). A major reason for this could be that it is not well
understood what the term productivity actually means (Tangen, 2002; Koss and Lewis, 1993).

Productivity in manufacturing is defined as the ratio of output (e.g. produced goods) to input (e.g. consumed resources) in the transformation process (Tangen, 2002). Productivity is therefore, on one hand, closely connected to the use of available resources. Thus, it can be said that productivity is reduced if the company’s resources are not properly used. On the other hand, productivity is strongly linked to the creation of value. Thus it can also be said that, high productivity is achieved when all activities and resources in the transformation process add value to the produced products. Moreover it is important to keep in mind that productivity is a relative concept and in some way also ambiguous in nature (Tangen, 2002). Furthermore, there exist several types of productivity (e.g. project productivity, organizational productivity) as well as hierarchical levels which productivity can be discussed within. Almost any transformation within a company is fed with several types of inputs (e.g. labor, material, energy and capital) and emits more than one output (e.g. project A, project B). Therefore it is important to separate partial productivity (i.e. output related to one type of input) from total productivity (i.e. output related to multiple types of inputs). Considering hierarchical levels in the company, for example, top management’s strategic perspective of productivity usually differs from the view of productivity of the individual project in an organization. The concept of productivity is strongly linked with efficiency and effectiveness; these are further explained in forthcoming sections:

**Efficiency:** Is “doing things right”. In order to be efficient, management is concerned with minimizing resource costs or how well the resources are utilized. According to Shenhar, et al., (1997) efficiency is strongly linked to the utilization of resources, whether the project is completed on time, within the specified budget. Success in terms of efficiency indicates a well-managed, efficient project, in situations of increased competition time-to-market (time from initial concept to market introduction) becomes a critical competitive component and customer often pay for the timely delivery. Enhanced efficiency should therefore be seen as adding to project productivity and competitiveness (Tangen, 2002).

**Effectiveness:** Is “doing right things”. In order to be effective, management is concerned with getting activities completed or output of transformation. It is often linked with projects value for the customer, meeting performance measures, functional requirements, and technical specifications are all part of project effectiveness (Shenhar, et al., 1997). Enhanced effectiveness should also be seen as adding to project productivity ratio (Tangen, 2002).
Thus, efficiency is concerned with means and effectiveness with ends. They are interrelated. According to Jackson (2000) focus on only one does not seem to be much beneficial to increase overall productivity. Especially in context of project management, it is important to not only get activities completed (effectiveness), but also to do so as efficiently as possible. It is easier to be effective if one ignores efficiency. For example, some organizations are reasonably effective, but are extremely inefficient. They get their jobs done, but at a very high cost. It is also possible for an efficient organization to be ineffective.

In conclusion, productivity is the combination of high values of both efficiency and effectiveness which eventually lead to high productivity. Tangen, (2002) argue that a higher productivity turn into higher profitability which consequently leads to better performance. Thus performance is an umbrella term of excellence and productivity.

### 4.2 Pluralism in project management

Research in the area of project management is developed extensively in the past decades. Söderlund (2010) reviewed 305 articles published over last five decades in leading management and organizational journals. He categorized the project management research into seven ‘schools of thought’. Which are briefly, Optimization School, Factor School, Contingency School, Behavior School, Governance School, Relationship school and Decision school. The schools and their main contributions are summarized in appendix in (12.0: Table 12-1)
The above mentioned schools vary in terms of their main focus, major research questions, methodological approaches and type of theories. The research from within these schools is elaborated in the coming sections.

**Optimization School**

Research within this school is mainly focused on diverse fields such as planning, work breakdown techniques and scheduling of complex project activities. The research methodologies used are based on logic-based modeling, simulation, experimentation, etc. The empirical context of the schools is based on research from engineering and R&D. This line of research starts from 1960 with a vast focus on topics exploring Program Evaluation and Review Technique (PERT) and Critical Path Planning (CPM) and understanding complex problems for managing difficult projects by using dynamic situations involving multi-pass, heuristic decomposition procedures for project scheduling and scheduling using divisible constrained resources, and extending the original PERT ideas by elaborating on Q-GERT simulation models. Others focus on analyzing the project activity networks and dealt with parallel strategies for project development, financial issues, project cost control and different planning and programming solutions for the problems of cost-time trade-offs. The other ideas focus on developing models for formalized project management, network planning and PERT. There is a common view within this school that projects as complex activities need to be planned by advanced management models and techniques. Thus in this school project management is largely defined as application of techniques to approach the complex scheduling problem of executing a project. A believe within this school is that ‘successful management of projects requires a careful planning and scheduling of activities’ (Söderlund, 2010, p 7).

**Factor School**

Research within this school is focused on identifying project outcomes. The researchers used surveys, quantitative cross sectional analysis with an empirical context of R&D projects. The research in this school dates back to late 1960s. Mainly this school reflects the investigation of criteria for project success or failure in project management. It is believed within this school that the identification of success factors can help to avoid the overwhelming failure of projects and this can consequently separate the low performance from higher performance projects. Diverse lines of developments exist in this school; one line is focused on particular types of industries (pharmaceuticals, electrical, IT, oil and gas, with wide geographical contexts, however different organizational conditions may also make
the research finer. The second line is related to the nature of the analysis with regard to its dynamics and specificity. Some authors focus on providing a dynamic view of projects variations with respect to success factors, others focus on primary phases of projects, some focus only on a particular issue of projects, such as teamwork and team location, decision making, cross functional cooperation’s and other management and organizational issues of projects (Söderlund, 2010).

**Contingency School**

Research within this school focuses on organizational design and structure issues; most of the research is conducted using surveys, and multiple case studies. One important stream of research in this school involves contingency approaches and comparative analysis of projects and project management. This stream details contingency factors for the design of project organization and management, using task certainty and task interdependence. The other researchers discuss the advantages and disadvantages of organizing, various forms of project organization ranging from individual project organization, staff project organization, intermix project organization, and issues related with matrix organization in R&D settings. The authors suggest that the project organization should be designed according to the nature of the on hand project. Some research is concentrated on analyzing different project environments and how these different environments require alternative approaches of planning, controlling and management. Authors proposed different approaches to meet the unique demands in each environment. The others focused on contrasting models for understanding project management in competitive, fast paced situations. In sum, the school focuses on organizational theories relating to a variety of contingency dimensions, role of technological uncertainty and complexity for the design of project management and project organization (Söderlund, 2010).

**Behavior School**

In this school researchers are inspired from organizational-theory research on project organization, organizational behavior and processes of organizing. The research approaches are case studies, experiments and inductive reasoning with empirical context of change development. A group of studies focus on ambiguities and conflicts in project management, human problems and frustrations of peoples working in project organizations, including the issues of phase out and temporary relationships. Others argue that projects have definite characteristics and thus a unique way of life in comparison to permanent organizations. This line of argument is supported by other researchers and they provided more dynamic views and
interpretations on projects and project management; like effects of working under deadlines. Other studies also found sharing the interest of enhancing the dynamic and behavioral interpretation of projects as organizational forms and processes. In summary research within this school admire the process and dynamic nature of projects, investigate the effects of time pressures, trust building, problem solving, and other learning dimensions (Söderlund, 2010).

**Governance School**

Research within this school dates back to 1959, mainly all the publications focus on an economic approach on projects and project management in the construction industry. The research approaches within this school are case studies and deductive reasoning. Papers present an analysis of bureaucratic and craft administrative problems of projects, and the effects of variability. Other papers discuss problems pertaining to contracting and governance; problems of audit and performance evaluation in R&D projects; authority problems and general questions of why projects exist; issues like e.g. role of contracts and role of incentive contracts in project management. The latest research discusses the governance problems in strategic alliances, project alliances, project based international joint ventures, mutual organizations and complex consortia. Starting from focus on construction projects, research within this school has developed to cover other types of projects (e.g. service and R&D). Other themes revolve around alternative forms of contracting and governance modes; relationship between project owners and project executers/administrators - most of these papers rely on agency theory. One other aspect of the school is that project management is depicted largely as a macro-level concern and strategic management issue. In summary the school focuses on contractual aspects and choice of contracts and large scale industrial projects (Söderlund, 2010).

**Relationship School**

This school shows several similarities to both Governance school and Behavior school. However, research within this school draws on alternative theories taken from fields of inter-organizational relations and marketing, the research approaches used within this school are case studies, inductive reasoning, longitudinal, dynamic with an empirical context of engineering and construction. A number of papers discusses: network formation and development; stakeholder interaction; project networks; project marketing and relational interactions. Research in marketing contributes to the field of project management by explaining how companies plan and sell their projects, and how early stages of projects can be seen as the
management and organization of interactions between clients and contractors. A number of papers addresses on understanding the early phases, and how projects are organized during the implementation phase, and what characterizes good cooperation and coordination in complex, inter-organizational projects, and the importance of actor’s that influence progress of the project; issues related to negotiations and importance of forming supplier and buyer alliances. In summary, this school is largely devoted to research in management of the early phases of projects, client needs, dynamics of project networks, and formation of project organization (Söderlund, 2010).

**Decision School**

Research in Decision school is mainly focused on identifying the affect of decisions that decide the termination or continuation of a project. The research approaches and methodologies are case studies, deductive/ inductive reasoning, and etc. One theme of the research analyzes the use of various strategies and actions during project realization, including ‘rapid-results’ and ‘out-side views’ to deal with over-optimism in project decisions. In some ways these strategies relate to ‘escalating commitment’ and the difficulties of terminating ongoing projects. Several other studies focus on investigating the difficulties and issues associated with decision-making in complex projects using the economic and financial calculations and the politics surrounding projects. Another matter is how to identify risky projects, issues related to risk tolerance, decision making. While the other focuses on political aspects of projects. In summary this school focuses on early stages of projects, emphasize on in-depth analysis of, projects, the escalation processes in projects, and the investigation why good projects die and bad projects survive (Söderlund, 2010).

Based on the review of research, we can see that research within each school presents different focus; however the schools also overlap with each other. The presence of different schools shows that the study of projects and project management has gained increased attention from a wide range of disciplines. This also shows that project management research differs considerably, covering different topics with focus on planning and scheduling of complex tasks, investigations of success factors to achieve project success, organizational structures, organizational processes, governance of complex project transactions, formation of project networks and project investment decision. The schools hence have various foci and seek to answer different fundamental questions.
4.3 Articulation of project work

In order to explore the possibilities of lean thinking in project management, some important aspects in project work are discussed in this section. These include project scope management. Research related to these aspects and project performance is discussed in the following sections.

**Project Scope Management**

Managing the scope of a project is the most important part of project management. Scope management is applicable to all kinds of projects industrial or non-industrial, manufacturing or service, private or public, government or non-government undertakings. Effective scope management of a project ensures the successful management of other key project management areas, including, time cost and performance.

Once the project is approved and allowed to proceed the project manager gets down to work with a project team for development and management of project scope. The project scope is all the work that is to be performed in a project. Scope management is about defining the scope and creating the Work Breakdown Structure (WBS) down to the level of work packages (for detail see Figure 5-1 and 5-2 in PMBOK® Guide [PMI, 2004]). PMBOK suggests for a product analysis by using Expected monetary value (EMV) analysis coupled with decision tree to identify the cost and average outcome. This also relate to the optimization school. Estimates of cost and durations are valuable. However, it is often difficult to achieve especially in innovative NPD projects, as the full scope of project often cannot be anticipated beforehand (Pons, 2008), and value of a project cannot be calculated. This imposes challenges on project management, which tends to prescribe complete scope definition (PMI, 2004), moreover the cost value analysis focus on customer requirements. It is often observed that customer requirements are poorly understood which turn into a project scope that is not completely value adding to the customer. This poor definition of customer requirements causes project delay (Gupta and Wilemon, 1990). In all kinds of projects, it is important that project scope should consist of only those activities that are of value to customer, and can also be accomplished in the fixed amount of time and budget.

Several authors have discussed the importance of project scope specification. Iansiti, (1995) argue to specify value of all activities and close the window of opportunity, “once the window is closed, the basic options and approaches will have been selected, tasks will have been partitioned and assigned, and the project will rapidly build up momentum to complete the project in specified direction”(Iansiti, 1995
The results of their research show that the organizations that use project specification approach “complete projects more quickly and using fewer resources” (Iansiti, 1995, p 534). In this kind of approach the final goal is fixed and a solution will be selected in feasibility phase. Thus, this kind of project specification eliminates non value adding activities and fixes the project scope, which in turn save resources, time and improves efficiency of project. Gupta and Wilemon (1990) argue for detailed planning which in their opinion can eliminate unnecessary steps and sequence activities in efficient order. They further argue that without such planning developers are more likely to do tasks that are not needed or to do them incorrectly, resulting in wasted resources through substantial delays and backtracking as these mistakes are fixed.

Project specifications are often over interpreted, which increase the amount of project scope. This is very often observed in innovative complex projects. According to Berggren, et al. (2008) engineers have a tendency to add ambitions either as an attempt to do things they believe will be asked for later on or just as a way to deal with vague specifications where one possible way is to “over interpret” specifications. With such over interpreted project scope it is not possible to meet delivery time. In their opinion the real challenge is to deliver project at right day which can only be achieved by “Lagomizing (from the Swedish word lagom, which may perhaps be translated as “just right”) and reinterpreting specifications and identifying ‘just right’ and keep doing this throughout project” (Berggren, et al., 2008). Essentially, this is a top down reduction of project scope specifications and fixing it only to those functions and capabilities that are of value to the customer.

**Project Scope and Suppliers**

The concept of supplier involvement in project is obvious in some projects for the supplies of materials and goods (e.g. in construction projects). However it is not the same in several other projects. Especially in the case of the NPD projects going outside the boundaries of their own organization depend on project scope. Further the scope has two elements: the choice for unique versus of the shelf parts. Developing unique parts add new activities (and cost) to the project and may affect the time. The second element is related to the choice of supplier involvement (Clark, 1989). Organizations strategy matters a lot on how suppliers are involved. For example, In 1989 when Clark performed his study; Japanese automotive manufacturers were using a black box design, this means suppliers are involved early and are an integral part of the development process. U.S. automotive manufacturers did most engineering work in-house (rely on detailed control parts with suppliers) this setting is called the gray box design. The Europeans fall
between the Japanese and the Americans in both categories, and use a *white box design* in which buyer consult with supplier for design. Thus, the organization’s strategy for supplier involvement determines how much of the project work is done by supplier or is accomplished in house. In all of the above mentioned settings organizations depend on suppliers. However the extent of relationship differs. In a black box setting an extensive amount of project scope is delegated to the supplier which makes it essential to identify the non value adding activities in project work performed by supplier.

Authors within the relationship school, research on the effect of suppliers in project success mention that delegating the project work to suppliers shortens the project time (Gold, 1987; Imai, et al., 1985). According to Imai, et al., (1985), Gold (1987), Clark and Fujimoto (1991) supplier involvement increase the project speed. Supplier involvement in many steps helps to catch problems earlier (Takeuchi and Nonaka, 1986). Eisenhardt and Tabrizi (1995) anticipated that supplier involvement would simplify the process, but the results of their study show a negative and mixed association. They also added the exception for mature industries and suggest that “for mature industries it is preferable to involve supplier early in process’ (Eisenhardt and Tabrizi, 1995, p 105).

**Project Process Management**

The project process is the set of those steps that the project must go through in order to move from inputs to output this is also called a business process. Modern organizational theory increasingly concentrates around the business processes, since these originate in the business plan. The project process is structured in disciplined, measurable, and repeatable phases. According to Tonnquist, (2008) a process is a chain of interconnected activities both internally and externally of the company, which creates an added value the customer is ready to pay for. Every activity in the chain has a supplier and a customer. The purpose of identifying the business process is to eliminate any unnecessary work which does not generate customer added value (Tonnquist, 2008).

The project process is influenced by several stakeholders. According to some authors, the presence of a powerful project manager also influences the project process. Powerful leaders accelerate projects by keeping the team focused by maintaining a vision that keeps the chaos of experiential product development under control (Brown and Eisenhardt, 1995a; in Eisenhardt and Tabrizi, 1995). A powerful leader can easily secure resources, which team needs for executing the project. The continuous availability of resources has tremendous effects on project...
flow. Clark, et al., (1987) and Clark and Fujimoto, (1991) have provided evidence for the importance of a powerful leader. They used the term “heavy weight” to describe such project leaders who report to the high levels within the hierarchy and have high status within the organization. They further found that projects managed by such heavyweight managers had a nine-month advantage over projects run by managers with little influence.

**Project work management approaches**

A sequential approach is the oldest approach in project management; it is also called traditional project management. A sequential approach involves disciplined and deliberate planning and control throughout the project. In this approach, project lifecycle phases are easily identifiable. Tasks are completed one after the other in a specified sequence. Figure 4.2: show the sequential (Traditional) model, in this model progress flow from top to the bottom.

![Sequential (Traditional / Waterfall) model of project management](image)

Under this method, functions are specialized and segmented, each team perform their part of work and forward it to the next team. This sequential approach is often used in projects with clear goals and sequence of project. This approach needs proper planning and rationalizing the process. Rationalizing the project process also help in shortening the delays in project process (Rosenau, 1988; Gupta and Wilemon, 1990; Cordero, 1991; Iansiti, 1992), however this approach also have some drawbacks like handover problems from one team to another which causes delays in project process. According to Takeuchi and Nonaka (1986) sequential approach may conflict with the goals of maximum speed and flexibility. According to Imai, et al., (1985) speed can be increased by reducing waiting times between steps or even overlapping those steps. In contrast to a sequential approach Takeuchi and Nonaka
(1986) introduced an alternative approach to what they called as holistic or “rugby” approach—where teams work in collaboration and go to the distance as a unit, passing the ball back and forth—may better serve today’s competitive requirements. Under the rugby approach, the project process emerges from the constant interaction of handpicked, multidisciplinary team whose members work together from start to finish, rather than following defined, highly structured stages, process is born out of the team members. According to Takeuchi and Nonaka, (1986) this rugby (overlapping) approach is essential especially for those companies that are trying to develop new products quickly and flexibly. Figure 4·5: illustrate the difference between the traditional sequential approach (See Figure 4·5, Type A) and rugby approach (Figure 4·5, Type B & C).

![Figure 4·5: Sequential (A) vs. overlapping (B and C) phases of development](image)

The change from a sequential to rugby approach encourages trial and error and challenges the status quo. It further stimulates learning and thinking in organization. Under the rugby approach, the phases overlap considerably which consequently offer a better flow of project process. It enables the group to absorb the obstacles throughout the project process, in this approach when a bottleneck appears; the level of noise obviously increases. But the process does not come to a sudden halt, the team manages to push itself forward (Takeuchi and Nonaka, 1986).

Predictable steps can be easily overlapped because they are well known in advance, more tasks can be accomplished in parallel, and the waiting time between steps can be eliminated by overlapping these steps. According to Imai, et al., (1985), even problem solving could be overlapped by overlaying engineering and production phases.
Beggren, et al., (2008) argue that complex projects are often challenging and call for new ways for, rapid, concentrated and visible action to keep the flow of project. According to them one possible method for accomplishing pace in projects is what Ericsson terms the Systemakut (“Systems Emergency Ward”), where the project management team and relevant specialists meet on a daily basis to discuss the problems item by item and making fast decisions not to lose the pace in project (Berggren, et al., 2008).

According to several authors the involvement of downstream teams or functions in upstream decisions reduce the time it takes to complete the project (Gupta and Wilemon, 1990; Cordero, 1991; Mabert, et al., 1992). This type of overlapping is often called as functional involvement or multifunctional teams in product development projects. In functional overlapping the downstream teams participate in meetings with upstream to discuss the content of deliverable. Another aspect of the project process discussed in literature is the concept of frequent milestones. Frequent milestones (project review points) accelerate the project process as the steering committee naturally pulls the work from team at every milestone to review the progress. This is very often discussed in literature on product development projects that frequent milestones shorten development time because they force people to look often at what they are doing so that if actions are going in right direction, or they need to be corrected. According to Gersick (1994) frequent milestones work effectively in uncertain situations for checking current progress. Moreover, frequency of milestones creates a sense of urgency that keeps project teams away from delaying work. According to some authors successful achievement of milestones also give project teams a sense of accomplishment and motivation (McClelland, 1961) and increase individual’s confidence (Langer, 1975). In addition milestones may also enhance coordination and communication among project teams. In contrast widely spaced milestones and delayed stage gates can delay the speed of projects.

**Project Quality Management**

Quality management is a broad topic that originally was developed in manufacturing and engineering areas. Topics such as Total Quality Management (TQM) have since been developed to apply quality principles to the whole organization. In the process, the focus of quality has moved away from statistical techniques, though those are still useful in production environments, to include customer satisfaction and continuous improvement. Six sigma and Design of experiments are also included but these are mainly statistical tools for problem solving. According to Pons, (2008) these are of little relevance to projects.
The PMBOK Guide provides an abbreviated coverage of the comprehensive topic of TQM (See Figure 8-1 and 8-2 of the PMBOK Guide [PMI, 2004]). One aspect of TQM mentioned by PMI is continuous improvement, which is Shewhart’s cycle of Plan, Do, Check, Act which was later made popular by W. Edwards Deming in 1930's in his theory of ‘the advancement of quality’. According to (PMI, 2004) continuous improvement provides iterative means for improving quality of processes (PMI, 2004, p 187). According to Tonnquist, (2008) continuous improvement is a practice for quality improvement of projects. However, the PMBOK offers a high level introduction of several tools; cause and effect diagram, control chart, run charts, scatter diagram. These relate to optimization school. Moreover, many of these tools are actually used in continuous production process. According to Pons, (2008, p. 86) “control charts, run charts and scatter diagrams are not particularly relevant to Project management”.

The probability of improving a process is improved when there is a standard process or when a process can be visualized. The process visualization provides opportunity to visualize the process. However, in recent years project management research has widely focused on planning techniques and work breakdown tools, these tools reduced the need to develop a common understanding of project process. This sort of tools works efficiently in some projects. However, the lack of visualization of processes is of great importance especially in complex projects with rapidly changing industry. Thus, there is need to have a shared understanding by visualizing the interdependencies of process among key actors of the project process. Having a shared understanding is similar to one of the elements of organic integration and anatomy approach introduced by Berggren, et al., (2008) which argues to develop a shared understanding within the project – a organic integration plan visualizes the process and logical steps. This kind of understanding and visualization of process improves the individual participation in process improvements. According to Takeuchi and Nonaka (1984) continuous improvement happens by transfer of learning which regularly take place through ‘osmosis’ by assigning key individuals to subsequent projects.

4.4 Lean in project management

Turning to the purpose of this thesis, it must be noted that this thesis is not the first attempt to integrate lean and project management. In this section previous research which concern lean and PM is discussed.
**Evolution of LPM**

During the 1990s, traditional project management was increasingly criticized for the lack of its impact and benefits. One part of the criticism dealt with the theory of project management. Morris (1994) argues that the Project management theory remains “stuck in a 1960s time warp”.

Barnes (2002) argues that a theory based approach is needed for developing project management further:

“We enthusiasts for project management have a choice. We can already manage projects well – not always, but we know how to do it. One route is for us to let the science stabilize and to concentrate on broadening its range of application – applying currently defined best practice. The other route is development of the science itself letting its application go where it will”.

“Choosing the first route is likely to lead to the end of project management”.

Following a similar line of arguments Koskela and Howell (2002, p 1) argue that

“The underlying theory of project management is obsolete”.

These seem to be harsh criticism, but these may also become the primary basis for identifying new ways and/or integrating existing ways for managing projects. As mentioned by Winter and Szczepanek, (2008) the pattern now emerging in research on project management around the world is one of increasing concern about relevance of conventional project management theory and how it relates to growing practice of managing projects across different industry sectors.

Against these above mentioned background the researchers introduced a new approach, the production based approach to project management.

**Production based approach to project management**

In this production-based approach, projects are conceptualized as temporary production systems. This new approach relate to governance school and
construction projects. Project management thus equals production management.

“Production is defined as designing and making things. Designing and making things for the first time is done through a project, which is, for that reason, arguably the fundamental form of production system” (Ballard & Howell, 2003).

Winter and Szczepanek (2008) acknowledged the argument of Ballard and Howell (2003) but, also presented a more extensive perspective by suggesting that

“Projects and programs can be seen from many different perspectives, including the image of temporary production systems, but also as value creation processes, change processes, and temporary organizations, etc”.

These temporary or Project based production systems are used for developing several types of products, e.g. product development, construction, software development, etc (Ballard and Howell, 2003). This new way of thinking about projects as production developed possibilities to use concepts of lean production in project management. As discussed previously one needs to keep in mind that projects show different characteristics then operations. Hence a certain amount of repetitive activities can usually also been found in projects. Still the application of the production based approach to PM including its limitations needs to be further investigated.

**Definition of LPM**

The only definition of lean project management found in literature is as following:

“Projects are temporary production systems. When those systems are structured to deliver the product while maximizing value and minimizing waste, they are said to be lean projects” (Ballard and Howell, 2003).

**What constitutes LPM?**

Previous research has not adequately focused on lean thinking in project management. There are only a few exceptions. Ballard and Howell (2003) provided a model called Lean Project Delivery System (LPDS) for construction projects, which in their opinion has emerged from theoretical insights from other industries (lean production). This model focuses on several aspects of project delivery, like improving conversation among stakeholders, deferring decisions, process design,
eliminating waste, flow and pull. For achieving Pull, they introduced the Last Planner System; it is not surprising that implementation of the last planner system has produced more reliable flow and higher throughput in projects (Ballard and Howell, 2003).

In their opinion their suggested model (LPDS) differs from traditional project management (Table 3-2), in terms of definition of phases, the relationship between phases and participation in each phase.

<table>
<thead>
<tr>
<th>Lean</th>
<th>Non-Lean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus is on the production system</td>
<td>Focus is on the transactions and contracts</td>
</tr>
<tr>
<td>Transformation, flow and value goals</td>
<td>Transformational goal</td>
</tr>
<tr>
<td>Downstream players are involved in upstream decisions</td>
<td>Decisions are made sequentially by specialists and &quot;thrown over the wall&quot;</td>
</tr>
<tr>
<td>Product and process are designed together</td>
<td>Product design is completed, then process design begins</td>
</tr>
<tr>
<td>All product life cycle stages are considered in design</td>
<td>Not all product lifecycle stages are considered in design</td>
</tr>
<tr>
<td>Activities are performed at the last possible moment</td>
<td>Activities are performed as soon as possible</td>
</tr>
<tr>
<td>Systematic efforts are made to reduce supply-chain lead times</td>
<td>Separate organizations link together through the market and take what the market offers</td>
</tr>
<tr>
<td>Learning is incorporated into project, firm and supply chain management</td>
<td>Learning occurs sporadically</td>
</tr>
<tr>
<td>Stakeholders interests are aligned</td>
<td>Stakeholders interests are not aligned</td>
</tr>
<tr>
<td>Buffers are sized and located to perform their function of absorbing system variability</td>
<td>Buffers are sized and located for local optimization</td>
</tr>
</tbody>
</table>

Table 4-1: Lean versus non-lean project delivery (from Ballard & Howell., 2003)

In contrast Nekofur and Karim, (2011) suggested for ‘standardization of projects’, in their opinion standardization of large scale industrial projects can provide opportunities for applying lean thinking to projects and project management. Other authors Hines, et al., (2006) also argue to develop standard project processes, we are attempting to move from a single project theoretical-world environment to one that has repetitive cycles of product development, where any innovation in project management can be incorporated in the future template. In terms of product development or project lifecycle management it may be possible to categories certain types of products into different types based on their frequency and complexity of occurrence and groups of activity required within the process. In fact, in lean terms we are seeking to define particular product value streams. According to Hines, et al., (2006) it might be possible to categorize various types of sub-process, for instance:

- Major new high innovation projects requiring significant market research and Research and Development time;
• Mid-level reverse-engineering projects designed to copy market leading products; and
• Low innovation development, for instance involving product promotions requiring only minor modifications to existing products.

What frequently occurs in practice is that firms either reinvent the process every time, hence losing learning curve effects, or design every product as if it was a high innovation product and fail to reap the benefit of a simpler process for the majority of their products (Francis, 2002). Thus, the Lean PLM approach defines a few standard PLM sub-processes that can be used as templates for future projects (Hines, et al., 2006).

When lean has been connected to project management, mostly the construction industry is used as an example, e.g. in Ballard and Howell, (2003) and Nekofur and Karim, (2011). Construction projects are up to a great extent similar to manufacturing, as in many projects (e.g. construction, shipbuilding, aerospace, etc.) the materials move around the product and product remain fixed, in (automobile) manufacturing both products and materials move at the assembly line, furthermore many of the construction projects are repetitive as companies often do repetitive tasks for example by developing similar floors and buildings. This of course provides means that many of the principles from lean production can be applied to construction projects. In contrast to this many projects, for example knowledge intensive projects differ from repetitive projects (Pons, 2008).

Staats, et al., (2011) investigated the case of rapidly growing software firm (Wipro), which implemented lean in software projects (knowledge work). The authors mentioned the software projects as production system (Wipro production system), this is exactly similar to what other authors mentioned as temporary production systems (e.g. in Ballard and Howell, 2003; Winter and Szczepanek, 2008).

According to Staats, et al., (2011) it is possible to implement lean production system in software projects, by such implementation organization learns through hypothesis driven problem solving, streamlined communications, simplified process, and to a lesser degree, specified tasks, the implementation at Wipro included four rules of TPS. A summary of principles applied (Table 3.3).

The findings of their research shows that “lean software projects perform better than non lean software projects” (Staats, et al., 2011, p.376). They also highlighted that the most significant challenge linked with using ideas from lean production in
projects is lack of repetitive nature of projects. In their opinion this implementation is far from complete.

<table>
<thead>
<tr>
<th>Rule 1: specified tasks</th>
<th>Rule 2: streamlined communication</th>
<th>Rule 3: simple process architecture</th>
<th>Rule 4: hypothesis driven problem solving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized error codes</td>
<td>Visual control boards</td>
<td>Value stream mapping</td>
<td>Iterations</td>
</tr>
<tr>
<td>5S</td>
<td>Design structure matrix</td>
<td>Single piece flow</td>
<td>periodic builds</td>
</tr>
<tr>
<td>Pre-specified test cases</td>
<td>System complexity estimator</td>
<td>Heijunka</td>
<td>periodic code reviews</td>
</tr>
<tr>
<td></td>
<td>WebEx to connect engineers at different locations</td>
<td></td>
<td>WebEx to go and see a problem at another location</td>
</tr>
</tbody>
</table>

Table 4-2: Case evidence of the four lean principles (from Staats, et al., 2011)

In the few scientific publications on LPM, the main focus is on projects as production systems, implementation and transfer of lean production to other areas. However, lean production is contextually bound to application in manufacturing industries with huge volumes, standardized repetitive production processes, and focus on reducing waste and lead time, in comparison to this many projects are not highly repetitive.

Therefore, many of the concepts / principles from lean production cannot be directly extrapolated to all contexts (projects). Thus it is interesting to explore the concepts of lean thinking that are relevant for project management and how they can improve the project productivity? As mentioned by Pons (2008) the effectiveness of many evolving methods for project management, “including lean project management have not yet been thoroughly researched, research is urgently required to increase our knowledge of the effectiveness of these methods” (Pons, 2008, p 93).
In this chapter, the empirical findings from the interview will be presented.

Presentation of the Interviewee

In order to connect with reality and to collect updated information on project management practices an interview is conducted with Carina Höyheim. She has worked on projects for over 15 years. She worked on various projects from product development to complex products within IT, telecom industry and insurance. She has experience in project management with PROPS with Ericsson, and has also worked as line manager with responsibility for projects. She worked as certified coach PDI at Personal Development Institute, 2007 and for several years as consultant in Project Management. Since 2002 she is running her own business, a project consultancy company to train and coach project managers. She provides coaching on both project methodology and project management. Further to her extensive experience she is also a certified PMP (Project Management Professional) from PMI Project Management Institute, USA. Moreover, she is also involved in teaching the course of PM at Linköping University, Sweden.

Characterization of Project Work

In the view of Carina Höyheim the project management differs from production management with respect to the aspects of uniqueness and nature of project work. She believes that projects have a fixed start and ending time, and projects often involve activities that need several different competences. In some of the projects the project sponsor and product manager perform key roles in controlling and evaluating the project progress. The project sponsor decides project delivery dates, according to Carina the delivery date of project is normally negotiated between sponsor and product manager. Project progress is monitored on weekly or monthly basis to see how all sub projects within the main project fit in. In normal practice project evaluation begins with a business analysis coupled with a pre study, to identify the economic benefits and the technical aspects are evaluated by different individuals in organization, depending on individual’s technical knowledge and position in organization.

Value Specification

The customer benefit (value) is very much ignored in projects. According to project consultant often value specification is not straight forward, “either value is not specified, or it is done quickly as the team is interested to start the project”. In some projects the value remain neglected until the end of project and then project
members start discussing what the value to customer was? At the same time she also believes that value specification of project should be done during business analysis, when the long term and short term goals are decided and value is accessed. The steering committee is responsible to analyze the business value and to identify what kind of value the project generates. In some projects the project team arranges a requirements workshop with the customer to collect the user requirements and to investigate what customer is willing to pay for. Further, the project team asks the customer for those features that will create most value for them. Afterwards the features and required capabilities are translated into user requirements.

According to the Carina Höyheim value adding is what the customer is willing to pay for, and non value adding activities are those activities that do not add value to the customer. She believes that there are a lot of product features that are non value adding. Moreover, in her opinion the laws, rules and regulations imposed by different regulatory bodies for specific kind of products are also non value adding from customer’s point of view, but if you really do not do that project may be at risk, as the regularity bodies may reject the product for not following the regulation. Furthermore, in her view the aspects of quality, time and cost influence what is value adding in a project. Whatever features and functions are selected, it has to be delivered on time. Thus, timely delivery is also one of the key aspects of project value.

**State of the art practices related to value stream mapping**

The project process and activities within a project are sequenced with respect to their dependency, each activity needs some input before it can be started. The sequential approach is very risk free as organizations verify each phase using collaborative decision making by involving a sponsor, product manager and steering committee for key decisions. This approach takes a long time since every phase has to be verified. As an alternative to a sequential approach organizations overlap phases so that next task can be started even if the input is delayed, overlapping approach increases the efficiency of project.

According to Carina Höyheim it is not common in companies following a sequential or an overlapping approach to map the value stream of project; nor involve supplier’s part of process in value stream mapping (VSM). Further, the tendency to identify the supplier’s process in project management is very low, and suppliers usually avoid sharing the information of in house process, but it also depends on the duration of buyer supplier relationship. As an alternative most of the organizations
involve supplier by asking supplier to write the requirements specifications to identify if they understand the problem well and if they will be working on the right goal and solution.

**Project Flow**

Carina Höyheim explains that there is no such thing, as a general project flow. This rather depends on the selected project approach. In some cases a sequential process is used. In a sequential approach the flow of work is planned in the planning phase. Afterwards, the flow is maintained according to the dependencies planned earlier in planning phase. Moreover, it is observed that there is not always a continuous flow in projects. Delays are experienced and “one cannot start working until someone else is finished”. In such situations project managers either gives some other work to the succeeding team, or if the succeeding team is skilled enough they may be asked to work with proceeding team. According to Carina Höyheim “waste in the form of waiting times are not stripped in sequential approach”. In contrast this is done to some extent in agile approaches. In a sequential approach, at the end of each phase the receiving team uses tollgate meeting to verify the requirements and quality of deliverables. The different types of check points used in sequential approach are e.g. stage gate, executive gate, tollgate meetings and approval cycles. These are not seen as waste. However, if these decision point meetings are delayed then these add delays in the project progress and add waste in the form of non value adding time.

Such delays are observed to be more common in companies that collect key peoples with different knowledge and expertise in one room for decision making. Carina Höyheim explains that there are some companies that arrange such control board meetings only six times in a year. This means that the project manager may have to wait for two months for a decision. In contrast, some companies avoid delayed meetings and prefer flexible meetings to maintain the pace of work. These flexible approaches make it easier to adapt to changes in requirements using frequent control board meetings.

In a sequential approach the process is predetermined and the receiver of a deliverable is clearly defined. However in agile the new features determine who will receive the task. At the same time it is identified that there is not always a clear clarity of process and roles of project teams. This lack of clarity creates frustration among team members, in order to counter that some companies sign a contract which makes things very clear. Furthermore Gantt charts and tollgate meetings inform the project team about the flow and progress of project work.
Carina Höyheim explains the critical path is most important as it can delay the project and a proper focus is maintained to complete those activities that are on critical path. In her opinion project activities are often completed as soon as possible. This means that when resources are available activity can be started and the deliverable will be pushed downward. However, in some projects activities are planned as late as possible, following an as late as possible approach. In this approach upstream activities are delayed until the downstream team notifies the upstream team to start preceding activity. This pull approach increases the number of activities on critical path. According Carina Höyheim in project context there is no one right methodology, both push and pull approaches are used to maintain the flow in projects. However, sequential or typical project management is not based on pull approach. As in sequential setting delivery dates are predefined in plans. In contrast to this some companies involve downstream teams using an overlapping to decide the delivery time and set up requirements and content of deliverable, but overlapping is not always practiced.

**Continuous Improvement**

In projects the product improvements are related to quality measurement. Carina Höyheim believes that in well handled projects it is mentioned in requirements that how quality will be measured and it is often done by project sponsor. The other aspect of continuous improvement is to improve the project management process. According to the Carina Höyheim, an improvement in project management process is done in companies that use the agile approach. The process improvements are more when team members can see the process. In her opinion what is observed in projects is that “team members are not always aware of process”. Employees sitting high in hierarchy of organization are often aware of project process and committed to improvements, in comparison to employees sitting low in hierarchy. It is often difficult to see the complete picture of process.

In order to achieve both standardization and flexibility in a process the companies use project management office models like PPS or PROPS™ for active planning and management of projects. The basics of PPS are to clearly define the work and goals, the model supports project work via checklists and templates. PROPS™ is a generic framework for the whole organization and work in all types of projects. The project management processes in PROPS cover the entire lifecycle of project. The problem is how to be flexible and standardized too. Carina Höyheim explains that a higher degree of standardization turns into extensive amount of administrative rules and
bureaucracy. Further the process of continuous improvement relates to having a common vision among project team members, according to the project manager there is “not always a common vision” in project organizations.
Chapter: Analysis

This chapter presents an analysis of lean concepts against concepts in project management and updated project management practices in organizations.

Application and Integration of lean concepts to Project Management

6.1 Specify value

Theoretical analysis: Value adding activities in projects are those activities for which customers are willing to pay. It is novel to analyze the planned activities if they will be adding value to customer. Therefore, each activity can be evaluated for its benefit to the customer and if the customer would really pay for that activity. Those activities that are not adding value to the customer should be eliminated. This is similar to what Gupta and Wilemon (1990) mentioned as elimination of unnecessary steps. This elimination of unnecessary steps, in turn saves resources, time and improves efficiency of project. Identification of value adding activities act on the whole project and it includes identifying customer requirements, sorting and validating the functions and capabilities that are of value to the customer. This eventually means that the identification of value adding activities crops the scope of project. This is similar to what Berggren, et al. (2008) introduced as Lagomizing, which they suggest as a top down reduction in project scope by eliminating those product features which cannot be thoroughly tested and consequently may not provide value to the customer. Lagomizing the project leads to timely delivery which has value for customer and customer pays for timely delivery. Also, referring to the concept of project specification introduced by Iansiti, in which the author argues for specifying value of all activities and closing the window of opportunity. Once the window is closed, the basic options and approaches will have been selected, tasks will have been partitioned and assigned, and the project will rapidly build up momentum to complete the project in specified direction. The results of their study shows that “organizations following a system focused approach complete projects more quickly and use less resources” (Iansiti, 1995, p 534), thus improving both efficiency and effectiveness.

Following the logic of the concept of value, we can see that several authors within the project management body of knowledge argue the same: reducing the project scope to those set of activities that are of value to customer. This customer focused value approach focuses on long-term strategic benefits. In a comparative manner it differs from product value analysis, expected monetary value analysis and cost based scope management suggested in PMBOK® Guide (PMI, 2004).

Thus, specifying the value of each product, information or service from the perspective of the customer is necessary in order to identify those activities,
features and capabilities that are not adding value to the customer. There are two underlying elements of this concept, which are used to think if something is value or waste: it is said that either an activity is value adding, or it is non value adding (waste). This kind of thinking for each activity identifies waste that usually escapes notice because it has become accepted as a natural part of the work.

**Effect on project productivity:** In the light of the above mentioned analysis and research findings, a value specification of the project reduces the project scope to a set of those activities that are essential for customer. This increase the project ‘effectiveness’ (Berggren, et al., 2008; Gupta and Wilemon., 1990). At the same time the lower amount of project scope increases the chances to complete the project in time, this increase the project ‘efficiency’ (Berggren, et al., 2008; Iansiti, 1995; Gupta and Wilemon., 1990).

**Practice:** Linking back to the empirical part, it is believed in project organizations that the value of the project should be identified during feasibility study and business analysis, when the long term and short term goals are decided. However, it is observed that value in projects is not straight forward, either value is not specified, or it is done partial quickly as the team is interested to start the project. As a consequence the customer benefit is very much ignored until the end of project and then project members start discussing what the value to customer was? According to the project consultant value adding is what the customer is willing to pay for. Those activities that do not add value to the customer or have to be followed for example, laws, rules and regulations imposed by different regulatory bodies for specific kind of products are also non value adding from customer’s point of view, but if you really do not do that project may be at risk, as the regularity bodies may reject the product for not following the regulation. Moreover, it is observed that there are a lot of product features that are non value adding in projects. Furthermore, in projects the aspects of quality, time and cost influence what is value in a project. Whatever features and functions are selected, it has to be delivered on time. Thus, timely delivery is one of the key aspects of value to customer.

**Associated constraints:** One important issue is the understanding of waste and value. In lean value is defined only as perceived by the end customer. This involves some important implications when applying lean to projects. As in projects, end customers can be multiple. This adds more complexity in using this principle in projects. Some of the projects e.g. R&D and Engineering projects are unique and complex in nature. In these projects the full scope of project cannot be anticipated beforehand, in research projects often the scope of work is dynamic (Pons, 2008).
Second important issue is the aspect of time. Some of the construction projects e.g. buildings that are produced over an extended period of time deliver their value and generate waste over a long period of time (Jorgensen and Emmit, 2008). Thus value cannot be calculated effectively in all projects. This adds challenges to the application of this concept in projects. However, this concept may work well in projects where the goal and the solution is clear and activities are clearly defined, e.g. in some services, construction and management projects.

6.2 Identify the value stream

Theoretical Analysis: The second concept in Lean thinking is to ‘Identify the value stream’. It is a method to identify the process used to develop a product. In lean manufacturing it is suggested to identify the whole value stream of the organization, including critical management tasks (problem solving task from design to production), the information management task from (order-taking to delivery), and the physical transformation task from (raw material to finished product). The value stream mapping (VSM) tool facilitates identification of value adding and non value adding activates along the value stream. Theoretically, it is visualization of all interconnected activities in an organization. This is similar to what Tonnquist, mentioned as “a process is a chain of interconnected activities which create an added value the customer is ready to pay for, the purpose of identifying the business process is to eliminate any unnecessary work which does not generate customer added value” (Tonnquist, 2008. P3). According to PMBOK®, “A process is a set of interrelated actions and activities that are performed to achieve a pre-specified set of products, results, or services” (PMI, 2004. p 38). However, any specific tools for project process mapping and identification of value and eliminating waste are not highlighted in PMBOK. In projects often network diagrams are developed that uses boxes or rectangles, to represent activities and connect them with arrows that show the dependencies (PMBOK Guide, 2004: Tonnquist, 2008). These network diagrams are not the same as lean VSM. The lean VSM uses different symbols (e.g. for supplier, logistics, people, electric information flow, inventory, data boxes) and also show the value adding time and non value adding times, for more details on symbols and two steps of VSM see(Figures in appendix C). VSM is useful tool for identifying waste if it can be properly applied in projects.

The underlying practice of using VSM in Toyota goes beyond the borders of their own organization. The processes within manufacturing depend on suppliers for the supply of materials and parts. However, this concept of focusing on whole (own
organization and also on partners and suppliers) is different in projects. All projects
are not based on supplies from suppliers. In some projects like services projects or
commercial construction projects do involve suppliers on regular basis for supply of
materials or services, in such setting it is possible to map the value stream of work
done by supplier. In contrast to this in NPD projects going outside the boundaries of
the own organization depends on the project scope, and the choice of unique versus
of the shelf parts. Developing unique parts add new activities (and cost) to the
project and may affect the time. The second element is the choice of supplier
involvement (Clark, 1989). Once unique parts have been selected, the firm may rely
on supplier. Clark identified significant differences in terms of supplier
involvement, the U.S firms do most engineering work in-house (rely on detail
control parts with suppliers) while the Japanese firms emphasize black box designs.
The Europeans fall between the Japanese and the Americans in both categories. In
all of the above mentioned settings organizations depend on supplier, however the
extent of relationship differs. Therefore, the value delivered to the customer consists
of value from the own organization and value from partners and suppliers. Thus
project scope goes beyond the lines of own organization and even reaches the
suppliers. In case if substantial amount of project work is given to supplier as in
Black box (Japanese), in such setting it is obvious that the activities undertaken by
suppliers may also involve non value adding activities, in efficiencies and delays
which can affect the project productivity. Then it is required to map the VSM of
supplier to identify waste. However, U.S firms do most engineering and design work
in house, in this setting buyer already know the entire process of the supplier and
there companies can easily use the VSM technique. In U.S setting the effect of
supplier is not that much on the project scope in comparison to the own
organization effect on value stream as most of the work is done in house. The VSM
of the project work done by supplier can identify the time the supplier spends on
creating value and time that is wasted. Involving suppliers in the VSM process may
also need an extensive supplier involvement, which may also provide some other
benefits, for example, Takeuchi and Nonaka (1986) mentioned that supplier
involvement in many steps helps to catch problems. Several other authors (Imai, et
al., 1985; Gold, 1987; Clark and Fujimoto, 1991; Eisenhardt and Tabrizi, 1995)
mentioned that supplier involvement in mature industries can increase the project
speed (efficiency). The effort to hunt for non-value adding activities along the value
stream of project work inside the organization and also for the work given to a
supplier is a novel approach, but it depends on type of project and further on the
selected approach to involve supplier.
Thus, Value stream mapping is a method to create a picture of the project process: whole set of activities, starting from order taking, to planning, execution and delivery of project. The underlying goal of value stream mapping is to identify the flow of information, materials and processes. The VSM helps to visualize the processes in order to eliminate / sequence activities in a more efficient order and eliminate non value adding time.

**Effect on project productivity**: The value stream mapping visualizes the whole process, including the supplier’s part of process. This tends to focus the attention toward the whole rather than just concentrating at improving own business. This removes all non value adding activities from project process, thus improve the project “effectiveness”. VSM also helps to sequence activities in a more efficient order, and eliminate the non value adding time, thus increasing project, “efficiency”.

**Practice**: Linking back, to the practice of process management in organizations. It is observed that project organizations sequence activities with respect to activity dependence, some organizations also use an overlapping approach to reduce the setup times of each activity. However, in both approaches the value stream of project process is not mapped, nor suppliers are involved. The reason for not mapping the process can be that processes are not in place as many of the projects are one time activity and same process may never be followed again, thus organizations avoid spending resources on mapping the value stream. Further it is also observed that some of the suppliers avoid sharing the in-house process because of lack of trust. In order to make sure that suppliers work with creating actually what is required, organizations use alternative ways. The project organizations ask the supplier to write the requirements specifications to identify if they have understood the problem well and if they will be working on the right set of activities.

**Associated Constraints**: There are several constraints associated with VSM. First: the value stream can only be mapped when a process is in place or is often repeated, and the processes and activities are clearly defined and standardized, thus the effective use of this concept requires repetitive processes (e.g. in some services or construction projects) where the process is in place. The same cannot be said for all types of projects for example in R&D projects the process is not in place and may not be identified, further processes in such projects often interact with each other in complex ways that cannot be completely explained in graphics (PMBOK®, 2004). Further, R&D projects are very unique and often involve creative and knowledge work. Thus, organizations often avoid disclosing their knowledge work processes, as they consider it as a matter of confidentiality and because of the fear that
information regarding internal processes and waste could be counter used by upstream or downstream partners for bargain. Moreover, some projects are a onetime activity; this means that value may pass through the process only once. Thus, spending resources on mapping the processes may not benefit in that scenario. If VSM cannot be mapped for main process problem solving task, VSM can still be used for information management tasks. As Staats, et al. (2011) mentioned, a software company that used VSM and found that four peoples were using the same test printer resulting in wasted time from waiting and changeover. Further the printer was on another floor so if someone found an error he or she had to go downstairs to print again.

6.3 Flow

Theoretical Analysis: In manufacturing the flow is the flow of materials and obstacles are in the form of queues and batches. Projects are different and flow in projects can be in many different forms: in projects flow can be the flow of materials (construction) as well as the flow of information, data, specifications and instructions (NPD). Thus, in terms or projects the concept of flow is applicable to the project process, instead of materials or information specifically. There will be a flow in project as long as an obstacle affects the flow. Thus, obstacles moderate the relationship between ‘flow of processes’ and ‘efficiency’. It is conceived that in projects obstacles are any such constraints that halt the flow of process. In projects obstacles to the flow of process can be of many different kinds. For example in project organizations that use a sequential approach, the project goes through several phases in a step by step fashion, moving from one phase to the next only after all the requirements of the preceding phase are satisfied, which causes obstacles (delays) in process (Takeuchi and Nonaka, 1984). Several authors (Rosenau, 1988; Gupta and Wilemon, 1990; Cordero, 1991; Iansiti, 1992) argue to rationalize the process for shortening these delays. Moreover, in this sequential approach, the preceding team pushes the output of a task to the next responsible team; the next team may place it in queue or might have some other high priority project. In contrast there are situations when the succeeding team (downstream) remains waiting for the delivery from the upstream team. Crucial problems occur when one team handover the project to next (Takeuchi and Nonaka, 1984). This approach further uses approval cycles and stage gate meetings which are intended to control risks, but often turn into obstacles. In this approach, a bottleneck in one phase can slow or even halt the entire development process. The obstacles in projects are more challenging then manufacturing, and call for rapid, concentrated and visible actions for maintaining flow. These obstacles can be eliminated by developing methods for immediate decision making. This is similar to what
Berggren, et al. (2008) introduced as System Emergency Ward, where the project management team and relevant specialists gather to discuss the problems and make fast decisions not to lose the pace in projects. According to Takeuchi and Nonaka (1984) a sequential approach conflicts with goals of maximum speed and flexibility and they suggested an alternative approach to what they name as rugby (overlapping) approach to achieve maximum speed and flow of projects. In this approach the phases overlap considerably, which enables the group to absorb the vibration or noise generated throughout the development process, when a bottleneck appears, the level of noise obviously increases, but the process does not come to sudden halt. In projects, predictable steps can be easily overlapped and more tasks can be accomplished in parallel. According to Imai, et al. (1985) even the problem solving tasks could be overlapped by overlying engineering and production phases.

The concept of flow is based on two elements, flow and obstacles. There is always a flow in project as long as there are no obstacles that halt the process. Thus, the continuity of work and flow in projects is achieved by rationalizing the project processes (Rosenau, 1988; Gupta and Wilemon, 1990; Corder, 1991; Iansiti, 1992) or adopting an overlapping approach (Takeuchi and Nonaka, 1984; Imai, et al, 1985) or eliminating obstacles using rapid decision making (Berggren, et al. 2008). Moreover in lean manufacturing flow is achieved by using a pull approach which is further discussed in next topic.

**Effect on Project productivity:** The elimination of obstacles creates flow in project process. This increases the chances to complete the project in time while using fewer resources, thus achieving “efficiency” (Shenhar, et al. 1997) and in time delivery of project and customer pay for timely delivery (Berggren, et al. 2008). An increase in efficiency indicates a well-managed, efficient project and efficiency is also a critical component in project performance.

**Practice:** Linking back to the project management practice in organization. It is observed that the flow of the project is properly planned in the planning phase. Critical paths are identified to keep a higher focus on those activities that can affect the delivery of project. Even though that flow is planned in planning phases, it is also observed that there is not always a flow in projects; obstacles are experienced in the forms of delays and waiting times. One cannot start working until someone else finishes. In order to utilize human resources in such situations a project manager engages a workforce on other tasks. Furthermore these obstacles are identified more often in organizations using a sequential approach. According to the project consultant decision points like stage gate and executive gate meetings that
are used in sequential approaches are not actually waste but when they are delayed they take the form of an obstacle. Some companies counter these delays by using flexible and agile approaches. Moreover, it is identified that the complexity reduces the clarity of process. This lack of clarity also creates frustration among team members, in order to counter that some companies sign a contract which makes things more clear.

**Associated constraints:** The flow in manufacturing can be easy because the flow direction of material is often unidirectional. However, in projects, the flow can be unidirectional, bidirectional, multidirectional, and can be in loops and iterations that are often planned as part of project for example as in NPD projects. Furthermore, the project processes are highly networked, sequential and parallel, uncertain and involve risk, highly iterative but not highly repetitive as in manufacturing. These differences add hindrances in achieving flow in projects.

### 6.4 Pull

**Theoretical analysis:** There are two elements of the concept of pull in manufacturing. The first element is to let the customer pull the product from your company instead of pushing the product toward customer. The second element is that the application of this concept goes deep into each activity thus no one upstream should produce or deliver a material, product or service until the downstream customer demands it. The first element pull is practiced in project organizations as the marketing department identifies the opportunity which turns into a further investigation (feasibility study) to identify whether organization should undertake the project (PMBOK®, 2004), thus projects are started on market demand. The second element of applying pull to each activity in projects is further analyzed in projects context.

Traditional project scheduling techniques, CPM and PERT represent a push system. This intends that every activity is pushed by its predecessor. In this push approach the output and end time of preceding activity determines the start of next activity (PMBOK®, 2004). Although the push approach is computationally less demanding, it does not ensure the elimination of gaps and schedule obtained using push approach may be less efficient (Belhe and Kusiak, 1996), thus continuous flow of process may not be achieved using a push approach. Doing the opposite to push is pull. A pull approach comes from lean (originally from Edward Deming) (Liker, 2004). In a pull approach the succeeding team (downstream) behaves as an internal customer and collaborates with preceding team to discuss the content, sequence, outcome and timing of delivery. Similar elements are discussed by researchers in the fields of project management. First: Succeeding team’s act of discussing content
and outcome is in some way similar to functions involvement. Previous researchers (Gupta and Wilemon, 1990; Cordero, 1991; Mabert, et al, 1992) mention that the time it takes to move between phases can be reduced by involving production people in project teams. Furthermore this is also reasonably similar to rugby (overlapping) approach introduced by Takeuchi and Nonaka (1984) in which the teams interact with each other. Second: In a pull approach the downstream activity determines the timing of delivery (when the previous activity is to be completed). This is similar to what project management achieves by using milestones in projects. The work is specified for each milestone and the time of delivery is determined. Thus, the steering committee eventually pulls the work from preceding team at each milestone. The presence of milestones creates a sense of urgency and increases the project efficiency, and work effectively even in uncertain situations (Gersick, 1994). Theoretically, push and pull are the two sides of same coin. However, the researchers in LPM mentioned that a continuous flow can only be achieved by applying pull. The construction industry developed a method for achieving pull in construction projects, called as Last Planner System, (Ballard & Howell, 2003) mentioned that it is not surprising that implementation of the last planner system has produced more reliable flows and a higher throughput in projects. Seemingly, the application of a pull approach in projects can eliminate considerable amount of delays and can endow some benefits.

**Effect on Productivity:** The first element of the pull is to start a project at customer demand. This improves the probability to produce what is actually required by customer, thus ‘doing the right things’ improving project ‘effectiveness’ (Shenhar, et al. 1997), the second element of pull focus on creating pull between project activities, which eliminates the gaps which consequently affect both ‘effectiveness’ and ‘efficiency’ of project.

**Practice:** According to the project consultant there is no one right methodology, both push and pull approaches are used to maintain the flow in projects. However, sequential or typical project management is not based on a pull approach as in sequential setting delivery dates are predetermined in plans. Furthermore some companies involve downstream teams by overlapping to set up requirements of deliverable, in what order, in what shape but overlapping is not always practiced.

**Associated Constraints:** The pull approach can be only be used when the succeeding team already knows what they need, and in what order and quantity. Further pull is achieved by using ‘kanban’. In projects kanban can be used for replenishing materials in projects that depend on materials like construction projects. However, kanban or a pull approach may not be relevant in many other kinds of projects.
6.5 Perfection (continuous improvement)

Theoretical Analysis: The fifth concept in lean is ‘Perfection’ the underlying practice of this principle is to continuously improve the processes. Continuous improvement is not new it is exactly Shewhart’s cycle of Plan, Do, Check, Act which was later made popular by W. Edwards Deming in 1930’s in his theory of the advancement of quality. Quality management is a broad discipline that originally developed in the manufacturing and engineering areas. The PMBOK® Guide (PMI, 2004) provides an abbreviated coverage of the comprehensive topic of TQM. One aspect of TQM in PMBOK is the continuous improvement. PMBOK mentioned that continuous improvement provides iterative means for improving quality of processes. Tonnquist (2008) mentioned that continuous improvement is a practice for quality improvement of projects. However, PMBOK and Tonnquist offer a high level introduction of quality and continuous improvement. There are two elements of continuous improvement, ‘standardization’ and ‘visualization’ of processes. These two play a significant role in improving process. The first element is to standardize the process. In manufacturing process improvements take place in cycles. As in production lines the process remains the same and every time product pass through the similar process. This repetition makes it possible to improve the process on continuous basis. In contrast the processes in projects are often iterative, not that repetitive. The researcher in LPM argues that similar process improvements can be achieved in project organizations by standardizing the project processes for different product lines. By standardizing process any innovation in process can be incorporated in future template. Hines, et al. (2006) argues that in general, when we discuss this with companies their usual reaction is that every product is different, however, on further analysis what is often found is that although products are different but there are only a few ways of developing them or managing their lifecycle. Thus, in mature organizations it is possible to define standard project processes. Once project processes are standardized it is possible to continuously improve them. According to Francis, (2002) what frequently occurs in practice, project firms either reinvent the process every time, hence loosing learning curve effects, or design every product as if it was a high innovation product and fail to reap the benefit of a simpler process for the majority of their products. The second element of continuous improvement ‘visualization’ is to graphically visualize the process. According to Womack and Jones (2003), Toyota continuously improve its processes by making process transparent to employees, all employees can see everything. Making value stream visible in such a way, make it easier to discover ways to create value and prevent waste. This visualization of process is similar to what Berggren, et al., (2008) introduced as one element of organic integration plan,
in which argues to develop a shared understanding within the project – an organic integration plan visualizes the process and logical steps. These kinds of visualization of process improve the individual participation in improving project processes.

Thus, the concept of continuous process improvement in projects can be achieved by standardization of process (Hines, et al, 2006) and by making a shared understanding of process (Berggren, et al, 2008). If applied properly it may yield benefits, undoubtedly there is no option to do a process related improvement and enjoy the benefits forever. Further, continuous improvement in projects is borne by acquiring organization, rather than an individual project, since the project may not last long enough to reap the rewards.

**Effect on Productivity:** The concept of continuous improvement is an alert that there is no end to the process if improvements. Following this concept means continuously repeating the first four concepts. The first four concepts interact with each other in a virtuous circle, thus improvement in any of these lead toward improvement in others. This means continuous improvement eliminates wastes, thus increasing ‘effectiveness’ and elimination of suboptimal processes and delays, thus increasing ‘efficiency’. Here, the emphasis is on incremental, continual steps rather than giant leaps.

**Practice:** In projects the product improvements are related to quality measurement. The project consultant believes that, in well handled projects quality goals are mentioned in requirements – these relate to the quality of product and is often measured by project sponsor. The other aspect of continuous improvement is to improve the project management process. According to project consultant it is practiced in organizations that use an agile approach. Further, the process improvements are more when team members can see the process. It is often difficult to see the complete picture of process. According to project consultant what is observed in projects is that team members are not always aware of process. Project leadership, sitting high in hierarchy of organization are often aware of project process and are committed to improvements, in comparison to team members sitting low in hierarchy. In order to achieve standardization, project organizations use PPS or PROPS™ models. These models help in clearly defining the work and goals via checklists and goals. Project consultant further explains that a higher degree of standardization turns into extensive amount of administrative rules and bureaucracy.
**Associated constraints:** The objective of continuous improvement is to reach a state of perfection, which is almost impossible even in production. In projects context, it does have more limitations because of the temporary nature of projects. When a project is one time activity the process will not be repeated again, in such a scenario there is no utility of improving process. The objective in NPD projects is to focus on the quality of deliverable, and improvements in product. In such projects payment is often conditional on quality of product not process. However, in repetitive service projects, where the process is repeated the concept of continuous improvement can endow several benefits.
Lean production is one of the management philosophies that changed the world of manufacturing. Lean was initially originated in Toyota, over time principles and thinking behind Lean production have been transferred to other functions of industries like, supply chain, product development, healthcare, etc. However an application and integration of lean concepts in project management is not widely researched and very little was found in the literature on this topic as mentioned earlier in methodology chapter. The possible reasons for lack of research on this topic can be: first, projects are different from manufacturing processes. Therefore, the direct application of concepts was not possible and transformation of ideas was required. Second, there is a perceived lack of information about what lean concepts can contribute to PM. Third, lean and PM are considered as two different subjects, as lean is believed as related to quality or production and project management is perceived as different from production. Further, in the academic world the subjects of lean and PM are often managed by different scholars located in different divisions. Therefore, the lack of multidisciplinary knowledge and interest may also be a reason for lack of academic debate on this topic.

The first concept in lean is to specify the value of project activities. This concept conceives that project scope consists of two sorts of activities either value adding or non value adding. The removal of all non value adding activities will of course reduce the project scope. Once non value adding will be eliminated from scope all the remaining activities will be purely value adding to the customer, working on purely value adding activities eventually saves resources, time and improves efficiency and effectiveness of project. It is important to comprehend that each concept is applicable to all activities including product related activities and administrative activities (project office). If this is to be followed and the objective is to identify the customer benefit of each activity, then one of the issues that may emerge is that – If the customer would pay for applying/using lean concepts in projects?

The second concept VSM holds two ideas in it. Firstly to identify the value stream, this idea focuses on identifying the set of activities that creates the product. This kind of visualization of the business process identifies all the activities along the value stream, and make it possible to identify non value adding activities and, if activities can be sequenced in a more efficient order, or how some of these activities can be carried out in parallel. Secondly to identify the value stream even outside the
boundaries of own organization as the project scope goes outside the boundaries of own organization. This idea of involving the suppliers into the project organization in a way that supplier makes their own process visible to you is not widely practiced in most of the project organizations. However, Toyota is a practical example, if Toyota has achieved such trust based extensive relations with its suppliers, other project organizations can also do that. However, it demands a different way of thinking for organizational relations, for which the world needs to learn from Toyota. However, the basic reason for Toyota to involve suppliers is their choice of supplier setting. For example in black box supplier setting, design work is given to the supplier, when the design and development task is given to supplier then it is obvious that they might have some non value adding activities during the design and development work, in that case it is obligatory to identify the suppliers value stream and direct all activities toward creating value. Thus, the application of this idea in projects is completely dependent on the selected supplier setting. Further, the use of VSM is always possible for information management tasks. This finding is in agreement with Staats, et al. (2011) finding which showed evidence for using VSM for information management tasks.

The third concept (flow) is about eliminating obstacles to make a continuous flow of value adding activities. This idea is dependent on the presence of obstacles, in case that there are no obstacles then the work is already flowing. Obstacles can be identified by visualizing the business process. The empirical data shows that companies face obstacles to the flow of value, these obstacles are often in the form of waiting times and queues. The presence of these obstacles consequently delays the project. However, this concept presumes projects running in a sequential approach. Organizations using overlapping approaches may not face the similar obstacles.

The fourth concept (pull) focuses on creating a continuous flow of value by pulling the work from preceding team, this idea seems to be coming from lean but it was first introduced by Dr Edward Deming in his seminars on quality where he argued that every succeeding team should behave as an internal customer toward the preceding team. This also shows that lean is not completely innovated in Toyota but is a collection of ideas from different sources. However, Toyota is the first one to practice them properly. This pull approach seems to have great benefits, for example if the specifications of a deliverable or activity will be specified by succeeding team there will be very few chances of generating, developing, creating, supplying something that do not meet the requirements. This concept is not widely used in projects, with the exception of construction industry. However, the empirical data shows that project teams use both push and pull approach. Seemingly a
successful implementation of this idea may eliminate plenty of waste and extra iterations from projects.

The fifth concept (continuous improvement) diverts the attention toward continuously improving the products and processes. In reality project organizations understand the importance of improvements, but often project processes are improved and then left for years to be used, the underlying reason of huge changes and afterwards silence is that most of such changes come from top management and the teams just follow them. However, LPM suggests for continuous incremental improvements at the bottom level, thus it should be the project team members that identify problems in process and generate solutions for them. Implementation of such idea where the organization maintains a system of improvements in itself can bring huge benefits for project organizations.

A concept and state based approach in this thesis identified nature and behavior of lean concepts, which assisted in the analysis and integration of concepts. This systematic analysis and results of study show that lean concepts are not completely new. These concepts are similar to several concepts in project management body of knowledge for example the first concept of LPM crop the project scope and argue to do the ‘right things’ (purely value adding), the concept of Lagomizing also crop the scope and call it ‘just right’. The concept of identifying value stream is similar to identification of business process. Thus, these concepts cannot be called completely new for project management. They somehow exist in project management literature with different names. However, the empirical analysis shows that they are not always and completely practiced in projects. Project Management Institutes Pulse of the Profession report 2011, mentioned that LPM is used always or often by 29% globally (PMI’s, 2011). This means that many of these ideas are taking attention among the project management practitioners.

In light of analysis of lean concept, a tentative definition of LPM can be:

“Lean Project Management is the application of Lean Thinking in Project management, it tends to focus project management toward creating value and preventing waste, LPM improves project productivity”.

The above suggested definition relatively differs from the previous definition of LPM, provided by Ballard and Howell, (2003) which argues that.

“Projects are temporary production systems. When those systems are structured to deliver the product while maximizing value and
minimizing waste, they are said to be lean projects” (Ballard and Howell, 2003).

Even if projects are not conceived as temporary production systems, lean concepts can still be used in projects. At the same time, some of the findings of the current study: pull, and involvement of downstream teams are consistent with those of Ballard and Howell, (2003). However, their work focuses on project delivery. In contrast this research focuses on projects in general, including planning and delivery.

This research achieves its goal by answering the research questions. The conclusions of this research can be re-investigated, and such re-investigation will of course validate the results of this research. Further, the integration and analysis of concepts in this thesis is to be seen as a tentative framework intended to stimulate further discussion about using lean concepts in the field of project management.
Chapter: Conclusion

In this chapter the main findings from the analysis will be summarized with the intention of providing a clear answer to the research questions.

Answering the Research Questions

The research question 1, that the study has been aiming to answer is:

Question 1: What concepts of lean thinking are relevant for PM?

The results of this study indicate that all concepts of lean thinking are relevant to PM in specific kinds of projects. A possible explanation for this might be that projects are different from each other and some of the projects (e.g. construction), are very much similar to production processes. This makes many of the production concepts relevant in such projects. Therefore, the kind of project determines the relevance of lean concepts in PM. The lean concepts, therefore, need to be interpreted with caution for their use in PM. In order to give a clear and structured answer, the key findings from the research study will be presented, going through each concept.

Specify Value

The concept of specify value needs to be interpreted in its original meaning when it is applied to projects; anything that does not create value to the customer should be considered as waste, and therefore should be eliminated. This concept is relevant to PM. Several concrete measures can be taken to prevent waste in projects. However, it might be difficult to fully practice this concept in projects where the goal and solution are not clearly defined. Furthermore, processes in some projects are similar to production (e.g. in construction and services). Thus, the types of wastes identified in production may also be relevant in these projects. The identification of all types of wastes in projects cannot be determined in general, as it will depend on type of project.

Identifying Value Stream

The original meaning of this concept is to visualize the process. VSM is used to identify the sequence of activities in a process and to recheck if all activities are value adding. The use of this concept is contingent on the presence of a clear project process. For this reason, this concept seems to be of less relevance to PM in general. There are several possible explanations for this. A possible explanation for this is
the temporary and non-repetitive nature of project work; in projects processes are not repeated hundreds or thousands of times as in manufacturing. Another possible explanation for this can be elaborated with an example of NPD projects. The VSM is intended to map the flow in a process. The direction of flow in manufacturing is: Unidirectional, thus VSM can be used easily. In contrast the direction of flow in NPD projects is: Multidirectional, in loops and iterations, thus, when the direction of flow is multidirectional and processes are highly networked, in such kinds of projects VSM may not be relevant to such projects. However, VSM still can be used in projects with repetitive processes for example in (services, construction) projects and/or for information management tasks. Therefore, a number of different factors determine the relevance of using VSM in PM.

**Flow**

The concept of flow is completely relevant to all kinds of projects ranging from construction to NPD projects. Flow in manufacturing is intended to create the flow of materials and products. This can be same in many projects where materials are used. However in projects where there are no materials involved, the concept will be applicable to the project process. Thereafter, the objective is to create flow of process; which may include the flow of materials or information. Further the flow in projects is affected by obstacles. In projects the obstacles can be in many different kinds (handovers, delays, stage gates, bottlenecks, lack or resources etc). Even though that the concept with respect to its primary nature is relevant to PM, still there can be constraints with using this concept in projects. For example the processes in NPD projects are: highly networked; sequential and parallel; uncertain and involve risk; highly iterative. These complicated processes may add constraints to using this concept in creating flow of processes in complex NPD projects. Thus, the concept is relevant but still cannot be extrapolated to all kinds of projects.

**Pull**

The concept of pull is intended to pull the materials and products whenever required and in whatever quantity. On the question of using this concept in projects, this tentative study found that CPM and PERT are push-based by nature. Thus, efforts need to be directed to successfully apply the pull approach in those projects. As mentioned earlier in analysis, attempts are made by scholars in construction industry to use a pull-based approach, using a Last Planner System. Further, the interesting findings from the study informed that projects teams structured using an overlapping approach also pull the work from proceeding team. This is further supported by the unanticipated finding from empirical data which
showed that teams do pull the work. Further it is identified that the services projects are pull-based by nature. Thus, this concept is verified for its use in services projects and efforts do not have to be directed to apply the concept in such projects.

**Continuous Improvement**

The concept of continuous improvement is an essential part of lean project management. Similar to production, a higher focus should be maintained on reducing the wastes – in order to improve the efficiency of project processes. Standardization, transparency, and employee’s involvement are crucial for continuous improvements. Project processes and tasks are difficult to control, analyze and improve by those who do not themselves participate in carrying out project tasks. Thus, project team’s engagement and commitment is important to obtain substantial measures.

**Question 2: How can concepts of lean thinking improve project productivity?**

The second question in this research was to determine the effect of lean concepts on productivity of projects. As mentioned earlier in the literature review; productivity is known to be a function of efficiency and effectiveness. Effectiveness is “doing right things” and Efficiency is “doing things in right way”. Effectiveness is concerned with end and Efficiency is concerned with means. They are interrelated to each other.

This study has shown that the concept specify value – limit the project scope to what is required to customer. According to Berggren, et al. (2008); Gupta and Wilemon, (1990) this increases the project effectiveness, at the same time less amount of scope is believed to increase the project efficiency (Berggren, et al. 2008; Iansiti, 1995; Gupta and Wilemon, 1990).

The second concept value stream mapping – eliminates the non value adding activities, and non value adding time, this increase the effectiveness, further the graphical visualization of activities increase the likelihood to sequence activities in more efficient manner, this effect the efficiency of project.

The concept of flow and pull – eliminates the obstacles and waiting times to create flow of work. This increases the probability to complete the project in time while using fewer resources, thus increasing efficiency (Shenhar, et al. 1997; Berggren, et al. 2008). Further, the pull approach also affects the effectiveness of project. This is because when content of deliverable is defined by succeeding team this mean that
the internal customer fixes the scope of activity this of course increases the effectiveness.

This research has shown that the concept of continuous improvement is intended to continuously improve the project processes. The lean concepts interact with each other in a virtuous circle, thus improvements in any of these lead toward improvement in the others. Therefore, continuous improvement affects both efficiency and effectiveness.

Taken together, these findings suggest that the lean concepts minimize wastes and the use of resources (peoples, materials, money, energy, provisions, communication, time, etc). In general, therefore, it seems that lean concepts keep higher focus on increasing efficiency. As an implication of higher efficiency, is the possibility that a higher focus on efficiency in some projects may reduce the effectiveness of final product. A reasonable approach to tackle this issue could be to take into account the type of project while integrating lean. Thus, caution must be applied, as the concepts may not be directly useful in all kinds of projects.

**A theoretical view point on the findings**

By using the concepts of lean thinking to determine their relevance for project management, it is interesting to note that all five concepts of lean are relevant to PM in specific states (kinds of projects). The activities in projects are similar as well as different from production activities – this is because of the different kinds of projects. The use of some concepts seems to be a challenge for their use in PM, whereas, some concepts of lean are found to be similar to concepts from within the PM body of knowledge. This means that some concepts are already integrated in PM. However, they are not always practiced together in a consistent way. A greater degree of understanding and interpretation of each concept is needed when applying lean in projects. It can be concluded that projects with a production nature (e.g. construction, services, administration) are very suitable for the introduction of lean concepts. For example, the administrative projects, being of a back office nature, as in financial departments the reports are only produced when requested by headquarters. At the same time some of the concepts have to be interpreted with caution when they are used in project management. Some of the findings of the current study are consistent with those of Ballard and Howell (2003) and Staats, et al. (2011), who also have examined how the concepts of lean can be used within projects.
An empirical viewpoint on the findings

The relevance of lean concepts is partially supported by the empirical findings. However, it is identified that the latest project management practices use several alternative ways that substitute the lean concepts. A serious weakness with this argument, however, is that research analysis and arguments of this study relies too heavily on qualitative analysis. A quantitative analysis is of course required to identify the actual benefits.

Managerial Implications

Returning to the problem description posed at the beginning of this study. The problem with projects is that, projects are behind schedule, over budget and do not deliver the required quality. The purpose of study was not exactly to resolve these problems. However, the purpose was to explore the possibilities of integrating lean and project management to identify if some of the problems of projects can be resolved by using lean concepts. The findings of research enhanced our understanding of lean and PM practices. It is now possible to state some managerial implications of lean concepts in project organizations. These are not directly related to specific concept in the analysis. But rather ideas and aspects that need to be kept in mind in order to comprehensively design the management activities to apply the lean concepts in a project organization.

In general, therefore, it seems that, application of lean ideas in project organizations can create a big impact on projects. The lean concepts can reduce the use of resources and time which are two measures of project success. In order to successfully apply these concepts, both lean and type of projects undertaken by an organization should be taken into account. Furthermore, in general, it seems that the successful application of lean in project organizations needs patience and long term commitment by Top management. Lean is a way of thinking. Unless employees adopt the new way of thinking lean will not be attained. There is, therefore, a definite need to make sure that all employees are engaged and involved in the process of introducing lean. One possible way to ensure that everyone is involved and determined to adjust themselves to the new way of thinking /working according to lean concepts can be to start to introduce lean in a step by step fashion. By following such cautious way, it might be easier to analyze the progress and benefits. There are a number of important changes which need to be made in organizations way of working. Thus, a lot of effort and time has to be devoted to planning and educating employees for the implementation to succeed. Furthermore, it is important to be aware of the fact that large investment of time, effort and
resources will have to be made in order to be successfully being able to introduce and apply the lean concepts. The study did not evaluate a real case where lean is practiced completely, thus it cannot be said that how much benefit can be gained by introducing lean. However, it seems that the gains from successful application of lean are likely to eventually outweigh the initial investments that had to be made.

**Suggestions for Future Research:**

This study set out with the aim of exploring the possibilities to integrate lean concepts in PM, and how the concepts of lean can improve the productivity of projects. The projects that are studied in this research are on a broader level. To really understand the true relevance at specific level, more specific projects have to be studied. If the debate is to be moved forward, a better interpretation of concepts needs to be developed. Further quantitative investigations are needed to estimate the actual effect of lean concepts on organizational productivity. It would be interesting to see a development of how lean concepts are used within projects in future research, and eventually be able to form specific concepts of lean project management that can be generalized to the entirety of project management.


Institution; in Eisenhardt and Tabrizi., 1995.

Cordero, Rene., 1991. Managing for speed to avoid product obsolescence: A survey of

Transferability, and the Limitations of "Lean" Production. *MIT Symposium on
"Managing Technology: The Role of Asia in the 21st Century,"* Hong Kong, 2-3 July

Delbridge, R., Lowe, J., Oliver, N., 2000. Shop floor responsibilities under lean team


innovation in the global computer industry. *Administrative Science Quarterly*,
40(1), pp. 84-110.


of Project Management processes, Metrics, and Benchmarking process models.
Ph.D. Norwegian University of Science and Technology.

Engwall, M., 2003. No Project is an island: linking projects to history and context,

development projects. *Communications of the Association for Computing

anatomy of ambition*. Cambridge: Cambridge University Press; cited in Cicmil and

Flyvbjerg, B., Holm, M. S., Buhl, S., 2002. Understanding costs in public works
projects·Error or lie?, *Journal of American Planning Association*, 68, pp. 279-295;


Appendices

Appendix A:

Interview Questions

Background

- What is your position at company, work assignments?
- For how long you have been working in this field?
- What experiences you have gained from projects?

General Project management

- How do you describe project management as a work method?
- Who decide the project delivery date?
- Who is responsible to evaluate and control the project? And
- How do you evaluate a project during development phases?
- Do you see project team members having any common vision?
- How activities are performed in projects?
  - As soon as possible?

Specify Value

- Who specify the value of a project? (Customer focused)
- How you determine what customer is willing to pay for?
- What is value adding in a project?
- What is non value adding in a project? and
  - How do you measure?
- How do you differentiate among value and waste?
- What all, you measure about projects? (Hours consumed? Number of iterations, Etc?)
  - Do you use any special tools or methods for measuring?
- How you strip waste from project team’s daily activities?
- What is your opinion about activates, e.g. inspections, status meetings, approval cycles, etc. are they value adding from customer’s perspective?
- In throw over the wall setup, how do you see the behavior of the receiver?

Value stream

- How activities are sequenced in projects?
- Who determines when a specific task should end?
- Do you map the value stream from first supplier to the customer? (Partners and suppliers)
- How decisions are made? Sequentially by specialists – and thrown over the wall?
- Do companies share information of in house process with partners and suppliers?

**Flow**

- How work flow is created in projects?
- How project team members come to know what process is performed before and after their task?
- How do you see the stage gate or executive gate meetings and approval cycles? Are they waste?
- How waiting times are eliminated in project management?
- When each task is finished how it is determined that who is the next receiver of this deliverable?
- Do you see clarity of roles in project teams?
- How the project team members come to know about the project progress?

**Pull**

- Do you push or pull the work during project? How and why?
- How project managers deal with waiting times in between deliverables?

**Perfection**

- How quality is measured in projects? And
  - Who measure quality?
- How do project teams work to improve the process?
- Do you see project teams working with continuous improvement? How?
## Appendix B: 7 Schools of PM, Highly cited papers

<table>
<thead>
<tr>
<th>School</th>
<th>No of papers in data set</th>
<th>Examples of highly cited contributions (based on citation analysis, presented in chronological order)</th>
<th>Keywords from paper summaries</th>
<th>Base discipline/ key influences</th>
</tr>
</thead>
</table>

Table 10-1: Schools of project management contributions and keywords (Söderlund, 2010)
Appendix C: Symbols of Lean VSM

Typical VSM symbols

Customer or Supplier Plant

Trucking and/or Logistics

Lightening Bolt of Opportunity

People Operator

Electronic Information Flow

Inventory

Push of Production

Supplier Kanban "Full"

5 Days

Tombstone Inventory Waste

Information Flow

Timeline of Value-Added Activities Vs. Non-Value-Added Activities

Typical VSM symbols
Current State Map – 20 Days Lead-Time

Value Added Time as a % of Total Time in Plant = \( \frac{505 \text{ Minutes}}{20 \text{ Days} \times 24 \text{ Hours/Day} \times 60 \text{ Minutes/Hour}} \times 100 = 2.1\% \)

Date: 31/01/2003

Current state VSM
Future State Map – "Green Cell Team" – 5 Days or Less Lead-Time

Green Cell Team, One Part = 0.75 Hours Plus Assembly


day

Value Added Time as a % of Total Time in Plant = \frac{550 \text{ Minutes}}{(24 \text{ Hours/Day})(80 \text{ Minutes/ Hour}) + 750 \text{ Min}} = 36.8\%

Manager: 3/01/2003 - Release Date

Future state VSM