DOCTORAL THESIS

On Value and Waste

THE word VALUE, it is to be obſerved, has two different meanings, and ſometimes expreſſes the utility of ſome particular object, and ſometimes the power of purchaſing other goods which the poſſeſſion of that object conveys. The one may be called, "value in uſe;" the other, "value in exchange." The things which have the greateſt value in uſe have frequently little or no value in exchange; and, on the contrary, thoſe which have the greateſt value in exchange have frequently little or no value in uſe. Nothing is more uſeful than water: but it will purchaſe ſcarce any thing; ſcarce any thing can be had in exchange for it. A diamond, on the contrary, has ſcarce any value in uſe; but a very great quantity of other goods may frequently be had in exchange for it.

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DOCTORAL THESIS

ON VALUE AND WASTE

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Perfection, of a kind, was what he was after,

W. H. Auden

Unstable condition. A symptom of life

Lee, Lifeson, Peart

An nescis, mi fili, quantilla prudentia mundus regatur?

Axel Oxenstierna

On nous ment comme on respire

Lazuli

In walks just another client, Crazed and bored, he's got the morning look

Dubois, Mitchell

Time has no respect for man's vanity

Tony Clarkin

Blah blah blah blah blah

Geoff Mann

Blah!

Alex Lifeson

Abstract

Value and waste are concepts that are used in improvement projects. In lean the concepts are fairly simple. Reduce the waste and the value has increased. However, value is both multidimensional and differs over time. If the concepts value and waste are to be used, the concepts must be clearly defined and measured. Otherwise, value can be reduced for the customer/user and the cost increased for the producer/seller. The purpose in this thesis is to investigate how value and waste are perceived by different stakeholders, how value and waste are related, and how value and waste are measured.

The focus of the study is the improvement of production and services. The study does not investigate the product/service development. The conclusions are based on a number of cases and research from different fields such as resource-based view and marketing.

The study use mix of qualitative and quantitative methods. Measures of forecasting accuracy and their relations where explored with different statistical tools in order to understand the influence of measures and dimensions. The view of value concerning energy efficiency was examined in a statistical analysis of a survey concerning stakeholders' view of a specific value, energy efficiency, as well as their influence on the value creation process. A multiple qualitative case study explores the relation between value and waste in different settings and the consequences of waste focus. The findings in the multiple case study are confirmed and elaborated further by an additional case study, both qualitative and quantitative, of value stream mapping.

Value and waste are analysed with the use of order winners and qualifiers. Also, a model to clarify the consequences of mixing value creation and value exchange for customer/user and producer/seller have been defined and used in the analysis.

Depending on the stakeholder there is a difference between whether value can be regarded as a use value, exchange value or both. Even if exchange value is related to a specific moment in time, use value is not. The view of value differs among stakeholders which increase the risk of sub-optimisation in production.

Value and waste have multi-dimensional properties and there are links between the different dimensions. The relationships depend upon the situation in question. The lean seven types of waste are not independent dimensions. Also, the concept of waste as anti-value is too simplistic. In all cases studied the focus is on waste, not value. Also, it is often the symptoms of waste that are of interest in measures taken not the root causes. Reduction of waste without considering the value can create new waste. Since waste is a dependent variable, it should not be measured without considering value. Another complication is that value and waste often occurs at different points in time and in different settings.

Single measures are sensitive to its environment. Several measures are more robust. Measures distort and influence the perception and thereby the decision of the studied phenomena. Also, the notion of value and waste becomes harder to define and trace as the resolution and detailing of the studied process increases.

Abstract in Swedish

Värde och slöseri är koncept som används i förbättringsprojekt. I lean framställs koncepten som tämligen enkla. Minska slöseriet och värdet ökar. Men värde är multidimensionellt och komplext vilket kräver en förståelse av begreppet värde. Om värde och slöseri ska kunna användas framgångsrikt måste koncepten/begreppen vara definierade och mätbara. Annars kan värdet minska för kunden/användaren och kostnaderna öka för producenten/säljaren. Syftet med avhandlingen är att undersöka hur värde och slöseri uppfattas av olika intressenter, hur värde och slöseri är relaterade och hur värde och slöseri kan mätas.

Fokus är på förbättringar av produktionprocesser (service och varor) och kopplingar till värde och slöseri, inte utveckling av produkt/service. Slutsatserna är baserade på ett antal fall med stöd i olika forskningsområden som resource-based view och marknadsföring.

Studien använder sig av kvalitativa och kvantitativa metoder. Mått för prognosnoggrannhet och deras relationer undersöktes med olika statistiska verktyg för att förstå influensen av mått och dimensioner. Därefter undersöktes synen på värdet kring energieffektivitet hos olika intressenter i Sverige och Tyskland. En multipel kvalitativ fallstudie undersökte förhållanden mellan värde och slöseri i olika miljöer samt konsekvenserna av slöserifokus. Resultaten bekräftades och utvecklades i en fallstudie av en värdeflödeskartläggning som kombinerade kvalitativa och kvantitativa metoder. Dessutom gjordes en litteraturstudie och analys som komplement och utveckling till artiklarna inom värde, slöseri, intressenter och angränsande områden.

Värde och slöseri analyseras med hjälp av ordervinnare och orderkvalificerare. Dessutom föreslås en modell för att tydliggöra konsekvenserna av att blanda värdeskapande och värdefångande åtgärder för användare och producent.

Beroende på intressent är det en skillnad huruvida värdet kan anses vara bruksvärde, utbytesvärde, eller båda. Utbytesvärde är relaterat till en viss tidpunkt emedan bruksvärde har ett större tidsspann. Värdesynen skiljer sig mellan olika intressenter vilket ökar risken för suboptimering i en produktion.

Värde och slöseri har multidimensionella egenskaper som är relaterade. Dessa relationer är situationsberoende. De sju varianterna av slöseri som används inom lean är inte oberoende och att se slöseri som anti-värde är för enkelt. I de studerade fallen är fokus på slöseri och orsakerna till slöseri utreds sällan. Att reducera det som anses vara slöseri, utan att ta hänsyn till värde, kan leda till nya former av slöseri. Eftersom slöseri är den beroende variabeln bör värde definieras före slöseri. Ytterligare en komplikation är att värde och slöseri ofta uppträder vid olika tidpunkter och i olika miljöer.

Flera typer av mått bör användas. Enskilda mått är känsliga. Flera mått är mer robusta. Mått influerar uppfattningen och därmed besluten kring ett visst fenomen. Exempelvis bör slöseri kompletteras med kostnad. I och med att upplösningen i en process ökar blir värde och slöseri svårare att definiera och mäta.

Contents

Preface

?

In the beginning confusion prevails.

The compass needle's desperate search for the magnetic north. The map's with the only words: "Terra incognita". And a mountain is reaching beyond the sky.

!

Somehow things find their directions. Maybe the endless Balthazar walks do work! The compass needle stops spinning (perhaps still tremble a bit). Hesitant lines starts to replace Terra incognita.

!

...and with a limited knowledge, the possibilities are endless.

A guitarist in Eagles that was convinced of the unearthly genius with fingers beyond magic. These fingers could play things any virtuoso would have dubbed. After years of practice the eagle got it. He could play what unearthly genius did years ago. Later, the eagle actually met the unearthly genius and the unearthly genius told him the secret: I dubbed it!

A Canadian drummer, with a surname that seems to be hard to pronounce even it is not spelled "Brzezicki", learned to play a part unknowing of that it was originally recorded with the tape slowed down.

A bass player practices to achieve the speed and clarity of another bass player produced by Ken Scott. Decades later Ken revealed so much more: It was dubbed with the tape slowed down.

Then, in a moment slightly longer than the Planck epoch, one detail, hardly visible in a microscope, grows larger than Mount Everest.

The compass needle spins and the lines in the map fade.

Back to the drawing board.

Still, of all the methods, approaches, theories this is probably the most important one:

?

Special thanks to (in no particular order): Anders Vennström, Jutta Schade, Ove Lagerqvist, Rickard Garvare, Thomas Olofsson, The crew at HIS, The crew at LTU, Diana Chroonéer (For the hedgehog care), Håkan Wallström (For a call beyond duty, else smthing wou mght be missing) Terese Lantto (Who still swears by: “Matematik kan inte användas, bara missförstås”, a statement which still does not lend itself to the English tongue.)

Somewhere in time and place

Peter Wallström

(The picture on the cover is from the original edition of An inquiry into the nature and causes of the wealth of nations by Adam Smith.)

Abbreviations

ASM – The American system of manufacturing

CFE – Cumulated forecast error

EQ - Equation

JIT – Just-in-time

MACs – Mean absolute change scaled

MAD – Mean absolute deviation

MSE – Mean squared error

NHTSA - National Highway Traffic Safety Administration

NOS – Number of stockouts

PCA – Principal component analysis

PDP – Product delivery process

PIS – Periods in stock

RBV – Resource-based view

5S's – Sort – seiri, Set – seiton, Shine – seiso, Standardise – seiketsu, and Sustain – shitsuke

SMED – Single-digit Minute Exchange of Die

TPS – Toyota production system

TQM – Total quality management

VSM – Value stream mapping…

1 INTRODUCTION

This chapter provides background and motivation for the thesis. The purpose, aim, and research questions are introduced. The chapter ends with the outline of the thesis and the personal contributions.

1.1 Background

In March 2014, the US Justice Department and Toyota reached a settlement of $1.2 billion. The charge was that Toyota defrauded consumers in the autumn of 2009 and early 2010 by issuing misleading statements about safety issues in Toyota and Lexus vehicle. Toyota was also misleading US authorities concerning the same issue, unintended acceleration by pedal entrapment. The unintended acceleration had two causes, entrapment of the gas pedal by an all-weather floor mat or a sticky gas pedal. In 2007 reports alleging unintended acceleration in Toyota and Lexus vehicles led to an investigation by the National Highway Traffic Safety Administration (NHTSA). NHTSA identified several Toyota and Lexus models that could have problems with unintended acceleration and should therefore be recalled. While denying the need to recall any of its vehicles to NHTSA, Toyota conducted an internal investigation with similar conclusions as NHTSA. Toyota's results were never shared with NHTSA instead the company negotiated a limited recall of 55000 mats and no vehicles. Within Toyota this was regarded as a major victory since it saved "$100 million + in unnecessary costs". Shortly after the announced mat recall, Toyota engineers revised the internal design guidelines to reduce the risk of unintended acceleration. However, Toyota decided that the revised guidelines would be applied only for the models receiving a "full model redesign" which a model underwent approximately every three to five years. In 2009 several new vehicles were produced and sold without the improved guidelines from

2007. Among these vehicles were, Lexus ES350, a model involved in an accident in August 2009 that killed a family of four. The accident was caused by the unintended acceleration (floor-mat entrapment). In the beginning of October the same year, Toyota engineers issued a design chance concerning the “sticky” gas pedal to the supplier in order to prevent the risk of unintended acceleration in the US market. Internally this was described as an “urgent” measure and a “major” change where inventory units of the old pedal should be scrapped. In the end of October, Toyota’s recall decision group cancelled the design change instruction of the “sticky” gas pedal in the United States. No information of the cancellation was allowed to be in writing. The recall of the change was to hinder NHTSA from learning about the “sticky” pedal problem. In the autumn of 2009 Toyota issued misleading statements, to both the public and authorities stating that the root cause had been addressed regarding the unintended acceleration. (e.g http://www.justice.gov/opa/pr/2014/March/14-ag-286.html, see "References on the web, background")

This illustrates the problem concerning waste and value. It is not an easy task to determine, in isolation, whether something is waste or not. Especially, if the focus is on a single measure (cost) at a single point in time. The saving that was made by the limited recall was significantly less than the final settlement, not to mention the loss of human life due to lethal accidents that occurred as a result of trying to minimise waste (unnecessary costs).

1.2 The construction industry

Eccles (1981) defines "construction" as "the erection, maintenance, and repair of immobile structures, the demolition of existing structures, and land development". There is a strong focus in construction on individual projects and on individual transaction needs which favours a narrow perspective, both in time and scope (Dubois and Gadde, 2000, 2002b). The uncertainty and ambiguity is a characteristic of construction projects which is compounded by the fragmentation of the architecture-engineering-construction supply chains (Gil, 2009). Traditional contracts do not support cooperation in the same degree as opportunistic behaviour (Kadefors, 2004). Construction has a high degree of outsourcing and the level has increased substantially over the years in the Swedish construction industry (Dubois and Gadde, 2002b): "Purchased materials and services account for about 75% of total costs in these firms".

According to Segerstedt and Olofsson (2010), the market volatility in housing is larger than in other manufacturing industries, see figure 1.1.

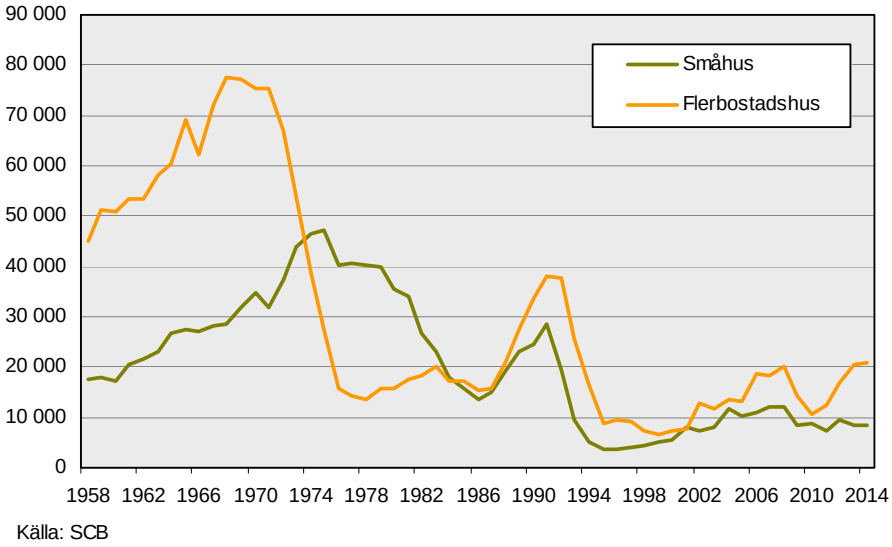

Figure 1.1: Started number of flats in apartment blocks (Flerbostadshus) and detached single houses (Småhus) in Sweden from 1950 to 2014 (source: Statistics Sweden).

Over the time period 1950-2014 three peaks occurred for both flats in apartment blocks and detached single houses. In each case the build up to the peak was slower compared with the rapid decline, which is quite steep, especially for flats in apartment blocks. This implies that the ability of fast downsizing of production is more important than to be able to increase the production capacity fast. One solution to minimise the risk with big downshifts in demand, is to rent the production equipment.

The building price has increased over the years, see figure 1.2. At the same time the median income increased by slightly more than 20 percent between 2000 and 2012 while the building price index with deduction for allowances and CPI increased 70 percent (multi-dwelling building) and 53 percent (collectively built one- or two-dwelling buildings). In Sweden there is a great need for dwellings in different price segments. A complication is the construction industry's ability to offer reasonable priced dwelling and a capacity to meet the needs.

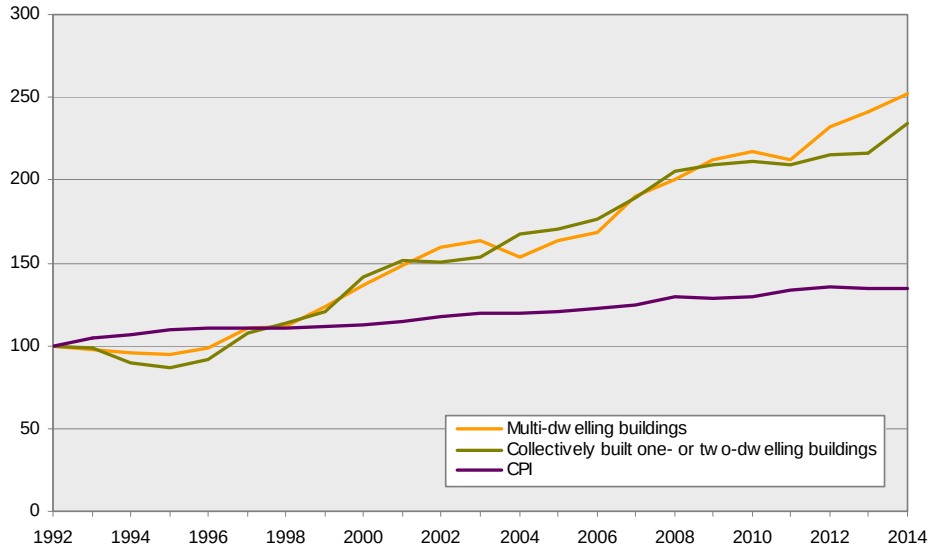

Figure 1.2: Building price index with deduction for allowances and CPI (Consumer price index). Note that the allowences vary between the years which contribute to variations of the Building price index (source: Statistics Sweden).

According to Statistics Sweden the Building price index: "illustrates the development of the prices for newly constructed dwellings of equal value. The index is based on the same data as the statistics on construction costs. To ensure comparability the data is adjusted for differences in quality and also for regional distribution."

The construction industry has for a long time been suffering from both low productivity and rising production costs (Vrijhoef and Koskela, 2000). In search of solutions the industry has over time put more attention on the benefits of implementing the concept of lean thinking in construction (Koskela, 1992, Ballard and Howell, 1998). End customer focus is a core element of lean construction (Jorgensen and Emmitt, 2009), and vital for maximising the value for the construction company (Winch, 2006; Jorgensen and Emmitt, 2008).

Jorgensen and Emmitt (2008) however argue that “it is still crucial to address the shortcomings of lean manufacturing and discuss/challenge them in the context of temporary construction projects”, since the concept of value to a specific single end costumer is problematic when considering the built product

in a whole-life context. From a construction context the end customers are multiple and the construction client can seldom represent a single ultimate customer.

A lean approach can lead to increased production orientation whilst reducing customer choice (Green, 1999). Companies that are not involved in the value proposition and not included in the benefits realisation plan (as many contractors are) often start their lean activities on eliminating the "seven wastes", mostly resulting in a site efficiency and a local optimising (Pasquire 2012). Furthermore, an understanding of the customer's perception of value is only useful if this information can be operationalised. Ideally, such an understanding would enable a continuous evolution of operational processes in order to create and deliver value according to customers' needs (Näslund et al., 2006). Silveira (2005) emphasises the need for managers to move away from panaceas and strategy replication, arguing that an awareness of current operational requirements and capabilities is crucial, as is the introduction of initiatives to reinforce links between objectives, markets, products and other firm operations.

According to Fearne and Fowler (2006) lean thinking "seeks to remove or significantly reduce variability in the operating environment". Fearne and Fowler (2006) furthermore argue that the construction sector, driven by cost reduction, rather remove capacity from the system, making it vulnerable to the inherent complexity and uncertainty in which most construction projects operate. Mostly because "Lean" measures generally is at the task level, rather than on the project level, thus a reliable workflow is more critical than individual activity (Miller et al. 2002). For example, whilst robustness (the ability of a system to resist change without adapting its initial stable configuration) is arbitrary for eliminating all waste and to ensure a level schedule (Leanness), it is a key characteristic for companies using market knowledge and virtual corporation to exploit profitable opportunities in a volatile market place (Agility). Similarly "smooth demand/level scheduling" is a key characteristic for leanness and arbitrary for agility (Naylor et al., 1999).

1.3 Value and waste in a lean context

Two of the key concepts in lean are value and waste (cf. Pavnaskar et al., 2003). The main purpose of lean production is manufacturing without any kind of waste (Jasti and Kodali, 2015). Value is the starting point of lean and is defined by the ultimate customer (Womack and Jones, 1996, p. 16). But to define value is difficult since value is a concept consisting of a multitude of

dimensions (Sheth et al., 1991; Hines et al., 2004; Oliver et al., 2007). Grönroos and Voima (2013, p. 134) consider value to be: " ...the most ill-defined and elusive concept in service marketing and management". Van der Haar et al. (2001) identify the conceptual gaps between the desired value and received value, see figure 1.3.

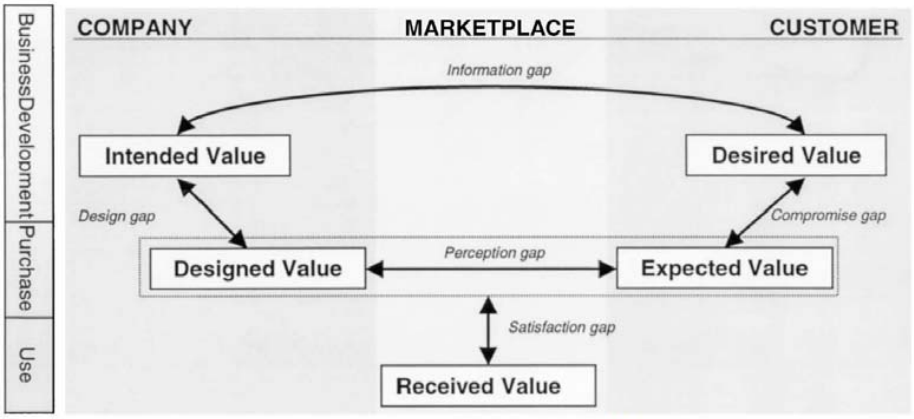

Figure 1.3: The customer value model (from Van der Haar et al., 2001)

With its roots in TPS (Toyota Production System), lean emphasise the reduction and elimination of waste (Benders and van Bijsterveld, 2000; Browning and Heath, 2009; Stone, 2012). While TPS focus on cost related waste issues, lean extend the TPS concept to resources in general. Waste is generally considered to be related to resources, see figure 1.4.

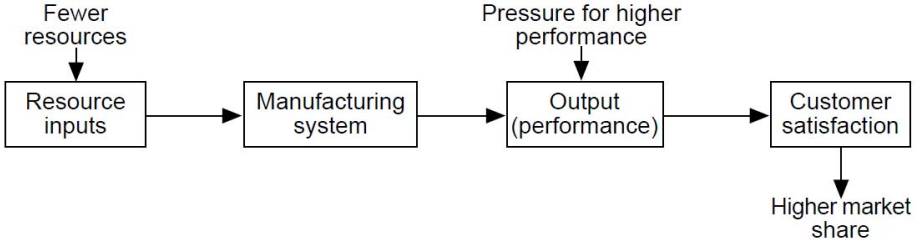

Figure 1.4: The essential elements of lean production where waste is linked to fewer resources (from Katayama and Bennett, 1996)

However Saunders and Preston (1994) and Dalu and Deshmukh (2002) regard waste as an outcome of a process where prerequisites are not fulfilled, see figure 1.5.

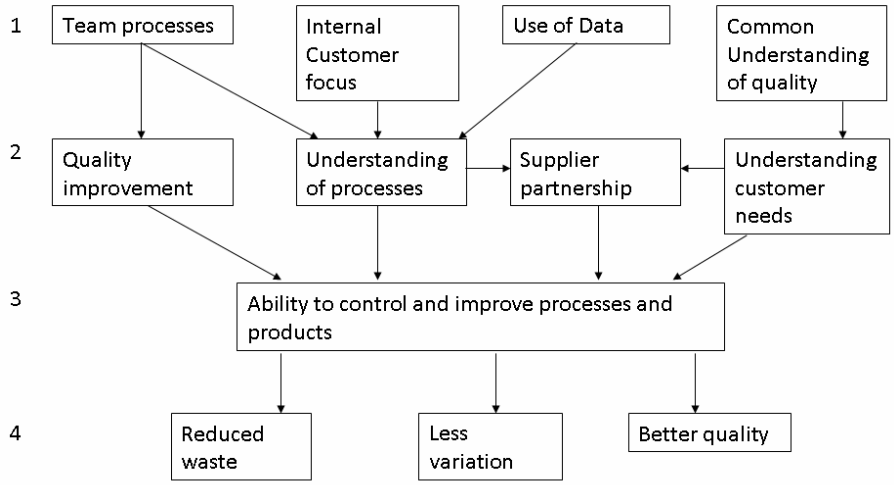

Figure 1.5: The S-P model from Saunders and Preston (1994).

A common definition of waste is based on the seven wastes of TPS or some variant of the seven wastes (e.g Hines and Rich, 1997; Arbulu et al., 2003; Chen et al., 2010). Another definition relates waste to value as "non-value" (e.g. Åhlström and Karlsson, 1996; Braglia et al. 2006; Moyano-Fuentes and Sacristán-Díaz, 2012). The elimination of waste increases customer value by optimising the use of resources (Womack and Jones, 1996; Narasimhan et al., 2006). This is based on assumptions that waste can be isolated and properly defined (Stentoft Arlbjørn and Vagn Freytag, 2013). In practice, it is difficult to separate waste from value in activities (Browning and Heath, 2009).

1.4 Purpose and aim

The purpose of this thesis is to explore how value and waste is perceived, related, and measured, and the consequences of this. The aim is to deepen the understanding of the relations between value and waste.

1.5 Research questions

Research question 1:

How are value and waste perceived by different stakeholders?

The purpose of the first question is to explore the views of different stakeholders regarding the concepts and the influence of value and waste definitions.

Research question 2:

How are value and waste related?

The second question sets out to explore whether the notion of value and waste as opposing dimension (waste is anti-value) are useful in a multidimensional value concept. The relations between value and waste are explored both in a quantitative and qualitative manner.

Research question 3:

How can value and waste be measured?

The answer of the last question is partly based on the result of the first two questions and the additional literature study of marketing, resource-based view and also of Toyota production system and its roots in the production system development starting from the 19th century.

1.6 Focus and limitations

The focus of the empirical studies was the construction industry from the start. These studies have later been supplemented with other types of industries. The empirical study of value and waste is limited to improvement projects in a lean context. The studied cases are all Swedish companies. The focus is on production related issues regarding value and waste, not product development.

The literature study focused on topics related to value, waste and to some degree measuring of forecast errors as a foundation of multidimensional measures. The focus in literature study is wider and incorporates other fields of research than lean.

1.7 Structure of the thesis

Chapter 1 introduces the historical background and motivation of the thesis, purpose, aim, research questions, and the limitations.

Chapter 2 presents the different research methods and the research design that was used. The literature study is also discussed.

Chapter 3 is the frame of reference for this study. The first part concerns the concept of productivity, efficiency and effectiveness. The second part describes different production systems from the early 1800s to the late 1900s. The concept of value is based on literature from mainly three fields: resource based view, marketing and lean related literature.

Chapter 4 concerns an analysis of the third chapter.

Chapter 5 presents summary of each appended paper, including the title of the paper, authors, the research question, keywords, introduction and purpose, method, main content and finally the results and contributions to this thesis.

Chapter 6 presents the answers to the research questions as well as conclusions and a discussion.

1.8 Appended papers

Paper I: Wallström, P., Segerstedt, A., 2010. Evaluation of forecasting error measurements and techniques for intermittent demand. International Journal of Production Economics, 128(2), pp. 625-636.

The data, forecasting techniques and "standard" forecast errors (MAD, MSE, CFE) were given. My contribution is the sampling of the data, additional forecast errors, the literature review, the analysis and the conclusions.

Paper II: Schade, J., Wallström, P., Olofsson, T., Lagerqvist, O., 2013. A comparative study of the design and construction process of energy efficient buildings in Germany and Sweden. Energy Policy, 58, pp. 28–37.

My contribution is the statistical analysis. Also, I have contributed to the literature review (such as the change from macro to micro perspective), discussion and conclusions.

Paper III: Chronéer, D., Wallström, P., Exploring waste and value in a lean context, submitted to International Journal of Business Management.

We have both equal contribution and we are both first authors. Even if we originally contributed with different parts and ideas, the other one has rewritten or added parts to the original idea. It is impossible to pinpoint our individual contributions.

Paper IV: Wallström, P., Vennström, A., Chronéer, D., The difficulties to operationalise value and waste: A case study of Value Stream Mapping, to be submitted (working paper).

My contributions are the analysis of the quantitative data, both raw and processed data, and the construction and analysis of the survey. I have also contributed to the analysis of the report and the literature review.

2 RESEARCH METHODS

This chapter presents the different research methods that were used in the studies to address the research questions. First, an overview of the chosen methods that is followed by a description of the research process. Then the literature study is discussed. This is followed by a description of the data collections and the methods used.

2.1 Research design

Scientific research is based on scientific methods with the objective to produce theoretical contribution according to Lundahl and Skärvad (1999). Dubois and Gadde (2002a, p.555) consider that scientific research should "confront theory with the empirical world". Therefore, the method used cannot be chosen arbitrary. Research design is an action plan to get from a starting point, with a number of initial questions, to an end point with a number of conclusions as a result of the answered questions (Yin, 2003). The design is the logical sequence based on what type of data that is available and the research questions. A part of the research design is to choose a suitable method according to the research questions and the data material that are available or possible to collect. However, the result of the scientific process is not known in advance and therefore it is a question of back and forth between research activities and between observations and theory (Dubois and Gadde, 2002a). Miles and Huberman (1994, p. 5) regard research to be more of a "craft than a slavish adherence to methodological rules".

In a social science context the scientists approach their subject with assumptions regarding the nature of the phenomenon and how to investigate it. Even if the theories adhere to opposing extremes, the scientists are generally

somewhere along the extremes. Two approaches to social sciences are the subjectivist or the objectivist approach, see figure 2.1. (Burell and Morgan, 1979)

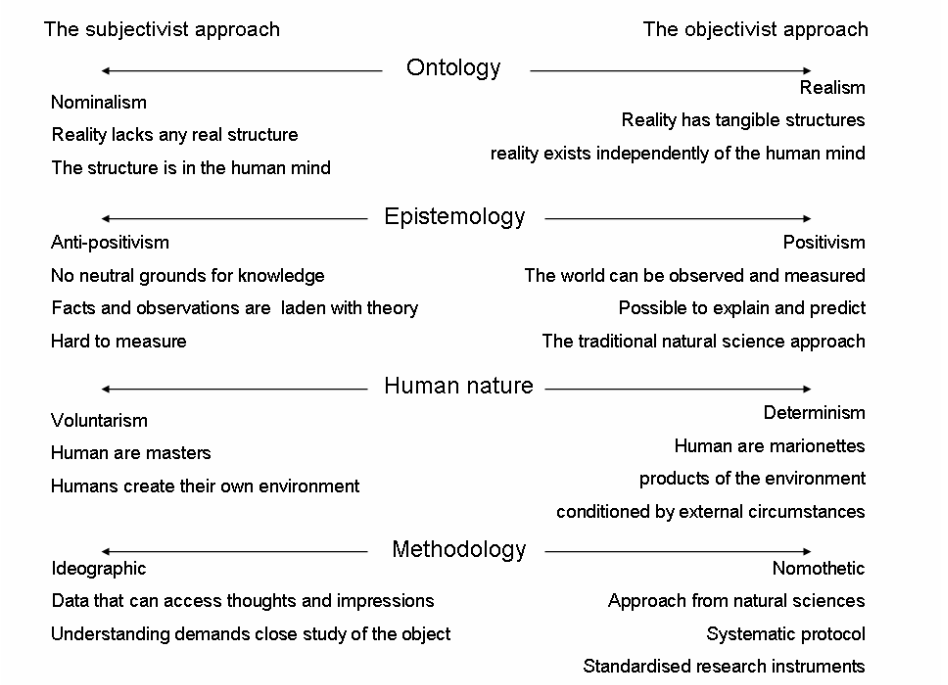

Figure 2.1: The subjective and objective dimensions about the nature of social science, adapted from Burell and Morgan (1979, pp. 1-7).

2.1.1 Chosen research methods

The research methods of choice are dependent of the type of research questions, the required control of behavioural events and whether the focus is on contemporary events or not (Yin, 2003). In this study, the research questions are 'how' questions. According to Yin (2003) five types of research strategies can be used with how' questions: experiment, survey, archival analyses, history, case study.

Table 2.1: Chosen methods for the research questions and the output.

Research questions	Methods	Output
RQ1: How are value and waste perceived by different stakeholders?	Literature study, survey, statistical analysis and case studies	Paper 2, 3, 4 Chapter 3 and 4
RQ2: How are value and waste related?	Literature study, survey, statistical analysis and case studies	Paper 3, 4 Chapter 3 and 4
RQ3: How can value and waste be measured?	Literature study , data sampling, statistical analysis and case studies	Paper 1, 3, 4 Chapter 3 and 4

2.1.2 Research process

The purpose of this thesis is to investigate how value and waste are perceived, related, and measured. However, this was not the purpose in the beginning of the process. Originally, what should have been studied was onsite production in construction in order to develop methods for flexible use of resources for cost-effective production under uncertainty. Part of the uncertainty was considered to be the variation in production time and supply. The main problem proved to be the access to production sites. A single case study took 15 months of conversations before letting me in on the site. With such a long lead time, it would be impossible to complete the originally intended studies within a realistic timeframe. (The paper for this study has been omitted here since it is not related to value and waste)

Parallel to these events two other studies took place, the energy paper (paper II: A comparative study of the design and construction process of energy efficient buildings in Germany and Sweden) and the first value and waste paper (paper III: Exploring waste and value in a lean context). The energy paper involved the stakeholder (and the principal agent) dilemma. In the value and waste paper problems with value and waste relationships had identified after first trying to apply a lean-agile view of the problems in the value and waste paper.

2.2 Literature studies

From the first study for the first paper and to the completion of the dissertation, literature studies were conducted to increase the knowledge and understanding of the different topics with key words depending on the subject (e.g. forecasting accuracy, policy instruments, lean, agile, value, waste). The databases used were; Scopus, Web of Science, Proquest, Google scholar, IEEE

Xplore, and EbscoHost. In addition, the search for new articles was also based on listed references in "used" articles and Google Scholar was used to find newer articles that cited the "used" articles. All articles, from an issue of a journal, where a potential interesting article was published were examined to determine whether there were additional articles of interest in that issue.

To complement the theory in “my own” papers theory been added to the frame of reference and this chapter. The first and second paper have slightly different purposes than the thesis. Therefore has additional theory been added to this chapter (measurements partly but not exclusively linked to paper I) and the frame of reference (principal-agent and “A combination of monetary and non-monetary relations” for the second paper). The third paper, with the four cases and the limit of number of words allowed by the journal, reduced the theoretical part in the paper, the theory is complemented in the frame of reference.

The classification of value and waste related literature (resource-based view, marketing and lean) was based on a combination of journal and topic. The classification by journal (and topic) was mainly used for the marketing related literature. To classify according to topic title keywords and content was used. The general description of value and waste are based, as far as possible, on references not directly linked to resource-based view, marketing and lean.

Generally, the scientific literature is not guaranteed to be without bias. According to Wijnberg (1995) science can be viewed as a competition to successfully market scientific products, the published papers. The "standard" scientific paper becomes a part of the standard scientific theory which all papers are measured against within a specific scientific field. Wijnberg (1995) compares the scientific requirements with consumer preferences. Wijnberg and Gemser (2000) exemplify the peer-selection system used in science and also earlier in art where the system hindered progress in favour of tradition. However, over time the scientific preferences will change and the preferences differ between research fields and journals (Wijnberg, 1995). The recognition of innovation takes time. Watson and Crick’s paper on the double helix was seldom cited in the first 10 years after its publication (Gigerenzer and Marewski, 2014). Furthermore, it is questionable whether a cited paper has been read. According to the study of Simkin and Roychowdhury (2003, cited in Gigerenzer and Marewski, 2014), 20 percent of the cited articles are estimated to actually have been read. With that in mind, the chosen articles are not first and foremost chosen from a citation perspective but whether the articles are relevant or not. Some search engines list the articles according to the number of

citations which may hide articles of interest. When I have not been able to read a reference of interest but the topic is described by another reference, it is noted as "cited in...".

There is a western bias among the available historical literature. Fagerberg (1994) concludes that a general weakness in many historical studies is the lack of concern for other countries other than US. The standardisation was not a phenomenon that exclusively occurred only in Europe and United States. Standardisation in Japanese can be traced to the Tokugawa era (1600-1685) (Bellah, 1985, cited in Wittrock, 2015). Hounshell (1984) describes the lack of incentive to industrialise labour intensive sectors such as furniture. Kyriazidou and Pesendorfer (1999) show that labour-intensive industries such as European bentwood furniture were industrialised, high volume manufacturers. One of the successful manufactures, Thonet In 1891 "Chair No. 14" had sold 7.3 million, a variant is still in production (Kvint, 1998).

There are also statements of judgemental nature. Abernathy et al. (1983) describe the US: industry degrading ability to meet the Japanese industry in the 1970s with words like: "comfortable maturity"; "lulled into complacency"; "exploited by aggressive foreign producers". Sugimori et al. (1977) consider the homogeneous Japanese race as a major part of the success of the Toyota production system. The judgement and classification of heroes and hooligans and lack of problems echoes also in the some of the description of lean and the hagiographic description of key persons in production system development.

The historic descriptions may not always address strengths and weaknesses for a certain phenomenon. Agnew (1993) discusses the problem of accurately historical account when a phenomenon has an iconic status. Both Chandler (1977) and Hounshell (1984) are cautious in claiming moral victories for the American system as some other authors do. Hounshell is even more cautious and do not offer any new theory but tries to bring clarity to a history partly based on myths instead of facts (e.g. the achievements of Eli Whitney). Sometimes there is a moral present. For example, Abernathy et al. (1983) describe the US: industry degrading ability to meet the Japanese industry in the 1970s with words like: "comfortable maturity"; "lulled into complacency"; "exploited by aggressive foreign producers". Sugimori et al. (1977) consider the homogeneous Japanese race as a major part of the success of the Toyota production system. The judgement and classification of heroes and hooligans and lack of problems echoes also in the some of the description of lean and the hagiographic description of key persons in production system development.

Toyota production system (TPS) is chosen to complement lean since lean can be traced to TPS (e.g. Womack et al., 1990; Womack and Jones, 1996; Liker, 2004). The used literature dates from the early 1980s to 2010s. To describe the company in one point in time with several sources was not possible. One problem concerning the literature where TPS is described, is the use of statements without proofs or examples. For example, an article can state that: TPS shows respects for humans. This is more or less the same expression in the cited article. This would work if respect for humans is defined but the original article lacks both a definition or proofs that illustrates the respect for humans.

One of the major books in the literature review concerning TPS is "Den nya japanska produktionsfilosofin" by Shigeo Shingo (Swedish version: 1984). The reason to use the book is partly that it was published before the lean movement could have any influence on the writing. Shigeo Shingo was a consultant and worked with Toyota from 1954 (Shingo, 1984). Shingo's view of TPS is based on his personal experience. While Monden (1998) has a more detailed description of how the system works, Shingo (1984) is more focused on the development and prerequisites for the system as well as some practical issues. Among the practical issues is the recommendation of depart from the "ideal TPS" when necessary conditions are not met. Both books have their emphasis on production rather than value and waste. Waste is present but not as distinct as in many lean articles. Monden (1998) links waste to production fairly early on but has not the word "waste" in the index. Shingo (1984) presents the seven wastes on page 183.

According to Schonberger (2007) Shingo was a co-developer of TPS and the book Shingo released in English in 1981 (*Study of 'Toyota' Production System from Industrial Engineering Viewpoint*) is one of the earliest books on TPS. The Swedish version was translated and adopted to Swedish condition by Lars O. Södahl, at that time a professor in material management at Chalmers. In 1984 the Swedish version was released and with another title compared with the 1981 English edition. Translated to English, the Swedish title is: "The New Japanese Production Philosophy". According to Södahl at that time several other Japanese companies were equally successful as Toyota, hence the title (Shingo, 1984, p. 10).

In the Swedish translation the word for waste is not used. Instead the word "spill" is used which means "remaining scraps" or "leftovers". The Swedish word for waste is "slöseri". This is less neutral then "spill" and implies a mismanage involved and is more of an accusation. Therefore the word “loss” will be used instead of waste, when referring to Shingo. “loss” is more severe than "spill" but it is more neutral than “slöseri” (Norstedts svenska synonym

ordbok 5:e upplagan, 2009; Norsteds svenska ordbok, 2003; Svensk ordbok, 1988).

2.3 Data collection and methods

Different types of data collection was applied in the papers depending on the purpose, see table 2.2.

Table 2.2: Summary of the different types of data collection used in the papers.

Paper	Methods	Type of collection
I	Experiment	Stratified sampling from demand data
II	Case study, statistical analysis	Questionnaire already available
III	Multi-case study, qualitative analysis	Secondary data collected on the behalf of the authors
IV	Case study, statistical analysis, qualitative analysis	Questionnaire, interviews, secondary data already available

2.3.1 The experimental study: forecasting methods and errors

According to Lundahl and Skärvad (1999) an experiment is when the researcher changes the values of the independent variables in order to measure the size of the effect among the dependent variables. The aim of the experiment is to measure the effect for one or more variables. The influence of sources that cannot be controlled must be eliminated. The experiments in paper I consisted of testing different forecasting error measurements and techniques based on real demand data. The parameters that were changed in the experiments were start values for the forecast and forecasting techniques parameters (smoothing constants).

The demand data, for the first paper, had already been collected and tested by a previous PhD student. The findings of the best method for intermittent demand could not be confirmed due to a lack of documentation of how the experiments had been performed. Therefore, the experiments had to start from the beginning by choosing the items to forecast, forecast methods and forecast errors.

The stratified selection was done from a dataset containing 3827 items with more than 44 demand occasions, where some of the demand occasions occurred on the same day. Only items with demand over the whole 18-month period were chosen. A total of 72 items were chosen. The items had periods with demand spanning from 42 to 391 (12 percent to 95 percent of the possible demand periods.

Stratified sampling is a subdivision of the population in homogenous groups called strata before the random sampling takes place from each stratum. The stratified sampling can be made in two ways. First and most common is when each stratum has a sample size that is in proportion to the size of the stratum. (Remenyi et al, 1998)

In the experiments the four forecasting methods had four start values each and each start value had 8 smoothing constants for each of the 72 items, which makes the total number of forecasts equal to 9216. Ten different error measures are used which makes the total number of error data to 92160. Initially, a pre experiment was carried out with 30 items and three different error measures. The whole time series were manually checked which lead to the proposition of additional error measures. The main analysis of 72 items was conducted with different statistical methods (e.g. regression analysis, principal component analysis, binary logistic regression)

2.3.2 Case studies

Case studies were used on two occasions. In both occasions the purpose was to study the use of value and waste in improvement projects and the consequences, see table 2.2 for an overview of the first case study. A case study is appropriate when:

- the problem formulation is not yet established (Ejvegård, 2003).
- the aim of the case study, in the initial stage, is to increase the understanding of the problem rather than being explanatory. (Lekvall and Wahlbin, 2001).
- the intent is to build and extend theories (Eisenhardt, 1989; Meredith, 1998; Yin, 2003; Barratt et al., 2011).
- to explore and better understand phenomena in their real world settings (Meredith, 1998).

The design of the first study can be characterised as a multi-case study (Yin, 2003). The unit of analysis was four organisations' improvement work processes and how they considered waste and value when attempting to improve their processes in a lean context. The overall approach to lean in the individual organisations was not studied. Eisenhardt (1989) concludes that there is no ideal number of cases. She recommends 4 to 10 case studies. With less than 4 cases it becomes difficult to generate theory and more than 10 cases increases the problems of complexity and volume of the data. Eisenhardt (1989: p. 545) recommends using 4 to 10 cases to increase generalisability.

The main data used in the cases consisted of secondary data obtained from these four industrial projects with a specific focus on the results/outcomes of the projects and their conclusions. The projects were selected from ten projects that were conducted in parallel. The reason for choosing these four projects was that the purpose of each project was to rationalise and improve processes with respect to waste and value in a lean context. The rationalisation took place in four different areas and different types of industries: inventory management, production, administration, and distribution.

During the execution of the case study projects, we (the authors of paper III) had supportive roles in the project teams and interacted with one of team members in each case and team. We had access to the collected data during the project time span and could suggest what type of data that would be collected during the entire project. The supportive role consisted of guidance and discussions. There was no direct interaction from our part with the organisations. A reason for the low profile was not to influence the behaviour of the people in the organisations in the cases since the outcome of the improvement projects were of interest. Would Stanley Milgram's obedience experiment (Milgram, 1963) have worked if the participants knew the purpose? Each industrial project had duration of 6 to 10 months. For information on the four industrial projects, see table 2.2.

The reports from the four industrial projects were analysed to determine how the recommended improvements were initiated and implemented in practice within each company. The analyses focused on the following areas: the specified purposes of the projects, the consequences of pursuing the purposes, and aspects not considered by the organisations in the rationalisation processes.

Table 2.3: Case data from paper III (Exploring waste and value in a lean context: A critical view). "Customer" is for the production process in focus and "project focus" is from the company's perspective

Case characteristics	**Case**			
	Inventory	**Production**	**Administration**	**Distribution**
Size	Large	Medium	Large	Large
Part of a Group	Yes	Yes	Yes	Yes
Employees (business unit)	2000	150-200	1000	2000
Customer	Internal and external	External	Internal	Internal
Degree of Lean	Continuous lean work (> 2 years)	Ongoing lean work (< 2 years)	Continuous lean work (> 5 years)	Initiated the previous year, but not fully implemented
Company location	International	Local	International	International
Competition	International (in Europe)	International (Nordic Countries)	Worldwide	Local
Type of product	Maintenance service	Prefabricated modules	Assembly line production	Constructions
Orientation	Customer-specific	Customer-specific	Mass-customisation	Customer-specific
Project focus	Decrease costs and waste	Decrease the throughput time and WIP	Cost reduction in support processes	Decrease transportation cost
Information collected	6 in-depth interviews, a survey (25) respondents),	6 interviews, observation, measurement of processes	14 interviews, historical data	Historical data of transports and contracts, dialogues with employees within one department.

The second study consisted of a single case where value stream mapping (VSM) (a method to identify value and waste) had been used. The VSM-study consisted of both primary and secondary data. The primary data consisted of a survey that was conducted to establish whether the used value definition in the secondary data was appropriate or not. The secondary data consisted of an Excel-file with observations and comments made during the four week study and the final report of the project.

The VSM-project was analysed with a combination of qualitative and quantitative methods. The analyses focused on the following areas: the specified purpose of the project, the conclusion of the project, and aspects not considered by the organisation. The quantitative methods were basic correlation and regression analysis to mimic what could have been used in the VSM-study. Therefore, the multivariate statistical analysis was abandoned. The use of quantitative methods was also a mean to establish if the conclusions made in the multi- case study could be confirmed.

2.3.3 Surveys

Questionnaire

In one of the surveys my role was to analyse the survey that had been constructed, distributed and collected before I entered the project. This survey investigated how architects and engineers in Sweden and Germany considered energy conservation strategies during the design and construction phases. For a full description of this survey, see paper II and Schade (2013).

The questionnaire consisted of three sections. The first section contained questions regarding the background of the respondent (e.g. age, education etc.). The second section concerned the analysis of the energy performance of buildings in relation to the design and construction process. The third section focused on process and reasons and motives for not carrying out an energy analysis. In the first section, the questions consisted of multiple choice alternatives and possibilities to add options not listed. The second and third section contained binary or multiple choice questions, in the latter case 5-point Likert scales was used.

The reason for using three types of statistical classification tests was that each method has its strengths and weaknesses. The binary logistic regression and the Mann-Whitney test make no distribution assumption. But the binary logistic regression is sensitive to small sample groups and the Mann-Whitney test works best if the distributions have similar appearances and scales. The 2-sample t-test does not require a similar variance between the groups but the

samples should preferably have normal distributions. If all tests were significant for a certain question, the difference between the two groups was considered to be significant.

The second survey was based on what was regarded to be value or waste in the final report by practioners studied the VSM-study. The purpose was to examine whether what was considered value in the final report could be confirmed by people not related to the construction site. The survey contained questions regarding quality, cleaning, timely delivery and some situations where quality and timely delivery could not be met simultaneously. These questions used a 6-point Likert scale plus the alternative "no opinion". The last four questions concerned the relation of what was identified as value-adding work in the VSM-study compared to other types of work. The respondents should determine the relation between value-adding and other types of work. The choices were 10%, 20%, 30%, 40%, "does not matter", and "no opinion". The first version was tested on two respondents who rejected on the use of "value" since they considered the term to only represent the transaction/exchange and not the use. The word "value" and "valuable" was replaced with "important" and the questions were rewritten to fit the change. The survey was distributed in a "snow ball" fashion. This resulted in 47 responses. In some cases an interview was conducted after the survey was completed, to get a better understanding of the thoughts behind the answers. The respondent was not allowed to make changes in the survey after the interview. In one case the respondent had answered the question regarding the cleaning with a "3", not very important or not very unimportant (the alternatives available were 0-5). But for the respondent the cleaning was very important but the person did not believe that a construction company was able to perform the cleaning satisfactory, hence a "3". The Likert scale may not always detect relative positions that can differentiate between the respondents.

The analysis of the second survey was performed based on the binominal distribution. According to Sprent and Smeeton (2001) the distribution is based on the probability of a specific outcome in a fixed number of independent binary trials. In this case, it was unknown when the respondents considered something to be important (of value) or not important. Therefore, several scenarios were tested: only 5 was equal to be important while 4 to 0 was not so important, 4 to 5 important and 3 to 0 not so important, 3 to 5 important and 2 to 0 not so important, and 2 to 5 important and 1 to 0 not so important.

2.4 Reliability and validity

Reliability is the consistency of a measurement or measuring instrument according to Ejvegård (2003). Reliability is a question to what degree the results are possible to repeat (Merrian, 1994). Replications increase the reliability of the findings (Hillebrand et al., 2001). The reliability is affected by the resolution. A high resolution makes it possible to detect small changes including random changes, which will decrease the reliability. If the resolution is decreased, it will increase the reliability since small random changes will not be detected, but this will decrease the usefulness of the results but at the same time it may not reveal differences among subgroups (Lekvall and Wahlbin, 2001). Single item measures are unreliable and are prone to distort (Peter, 1981; John and Benet-Martinez, 2000). The reliability can be reinforced by triangulation, a combination of different methodologies in the study of the same phenomenon (Jick, 1979). By using several methods in statistic test, "within-method" triangulation, the reliability increases. According to Jick (1979) a weakness in one method, must be a strength in another method.

In the research (paper II and IV) several types of statistical test were used to test whether there were differences between groups. Different statistical methods have different set of prerequisites. Binary logistic regression has no assumption of the distribution, linear relations or equal variance, but the model requires at least 10 observations per estimated parameter (Johnson, 1998; Hair et al, 2010). The Mann-Whitney does not require a normal distribution but the test assumes that the samples have similar shape and that they are independent (Sprent and Smeeton, 2001; Argyrous, 2011). 2-sample *t*-test requires that samples must be independent, have normal distributions, and equal variance (Cressie and Whitford, 1986; Moser and Stevens, 1992). In paper II all three tests were applied. However, since there were less than 10 observations in some cases the binary logistic regression was omitted.

Validity is the absence of systematic errors of measure, the measure corresponds to the studied phenomenon (Lundahl and Skärvad, 1999; Yin, 2003). Two types of validity are external and internal validity. External validity concerns the possibility to generalise findings on other data then the data used in the research. If the new data corresponds to the significant characteristics of the original data, a replication should be possible (Yin, 2003). Internal validity is of interest when explanatory or causal studies between a set of variables are performed. The internal validity has been given a great deal of consideration in experimental and quasi-experimental research (Yin, 2003).

Generalisability, external validity, is a problem for both studies in a positivistic tradition and case studies (Meredith, 1998). Multiple cases increase the external validity, generalisability (Meredith, 1998; Barratt, 2011). Meredith (1998) exemplifies this with case studies in different types of industries of the same phenomenon when the researcher suspects that the type of industry is not relevant for the studied phenomenon. Another method is testing the original theory on an alternative population. The use of multiple cases is likely to create more robust and testable theory (Eisenhardt, 1989; Yin, 1994). The number of measurements will affect the possibility to generalise since a single measurement may be distorted from numerous sources (John and Benet-Martinez, 2000).

Instead of statistical generalisability, case studies should be based on theoretical generalisability (Hillebrand et al., 2001). A part of theoretical generalisability is structural similarity (the result of the case study is valid for all identical situations). The result must also show the existence of a causal relationship based on logic reasoning. A logical proof is superior to statistical correlation. The logic approach does not require mathematics since mathematics is a subset of formal logic (Meredith, 1998).

To lessen the potential researcher bias, and increase the reliability, internal and external validity need to be considered (Johnston et al., 1999; Yin, 2003). One possible solution, is the use of multiple researchers (Barrat et al., 2011).

Initially, paper IV focused on measurements issues, not related to value and waste, which complemented one my studies. In the end the study linked to paper IV was omitted. After studying the secondary data of the fourth paper, I considered the secondary data (paper IV) to be a continuation of the third paper (value and waste). However, since I was heavily influenced of the conclusion of the third paper, it was because of Anders Vennström's similar view of the focus of the fourth paper that finalised the focus of the paper.

A third type of validity is construct validity. Establishing the correct operational measures for the concepts being studied must be done in order to achieve construct validity (Yin, 2003). Construct validity means that a measure can assess "the magnitude and direction of (1) all of the characteristics and (2) only the characteristics of the construct it is purported to assess" (Peter, 1981, p. 134). By definition, a construct is not observable and the interpretation of a construct depends on the theory in which the construct is embedded (Peter, 1981). Hence, the theory used by the researcher must be known. A more practical definition of construct validity is whether a measure accurately

reflects the construct intended to measure (John and Benet-Martinez, 2000). According to Peter (1981) a single case study can never establish construct validity.

3 FRAME OF REFERENCE

The main parts of this chapter concerns value and waste. Related topics are presented before the parts of value and waste. The first part describes productivity, efficiency and effectiveness which are measures to describe and evaluate production. Then, some of the production systems that have been used from the early industrialisation to the late 1900s are presented. The focus is on the types of problems the systems were trying to solve and how the problems were solved. The problems of the different eras represent a type of value for the stakeholders. The next part is the applied theory in this case agency theory which explain the possibilities of control and consequences of inability to control between different stakeholders. Finally, value and waste are introduced. .The concept of value is introduced with a general overview before it is separeted into three fields related to operation management: resource based view, marketing and lean related literature. The concept of waste is introduced with a general overview before mainly lean related literature is presented.

3.1 Productivity, efficiency and effectiveness

The ability to allocate resources in an efficient manner to produce goods and services has been and is still of great importance. To decide how to allocate the resources requires information regarding both what is put into a production and what is the outcome (e.g. quantity and quality). At least the inputs and outputs must be defined, measured, and understood to improve the production of goods and/or services.

Adam Smith's *An inquiry into the nature and causes of the wealth of nations* (1776) has been a major influence of the development of the classical

economic theory (Sabel and Zeitlin, 1985). Smith (1776) was concerned with the productive power of labour to increase the output of a production. The solution was the division of labour. Some 200 years after Adam Smith's publication, productivity and efficiency are still relevant. Womack et al. (1990, p. 13) motivated the superiority of the lean production system compared to mass production with smaller amount of resources that the lean system consumed for a certain output. Porter (1990, p. 617) argues: "The central goal of government policy toward the economy is to deploy a nation's resources (labor and capital) with high and rising levels of productivity ... productivity is the root cause of a nation's standard of living.".

Productivity is related to production (Stainer, 1997; Tangen, 2005). According to Stainer (1997, p. 224) "production is concerned with the activity of producing goods or services while productivity relates to the efficient utilisation of inputs". In its simplest form, productivity is a ratio between the consumed resources (input) and the produced goods (output) (Grünberg, 2004; Tangen, 2004), see eq 3.1. The measure is trying to capture how well the resources are put in use for a certain outcome. This makes it possible to trace the influence certain factors have on the productivity (Misterek et al., 1992).

$$\text{Productivity} = \frac{Output}{Input} \tag{3.1}$$

However, even if productivity is a commonly used measure it is difficult to define and use since it is an ambiguous term with numerous variations and dimensions (Cox, 1948; Tangen, 2005; Pekuri et al., 2011). Production has generally several types of input and the output can also have several types which complicate the measurements and the calculations (Tangen, 2005), see Figure 3.1. The productivity ranging from total productivity (every input and output dimension), that is the most complicated to measure, to partial productivity (down to one dimension) that is usually easier to measure (Misterek et al., 1992; Grünberg, 2004). However, partial productivity cannot reveal as much information as total productivity (Stainer, 1997). Marshall ([1890] 1927, cited in Vargo and Morgan, 2005) considers that productivity should be used with care due to its lack of precision. There is no best way to measure productivity and the measure will vary with definition and purpose (Cox, 1948).

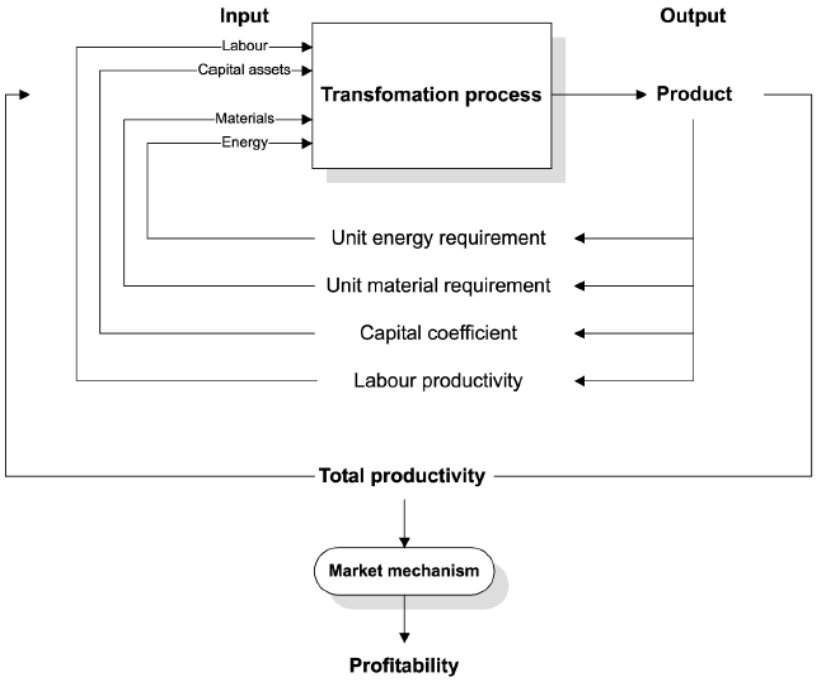

Figure 3.1: Transformation process and productivity model. From Tangen (2005).

The output of a production can be more than a quantity which makes it harder to measure. The most difficult problem is the measuring of the meaningful concept of the output (Cox, 1948). The performance of the output is generally not considering the overall economic and operational aspects (Grünberg, 2004; Tangen, 2005). Slack et al. (1998, cited in Grünberg, 2004; 2001, cited in Tangen, 2005) consider different dimensions of performance that most companies aim to improve: flexibility, speed, dependability and quality, see table 3.1. However, performance dimension can also be very case specific and not general (Grünberg, 2004).

Table 3.1 Performance objectives (Slack et al. (1998, cited in Grünberg, 2004; 2001, cited in Tangen, 2005)). The high total productivity related to cost is dependent of the other four internal dimensions.

Internal	External consequences
Error-free processes	On-specification product/services
Ability to change	Frequent new products, wide product range, volume and delivery flexible
Reliable operation	Dependable delivery
Fast throughput	Short delivery lead time
High total productivity	Low price, high margin or both

Efficiency and effectiveness are two terms often used in connection with productivity, which complicate matters further (Tangen, 2005). Effectiveness is related to the reciever of the production and can be described as “doing the right things”, and efficiency can be described as “doing things right” (Sink and Tuttle, 1989, cited in Grünberg (2004) and Tangen (2005). Efficiency is linked to utilisation of resources and will therefore largely affect the denominator (inputs) of the productivity ratio (Grünberg, 2004; Tangen, 2005). In a production of some sort, efficiency is a measure of comparison between the theoretical minimum resource level and the actual use of resources. Maximum efficiency can be reached when the good is standardised and produced away from the market (Vargo and Lusch, 2004).

The efficiency ratio is simple to measure compared to effectiveness (Tangen, 2005). Effectiveness can be viewed as how well a set of result is accomplished and is often linked to the value creation for the customer (Grünberg, 2004; Tangen, 2005). Therefore, effectiveness will largely affect the numerator (outputs) of the productivity ratio.

The reason for the dualistic approach of efficiency and effectiveness is to avoid sub optimisation (Grünberg, 2004). An effective system can be inefficient while an efficient system can be ineffective (Grünberg, 2004; Tangen, 2005). In the long-term, the effective but inefficient system will probably have customers but will not make as much profit as if the system also was efficient, while the efficient system lacks customers which will reduce the profit.

Productivity is linked to profitability but they are not the same phenomena (Tangen, 2004), see figure 3.2. Profitability has a market component. The profitability is affacted by product price and cost as well as the productivity (Grünberg, 2004). This relationship makes it possible to increase the profitability without improve the productivity as long as the market conditions allows it (Stainer, 1997; Grünberg, 2004). Also, an increased productivity will more likely affect the long-term profitability (Tangen, 2005). Increased efficiency by reducing the resources will increase the productivity, lower the cost, and increase the profit.

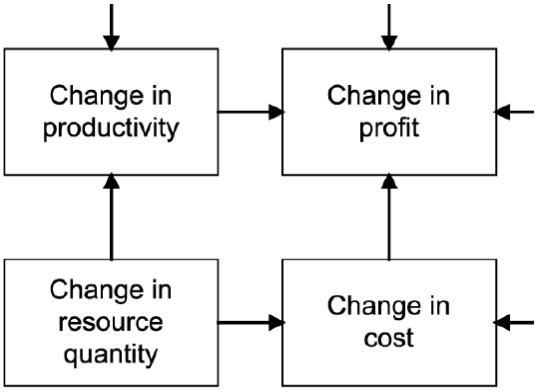

Figure 3.2: The relationships between profitability, productivity and resources, excerpt from from Stainer (1997).

3.2 Production systems and their context: a historical perspective

The purpose of this part is to describe the evolution and problems regarding productivity, efficiency and effectiveness, from the early stages of industrial production and management in the beginning of the 1800s to the Toyota Production System (TPS) and not to establish who was first. There is a difference between being first and being influential. While Woollard is now considered to be one of the originators of flow (later conned lean) production, it has generally been considered to be a Toyota invention (Emiliani and Seymour, 2011). Another purpose is to investigate value and waste in the context of TPS. The focus on Toyota depends on the attention the company has caused regarding waste and value where lean and TPS sometimes are considered to be one and the same.

What a production system is, seem to be so obvious that a production system does not need to be defined. Krafcik (1988), who introduced the term ‘lean’,

gives examples of characteristics of a production system (worker control, inventory levels, and size of repair areas) but do not define the concept. Miltenburg (1995) concludes that a production system is a system that provides the customer with a product that has a set of properties formed in different processes. Here, the definition of a production system is based on the definition of Storper and Harrison (1991). A production system has an input-output structure where some form of transformation and/or assembly is taken place. The system may consist of a set of production units linked together. The input consists of different resources ranging from raw material to manual labour. The parts of production can be performed by suppliers. A major purpose is to fulfil a demand (actual or planned) but not at any cost. A structure of governance (authority and power) is controlling or trying to control the system.

3.2.1 An historical overview

The industrial revolution

The industrial revolution caused a shift of focus from quality to quantity (Grünberg, 2004). The technological change fragmented work, deskilled labour, and reinforced the power of the bureaucracy (Tushman and Nelson, 1990). The industrialisation also separated production and consumption decisions from each other, both in time and space and lowered the price substantially compared with custom-made alternatives (Wikström, 1996). However, there where alternatives to reduce labour cost and at the same time offer small batch production in the beginning of the 1800s. The Jacquard loom, a precursor of numerical controlled machine tools, simplified the process of manufacturing textiles with complex patterns (Sabel and Zeitlin, 1985).The increase in efficiency, in the industrial revolution, also lead to an increased rigidity. Marx considered the specialisation to be the first step towards automatic machinery and necessary to increase the productivity (Sabel and Zeitlin, 1985). A task reduced to its bare essence of motions is the prerequisite to build a machine according to Marx (Sabel and Zeitlin, 1985). Generally, the industrialisation was based on three types of interrelated investments: large-scale production facilities; national and international marketing and distribution; and management (Chandler, 1977).

Early industrialisation high volume production

The British gun manufacturing situated in Birmingham had used divisions of labour since the late 1600s for the military volume contract. The lack of guilds allowed a high degree of the division of work. The system consisted of many

sub-contractors in small workshops. Large customers where the military and the slave trade. A vital part of the production was the use of fitting, craftsmen that manually made different components fit together generally by filing. The quality was not consistent which led to frequent rejection by the customers. (Williams, 2005)

The demand was volatile and the British government did not take any actions to lessen the instability of demand (Ames and Rosenberg, 1968). British gun makers decreased risks related to the demand by relying on subcontracting with extensive networks of craftsmen instead of developing the manufacturing prosesses (Wilson, 1998; Williams, 2005). The British arms manufacturers transferred the risk and the cost of demand fluctuations to the subcontractors and the cost of rapid expansion to the government (Wilson, 1998). The variation in orders for military weapons from the British Government emphasised flexibility from small producers with a low degree of capitalisation (Williams, 2005).

The volume production was partly a problem in craft production (Ames and Rosenberg, 1968; Williams, 2005). A major bottleneck in the firearms production was the gunstock. The (British) Birmingham methods produced 20 percent per worker compared to their "industrialised"American counterparts (Ames and Rosenberg, 1968). Despite the American productivity advantage, their gunstock was not appealing to the gun buying civilians who preferred custom sizes and not the American standard size.

3.2.2 The American system of manufacturing (weapons, 1800-1850)

In the early 1800s a production systems was developed to address both higher efficiency (higher output) and interchangeability. Interchangeability makes it possible to replace a type of component with another component of the same type without any adjustment or fitting. The lack of interchangeable parts was a major problem for the English military. In 1811, the English military had 200,000 muskets that had been rendered useless due to a lack of interchangeable parts (Ames and Rosenberg, 1968).

The establishment of American armour production in 1798 gave the producers a guaranteed and large and stable demand in the form of long-term contracts allowing production development (Ames and Rosenberg, 1968; Chandler, 1977, p. 73; Hounshell, 1984. p. 28; Wilson. 1998). The American system of manufacturing (ASM) was a political program to promote American industry (Hounshell, 1984, p. 15; Wilson. 1998). It was based on the ideas of the French general Jean-Baptiste Gribeauval, who introduced standardised weapons and

parts which enabled interchangeability (Hounshell, 1984, p. 25: Williams, 2005). By 1850 the goal of interchangeable parts was realised (Reeves and Bednar, 1994).

Significant production contributions of ASM were sequential series of operations, special-purpose machines and interchangeable parts (Hounshell, 1984, p. 15). Labour productivity was increasing by the use of several machines for each worker (Wilson, 1998). (A similar use of several machines and one worker would later be applied by Toyota). The Springfield Armory systemised the production by developing its organisation and bureaucratic procedures (Chandler, 1977. pp. 73-74, 272; Wren, 1994, p. 74, cited in Wilson 1998). The concept of machine-made parts reduced unit costs and began to show the possibility of economies of scale (Abernathy et al., 1983). According to Wilson (1998) the requirement of interchangeable parts affected both the view of quality and the development of the production system. The quality included consistent properties, according to the specifications, besides fulfilling a certain function.

The organisational problems of division labour never occurred in AMS since the companies were small (Chandler, 1977, p. 71). Wilson (1998) describes later problems with production where factory owners focused on finance and marketing while the factory was managed by internal contractors. The loss of control increased the material buffers to reduce the uncertainty for the contractors instead of benefiting the factory owner (Wilson, 1998).

3.2.3 Craft and industry Singer (1850-1890)

Singer, manufacturer of sewing machines and the market leader in the second half on the 1800s, based its success on marketing and production (Davies, 1969; Hounshell, 1984, pp. 5-6). The company positioned itself in the high price segment of the market. Service was important for Singer. Trained women demonstrated and educated the users/customers (Hounshell, 1984, p. 84). Both sales and production continued to grow throughout the nineteenth century (Hounshell, 1984, pp. 5-6), see figure 3.3. The company was self-financed (Davies, 1969).

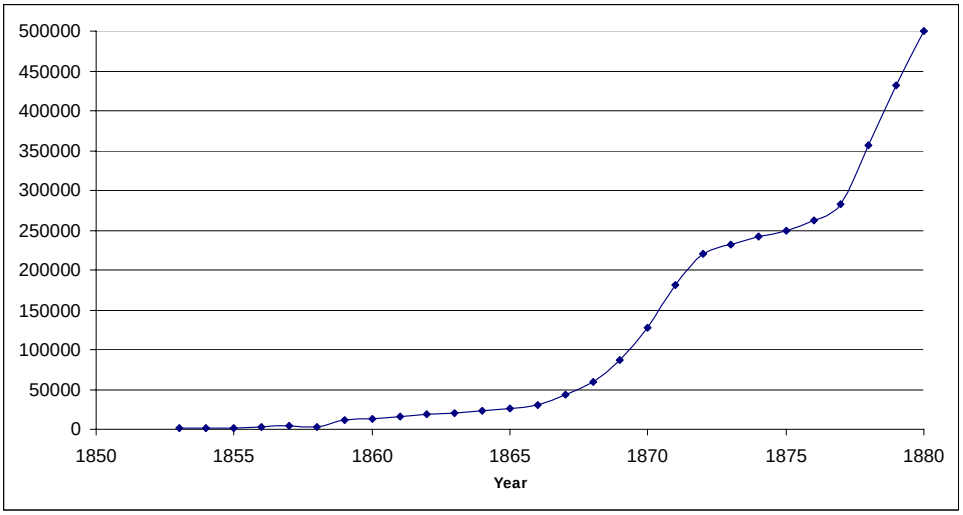

Figure 3.3: Production of Singer 1853-1880. The production increased every year, apart from 1858. (Hounshell, 1984, p. 89). In the 1870s United States experienced an economic depression (Chandler, 1977, pp. 272-273).

The production methods used by Singer were partly similar to the production methods used in the Birmingham gun manufacturing. The Singer production was based on skilled labour that provided the quality of the products, the European method. Skilled fitters (manual labour) where responsible for manually making the different parts fit. Probably the most important tool in the production was the file with thousands of different variants in use (Hounshell, 1984, pp. 5 and 96).

The increased production was managed by an increased number of general machines and skilled workers. Singer worked constantly to increase the production volume without diminish the quality. The number of unfilled orders was usually about twenty thousand with peaks of forty thousand (Hounshell, 1984, pp. 89-90, 100-109).

The European practices with skilled labour, were never fully excluded in the production. The production process became a blend of European methods and the American system. ASM was never fully implemented at Singer due to the limitations of ASM. The tolerances of the interchangeable parts proved to be insufficient to provide the same quality in the products as Singer's skilled labour. (Hounshell, 1984, pp. 99, 106, 122)

3.2.4 Mass production: Ford Motor Company (1900-1930)

The modern cooperation coordinated and allocated production and distribution in order to achieve economies of speed. A transition from the invisible hand of market coordination to the visible hand of hierarchical coordination took place during the second half of the 1800s. The administrative coordination after 1850 in the American production and distribution was more important than the market forces and the division of labour. The velocity of sales became important. A high flow was of great concern. It allowed lower margins which allowed lower prices. This required transportation and communication with a large and dependable capacity concerning speed and volume. (Chandler, 1977, pp. 2-5, 207, 214, 224-229, 489-490)

Mass production is based on stable demand and high volume standard product which allows the long-term investments in product-specific production machines (Sabel, 1982, pp. 195 and 201). This, in turn, demands that potential customers share the same well-defined wants for a number of products. The production of one model with fixed design, allow the routinisation and rationalisation of the production and workforce (Chandler, 1977, p.241; Sabel, 1982, p. 202). Hounshell (1984, p. 263) regards the Ford system as the first mass production system, signified by single purpose manufacturing, smooth flow of materials, the assembly line, large-volume production, and low prices. By maximising production and minimising costs, the profit could be maximised, see figure 4.2. In total, 15 million model T were produced. In the end mass production replaced one bottleneck with another, the demand was lower than the developed production capacity which proved to be a dead end for a system built on endless growth. (Porter, 1984). The company financed its own development and expansion (Hounshell, 1984, pp. 219-220). The flow was standardised and Ford used a type of just-in-time (JIT) (Petersen, 2002; Wilson, 1996). The production operations were organised to create a flow of work and high speed of production with as little inventory as possible (Abernathy et al., 1983; Hounshell, 1984, pp. 230 and 268).

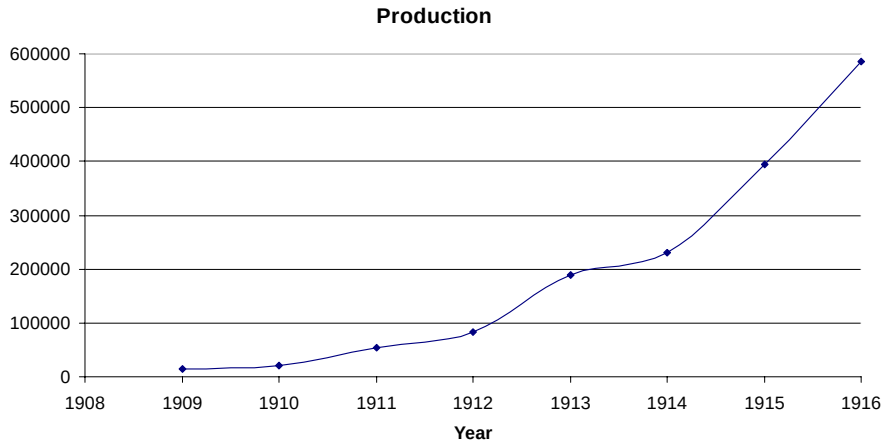

Figure 3.4: The production development of model T of Ford Motor Company (Hounshell. 1985, p. 224). Note the production increase after the introduction of the assembly line in 1913-1914.

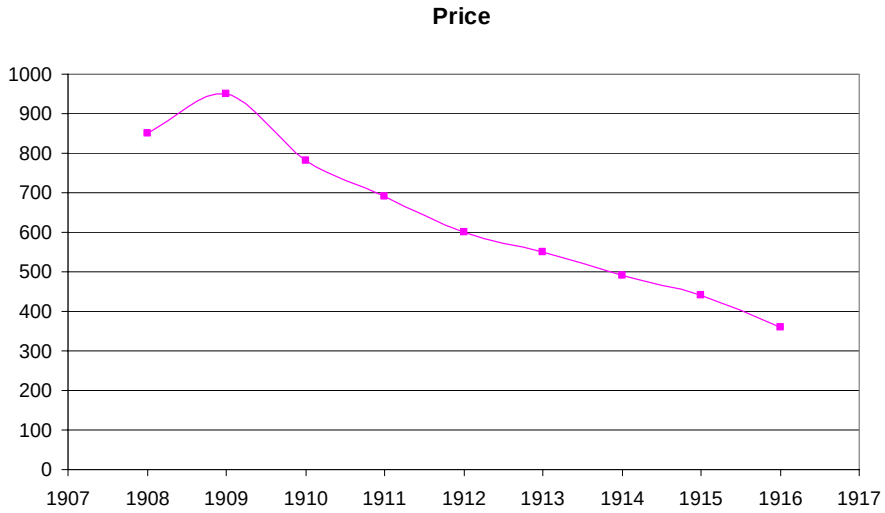

Figure 3.5: Price development of model T of Ford Motor Company in dollars (Hounshell. 1985, p. 224). Note that the major part of the price reduction appeared before the assembly line was introduced in 1913-1914. The price peaked in 1909 ($ 950).

The assembly line

One of the major inventions was the use assembly line that increased the productivity (Chandler. 1977, p. 280; Hounshell, 1984, pp. 248-249; Milgrom and Roberts, 1995). The assembly line production had been used before, but Ford's contribution was to balance the production line. Ford also integrated the whole chain of suppliers from raw materials and forward (Sandkull and Johansson, 2000, p. 36-37). The assembly line set the pace of the production, and evened out the production speed among the labour (Hounshell, 1984, pp. 252-253). This is a difference between Taylor and Ford. Taylor exerted control directly on the individual, while Ford controlled through the machine (Kanigel, 1997, p. 17, citied in Petersen, 2002).

In the spring of 1914, the labour time to produce one model T decreased from 12 hours and 8 minutes to 1 hour and 33 minutes. Ford reduced the price of one Model T to half of the price of the nearest competitor and at the same time paid the highest wages for unskilled labour in the Unites States (Chandler. 1977, p. 280).

Even if the model T was never changed on a yearly basis, some changes where made for the customers (e.g. mechanical improvements, easier maintenance), but the majority of the changes were made for the sake of production, such as the 1914 decision to make only black cars. The production, process and methods, was constantly developed and simplified for increased efficiency and use of unskilled labour. No Model T was road-tested. It was assumed that if the parts and the assembly were correct, the end product would be correct. (Hounshell, 1984, pp. 224-225, 229, 230-236, 273).

Stakeholders

Suppliers where located nearby the production plant and where required to carry inventory (Abernathy et al., 1983; Hounshell, 1984, p. 222). The inventory crises of 1920-1921 resulted in development techniques to better fit the production to the demand at the Ford Motor Company forced dealers to pay for unsold cars (Hounshell, 1985, p. 457).

Labour turnover was high at the Ford Motor Company, in 1913 the rate was 370-380 percent per year (Abernathy et al., 1983; Hounshell, p. 257). To address the problem with the labour turnover, a raise, the five-dollar day was introduced in 1914 (Hounshell, 1984, p. 259). To determine whether a worker was qualified for profit-sharing or not, the workers private lives were investigated (Hounshell, 1984, p. 259).

The Changeover

The lack of flexibility, in the form of traceable product changes for the customers, caused problems for Ford in the end. The strategy of price reduction was no longer effective when competitors offered yearly model updates instead of Ford's random updates. The yearly changes at Chevrolet were simplified by a higher degree of decentralisation and a production system that was based on standard or general-purpose machines (Hounshell, 1984, p. 264-266, 276-277).

As a response, Ford had to change its production system and introduce a new model, model A. The specialisation of the production system that produced the model T became a problem. The changeover caused a six-month shutdown of the production. The total cost for the changeover to Model A was approximately $250 million. (Hounshell, 1984, pp. 13, 261, 266, 294, 298, 301)

The assembly line was rapidly diffused in the Western world (Hounshell, 1984, p. 218). In the 1920s, mass production was considered to be the paradigm by leading industrialists (Sabel and Zeitlin. 1985). The ideas of the Ford Company spread to other industries. Foster Gunnison produced houses assembled on a line. In the end the housing industrialisation failed due to lack of demand not the technology (Hounshell, 1984, pp. 11-12). Small firms did not vanish. Approximately 70 percent of all the production in the metalworking sector in the United States consisted of small batched in the 1970s (Sabel and Zeitlin. 1985).

3.2.5 Morris Motors and flow production in the 1920s

Frank George Woollard (1883-1957) began the implementation of flow production in 1923 at the British car company Morris Motors Ltd. approximately twenty years before Toyota with a similar system (Emiliani and Seymour, 2011). Compared to a large-scale mass production system, the Woollard's system allowed flow for low volume and engineered products with costs as low as or lower than American counterparts (Emiliani and Seymour, 2011). A purpose of the Woollard system was to make small factories able to be competitive compared with the larger plants in the U.S. (Woollard, 1925). The system was implemented but for some reason (not known) Woollard resigned from Morris and with him, his system (Emiliani and Seymour, 2011).

To achieve business efficiency, the flow system must benefit everyone (consumers, employees, suppliers and owners). Whether the system will benefit the community, is a question of how the system is used (Woollard and Emiliani, 2009, pp. 60; 180-181). Woollard state that a difference between mass production and flow production is that the former demands high volumes

(mass consumtion) while the latter demands stable demand (Woollard and Emiliani, 2009, p. 50).

According to Woollard major advantages of flow production with small batches or one piece production is the much shorter throughput time; reduction of waiting time and fast feedback on quality issues (Woollard and Emiliani, 2009, p. 50). In order to succeed flow production requires a highly integrated system of operations producing standardised and specialised products with reduced buffers (Woollard and Emiliani, 2009, pp. 16, 51, 71). In order for the system to work there are a number of conditions that must be fulfilled, some of these conditions are: No or minor variation (predictability in demand and production); Quality (conformity to specification); Time (time cycle of production and timely deliveries); Accurate data (planning should be based on precise knowledge).

While both Toyota and Woollard addressed the importance of the workforce to achieve continuous improvements their views how to achieve it differed. According to Woollard the improvement "should cause no anxiety, but rather should be a matter for rejoicing" (Woollard, 1954, p. 463; citied in Emiliani and Seymour, 2011, p.68). Toyota use pressure on the workforce to release the creativity (Hampson, 1999; Shingo, 1984, p. 157)

3.2.6 The continuation of mass and flow production (1930s-1980s)

During the Second World War operations research was further developed to increase the efficiency of the war effort for UK and USA (Flood, 1993, pp. 7-9). Flow production principals were also used during the second world war in the production of Supermarine Spitfire, a British fighter aircraft, and Consolidated B-24 Liberator, an American heavy bomber (Holweg, 2007). The improved methods for quality in production which created thousands of quality specialists, did not have a large influence on the production in UK and USA after the Second World War (Flood, 1993, pp. 7-9). Mainly in Japan quality issues were regarded as important and not just productivity (Flood, 1993, pp. 7-9).

The period after the Second World War to the mid-1970s was a period of relatively high growth rates (Bello, 2006). Although warnings came that the view of production as a goods-producing process instead of a customer-satisfying process would result in problems, were largely ignored (Band, 1991, p. *v*). In 1966 and 1969 Skinner introduced the notion that an organisation's capabilities (e.g. cost, quality and time) can be used to increase the competitive strategy (Ferdows and De Meyer, 1990; White, 1996). There were trade-offs among the capabilities where high quality and low cost was an impossible

combination. Skinner developed the concept of the focused factory in 1974 stating that one should focus on just a few capabilities at most. This was to be proved wrong by the Japanese companies that could provide high quality and low cost (Flood, 1993, pp. 3-11).

With the competitive crises of the American modern corporation in the 1980s, scholars and practitioners started to search for alternatives to the American modern corporation, with its vertical integration, that did not perform as well as the production networks from Germany and Japan (Sturgeon, 2002). Both Germany and Japan base their manufacturing on craft production method in combination of general-purpose machines and skilled labours. Both mass production and craft production coexist in different variations and demand patterns (Broadberry, 1994).

The Toyota Production System (TPS) was largely unnoticed until the oil crises in 1973 (Ohno, 1988, p.1; Holweg, 2007). After the oil crises in 1973 TPS was adopted by many Japanese companies. By eliminating excessive workforce and inventory, profit is possible even in slow growing economies (Monden, 1998, p. 1). In the 1980s JIT was the term for TPS (Schonberg, 2007; Näslund, 2008). Milgrom and Roberts (1990) named this new pattern 'modern manufacturing' while Womack et al. (1990) used 'lean manufacturing'.

3.2.7 Toyota Production System (TPS)

Historical background

When the Toyota Motor Company was formed in the 1930s there were no Japanese industries that could supply a car manufacturer in Japan (Akerlof and Schiller, 2009, p. 137-140). The Japanese suppliers were developed together with the car manufacturers. From 1936, with the Automobile Manufacturing Business Act, the Japanese car manufacturers received government subsidies in the form of preferential tax and tariff treatment. (Akerlof and Schiller, 2009, p. 137-140) and foreign major ownership was not permitted until 1971 (Womack et al., 1990, pp.193-194). Companies had the ability to use the Meiji restoration, "banks" with a low-cost financing system with lower interest rates which would not be allowed in US and several European countries (Womack et al., 1990, pp.193-196).

According to Ohno (1988, p. 3) the low productivity compared with USA was a major problem. The productivity had to increase probably 10 times. The Japanese conditions with capital constraints and low sales did not suit the US production style (Monden, 1981; Holweg, 2007). According to Cusumano

(1988) the production in 1950 for cars and trucks in Japan was slightly more than one day of production for US auto industry.

Primary purpose

The purpose of TPS is cost reduction (Sugimori et al., 1977; Monden, 1981; Shingo, 1984, pp. 191-192). This is achieved by elimination of waste (or loss) (Sugimori et al., 1977; Shingo, 1984, pp. 191-192). Monden (1998, pp. 1 and 63) regard the increase profit by reducing waste, or improvement of productivity, as the ultimate purpose. The system should use the minimum amount of resources (e.g. equipment, materials, parts and workers) (Sugimori et al., 1977). One goal with TPS is to achieve cost reduction independent of economies of scale (Ohno, 1988). Regardless of volume, the numbers of working hours per product must decrease.

General System

TPS is rigid, similar to mass production, concerning production flow, activities, and connections, but with flexible operations (Towill, 2007). According to Shingo (1984, pp. 110-111) production system must be made according to the surrounding conditions. The market cannot be designed.

The fixed costs of TPS are a result of the infrastructure of the system. Examples of this is the high level of automation (Katayama and Bennett, 1999) and the relative high amount of indirect work related to maintenance and service in order to secure the flow (Sandkull and Johansson, 2000, p. 120). The degree of fixed cost makes the system sensitive to changes in demand (Katayama and Bennett, 1999).

TPS is a holistic system (Schonberg, 2007). To understand each element of the system is not enough, it is essential to understand the relations between the element as well (Shingo, 1984, p. 197). Spear (2004) suggests that it is the underlying principles that make TPS work. It is not the methods, tools and practices that are important, it is the development and experimentation (Spear and Bowen, 1999; Schonberg, 2007). The tools and practices are temporary countermeasures (Spear and Bowen, 1999). The implementation of TPS frequently fails among the suppliers of Toyota, even if the implementations are done with Toyota consultants (Towill, 2007).

Understanding is vital in TPS. Two forms of knowledge are essential: know-how and know-why (Shingo, 1984, pp. 210-211. Know-how is necessary to use new methods, but to correctly use the methods it is vital to understand why. Inventory is a loss, but in order to reduce stock there must be a sufficient number of counter measures introduced (Shingo, 1984, pp. 210-211). One must accept losses caused by current practices until the practice is improved

(Shingo, 1984, pp. 102-103). To imitate the TPS without a deeper understanding will just cause a disorder and another result than expected (Shingo, 1984, p. 147).

Stakeholders

The view of respect for human differs between the west and Japan (New, 2007). Stress seems to be a vital part to improve the production. Sugimori et al., (1977) state that workers should be treated "like human beings and with consideration" but develop this no further. Shingo (1984, p. 157) states that by letting the personnel voluntary be a part of a forced situation, the outcome of the pressure will be creative efficient improvements. Ohno (cited in Hampson, 1999) consider a perceived pressure of life and death results in "all sorts of ingenuity".

During the 1980s Toyota experienced labour shortages due to the working conditions and job opportunities in other sectors (Hampson, 1999; Sandkull and Johansson, 2000, p. 169). The new factories that were built used more conventional buffers and no time slack. Monden (1998, p. xvi) sees the labour shortage as a continuous problem since the number of 18-years-old will be reduced by 40 percent in the period 1998 to 2010.

A long term change of the demand can be solved by increasing or decreasing the number of employees. (Shingo, 1984, pp. 131-132). Temporary employees act as buffer (Shingo, 1984, p. 114; Lepadatu and Janoski 2011, cited in Janoski, 2015). With a decrease of the demand, the permanent employees will perform other types of work (e.g. maintenance of equipment, training and education, and technical improvements of the manufacturing system) (Shingo, 1984, pp. 132-133).

Japanese production networks are hierarchical and captive since it is based on dominant lead firms that "coordinate tiers of largely captive suppliers" (Sturgeon, 2002, p. 481-483). The close relation facilitates coordination (just-in-time deliveries) and flexibility (redeployment of workers and suppliers) which leads to high efficiency (Sturgeon, 2002). There is constant pressure on the Japanese suppliers to improve their performance and cost cutting is shared between the supplier and the lead firm (e.g Toyota) (Womack et at., 1990, pp. 154-155 and 168).

Production: a question of levelling

The capacity needed to meet the demand is balanced with the workforce. The calculated workloads are 100-110 percent, which is not too costly since overtime is a minor part of the salary (Pruijt, 2003). Between every shift there

is 4 hour time buffer that can be used for additional production if the demand is temporary high (Shingo, 1984 p. 131; Sandkull and Johansson, 2000, p. 120). Toyota factories with three shifts needs inventory buffers since there is no slack between the shifts (Hampson, 1999).

The aim of using a large number of machines is to decrease cost and adopt to variations in demand, not achieve a high utilisation rate (Shingo, 1984, pp. 96-98). One employee cost 3-5 times more than a machine and therefore one employee will usually serve several machines (Shingo, 1984, pp. 96-98). The mechanization of an operation should not take place until the operation has reached perfection (Shingo, 1984, p.190; Ohno, p. 41).

The Japanese vehicle industry generally had less volatility of production than the volatility of sales in the period 1985-1994 (Mollick, 2004). Towill (2007) regard this as a strong indication of make-to-stock strategies are applied among Japanese car manufacturers. In some cases Toyota use buffer stock when the demand fluctuates (Spear and Bowen, 1999). Buffer stocks are less costly than changing the production level (Towill, 2007). Long term demand stability is more important than short term waste (Spear and Bowen, 1999; Towill 2007).

The levelled production is one of the pillars of TPS and necessary for the system (Sugimori et al., 1977; Shingo, 1984, p. 181). TPS can handle a 10-30 percent variation (Shingo, 1984, p. 180). Fluctuations in production and orders at Toyota's final process will have a negative impact on all earlier processes (Monden, 1981; Shingo, 1984 p. 138; Ohno, 1988, p. 37) and destroy the possibility of Just-in-time (JIT) (Sugimori et al., 1977; Shingo, 1984 p. 138; Monden, 1998, p. 64). The levelled production is so important that customers unable to level their schedule may experience later deliveries (Towill, 2007). The Japanese motor vehicle production increased almost every year from the late 1950s to the late 1980s with a dip for the oil crises in 1974 (Womack et al., 1990, p.248).

The production planning consists of several layers and inputs (Sugimori et al., 1977; Shingo, 1984 pp. 117-118; Monden, 1998, pp. 75-79). The first input for the production planning is the long-term forecast (Sugimori et al., 1977). TPS depends on accurate market research. Twice a year Toyota Motor Sales interviews 60 000 respondents and perform 5-6 additional enquiries (Shingo, 1984, p. 116). The car sales are monitored closely (Shingo, 1984 p. 116; Monden, 1998, p. 75). TPS is based on approximation of the customer demand (Shingo, 1984, pp. 114 and 172). The production schedule is increasingly frozen (Sugimori et al., 1977; Shingo, 1984 pp. 117-118; Monden, 1998, pp.

75-79). The production plan is frozen 6-8 weeks before the actual production (De Treville et al., 2014). Approximately one-third of the production lacks real custom orders (Hines et al., 2004).

Kanban - a subsystem

Just-in-time (JIT) is a key concept in TPS and the purpose of JIT is to avoid large inventory and surplus equipment and workers (Sugimori et al., 1977; Monden, 1998, p. 5).Things should happen in exactly the right moment (Shingo, 1984, pp. 92-93; Monden, 1998, p. 5). In order for JIT to work a number of preconditions must be fulfilled: short throughput time, small lot sizes, short setup times, and stable pace of production, standardised components, etc. (Shingo, 1984, pp. 122-130 and 138; Monden, 1998, p.6). To control the flow of the JIT production the Kanban system is used (Sugimori et al., 1977; Shingo, 1984, pp. 91-92; Monden, 1998, p. 6). The Kanban cards hinder the build up of queues in the production and thereby an uncontrollable change of the throughput time (Shingo, 1984, pp. 91-92; Monden, 1998, p. 6). The work in progress in the production system can be compared with the water in a pond (Shingo, 1984, p. 181). (Author comment: Shingo do use the word ‘pond’ instead of ‘sea’). The real effort of TPS is not the Kanban system but the preconditions that allows a work without any disruptions and a minimum of inventory. (Shingo, 1984, p. 182)

Quality

The quality control movement in Japan, began at Suzuki in the 1950s and in the early 1960s at Toyota (Huxley. 2015). Quality is an important part of process improvement but every aspect of quality is difficult to measure (Shingo, 1984, pp. 19-39). The customer perceives the quality based on the bought product, not a quality percentage of the whole production. The purpose of a quality inspection should be to correct error not detect errors. Shingo (1984, p. 126) considers that a high throughput time and small lot sizes allows a fast feedback of quality issues.

Rationalisation of stock

Toyota separates between operations stocks and process stocks since it will hide the reasons and the ownership of stock keeping, which limits the possibilities of improvements (Shingo, 1984, pp. 86-88; Spear and Bowen, 1999). Process stock are used to limit the variation in demand, lead time and capacity while operations stocks are used to shield against machine downtime and poor quality, large series and long lead times. There is also a type of stock that is not a part of the production flow. According to Monden (1998, pp. 60-62) the emergency stock is stored both onsite and offsite. The size varies

depending on surrounding conditions (e.g season, traffic). To reduce the need for stock, the causes must be eliminated (Shingo, 1984, p. 87). An uncritical decrease of the stock can quickly result in problems more severe than a large stock. Under special circumstances, to build stock might momentary be the right decision and increase the batch sizes as well (Shingo, 1984, p.148; Spear and Bowen, 1999). It is cost reduction that is important, not to eliminate the stock. (Shingo, 1984, p. 148). Suppliers are a part of the stock control. Suppliers must be flexible and adapt to Toyota's production requests (Monden, 1998, p. 62). This may be in conflict with both non-stock production principle and the decrease of operation stock (Mishina and Takeda. 1994, citied in Hüttmeir et al., 2009).

Reduction of setup time

Levelled production of different product variants requires a mixed production to allow for numerous production combinations of the products. The decrease of the setup time was essential for the development of TPS since it enables smaller lot sizes, less stock, higher flexibility and mixed production (Shingo, 1984, pp. 66, 124, 128, 164; Spear and Bowen, 1999). The development of setup time reduction differs between authors and Toyota was not the only company to shorten setup times. Toyota needed 4 hours in 1970 for changing the tools in a certain pressing machine where Volkswagen needed 2 hours (Shingo, 1984, pp. 61-64). Eventually the setup time was reduced to under 10 minutes, Single-digit Minute Exchange of Die (SMED) (Shingo, 1984, p. 65). The development of SMED started outside of Toyota (Shingo, 1984, pp. 61-63). Ohno (1988) and Monden (1998, p. 10) state that the setup time of the pressing department between 1945 to 1954 was approximately two to three hours. Between 1955 to 1964 the setup time was reduced to a quarter-hour and after 1970, the setup time was three minutes. According to Monden (1981) the decrease to three minutes occurred after 1965.

Other considerations

The number of transports JIT generates between different locations have been criticised for being too frequent, affecting the environment, unnecessary energy consumption, and creating traffic jams (Cusumano, 1994; Katayama and Bennett, 1996). Bonney and Jaber (2011) consider that the traditional economics of JIT will change as the environmental concerns increases.

Cox and Ireland (2002) argue that the Japanese tradition of closer relations with their supplier is not plausible in every environment. Fearne and Fowler (2006) and Katayama and Bennett (1996) conclude that environment with high levels of complexity and uncertainty are troublesome concerning the

combination of low inventory and unreliable suppliers. Srinidhi and Tayi (2004) address the importance of controllability of the environment to take advantages of JIT. Without a dependable supply, JIT will not work (Mason-Hill and Towill, 1998). JIT depend on a stable and reasonable predictable demand. In 2008-2009 the lack of responsiveness to changes in demand, resulted in excessive inventory build-up at Toyota, which is more likely to have happened in a push production system (Emiliani and Seymor, 2011). (Push equal to produce according to plan based on forecast and not actual demand).

Lean is dependent on the environment. Inventory reduction can become too lean, beyond that point the performance start to deteriorate (Zipkin, 1991; Browning and Heath, 2009; Eroglu and Hofer, 2011). With an increased uncertainty in dynamic environments, the effectiveness of lean operations is reduced as it is increasingly difficult to synchronize production processes and reduce the inventory (Azadegana et al., 2013; Deif and ElMaraghy, 2014).

3.3 Principal-agents

To further understand the relationships and conflicts of interest between stakeholders such as customers and producers, the principal-agents theory is presented.

Principal-Agents relationships are in abundance in the real world. The phenomena arises when one party (the principal) is dependent on the performance of another party (the agent). The potential problems that might occur can be traced to differ in: goals; information; incentives etc. From the principal's perspective the question is how to measure and control that the agent fulfil the contract (real or a theoretical construct). There is always a loss of control involved in the relationship (Mitnick, 1992). The Principal-Agent configuration is appropriate in a number of settings ranging from micro- to macro-level (Eisenhardt, 1989). The theory of agency endeavours to model all principal-agents relationships in various fields e.g. finance, economics, political science, sociology and organisation (Eisenhardt, 1985; Mitnick, 1992).

Agency theory has its origin in the 1950s and was developed further in the 1970s (Lange, 2005). The theory evolved from research focusing on risk-sharing problems and originates from transaction cost theory (Eisenhardt, 1989). The transaction cost theory and agency theory share several assumptions such as: self-interests, bounded rationality, goal conflict and information asymmetry (Eisenhard 1989). Sharma (1997) suggests a more complex view of human nature and proposes that altruism is to be considered

and not only self-interest. Ghoshal and Moran (1996) propose that opportunistic behaviour is not static but rather a variable.

The theory has been criticised for being too limited and partner biased. Perrow (1986, cited in Eisenhardt, 1989) criticise the theory for focusing on just one of the two parties. The restricted set of assumptions may present a limited view of interpersonal relationships view (Sharma, 1997; Wright et al., 2001). Mitnick (1992) considers that the economics-based approaches can be too narrow and are more focused on prediction than understanding of underlying non economics causes. Also, the lack of input from other theoretical fields hamper both the concepts and the explanations.

The agency theory set out to identify contractual problems between the participants partly caused by self-interest and information asymmetry (Eisenhardt, 1985; Sharma, 1997). A firm can be regarded as a set of contracts, each motivated by self-interest, among the factors of production (Fama, 1980). The assumption that the principal has the best knowledge of what the desired outcome is can be questioned (Sharma, 1997; Emiliani, 2000). A problem, from the agent's perspective, is to determine their principals and their principals' goals (Mitnick, 1992). Another complication is that in reality there are other relationships than principal-agent relationships. There can be a network of agents (Sharma, 1997). The asymmetrical information where the agent controls the information favours the agent. Several layers of principal-agent relations will most likely lead to short-terms profits for the agents at the cost of the principal (Hirst and Brown, 1990; Brown, 2001; Nässén et al., 2008). For example, the tenants, are dependent of the decisions the intermediates have done earlier (Mundaca et al., 2010).

The asymmetric information to the agents' advantage is solved by control. The agent is monitored and measured (Ouchi, 1979; Eisenhardt 1985; Hennart, 1993; Das and Teng, 2001). Two limitations are the cost and/or possibilities of monitor and measuring (Eisenhardt, 1985; Sharma, 1997). The cost is the sum of measurement costs and the costs related to imperfect measurement (Hennart, 1993). To limit opportunistic behaviour, the principal can use internal (organisation-based) and external (market-based) types of control (Ouchi, 1979; Hennart, 1993; Sharma, 1997). Two major components in deciding type of control is the measurability of outcome and the knowledge of the transformation process. The degree of the measurability and knowledge determine type of control (Ouchi, 1979; Eisenhardt 1985; Sharma, 1997). According to Ouchi (1979) there are three types of control: market, bureaucracy and clan. Each type of control has its social and informational

prerequisites, see table 3.2. However, everything cannot be controlled in advance. Akerlof (1970) discusses the uncertainty regarding quality that can only be assessed after the purchase.

Table 3.2; Social and informational prerequisites of Control (Ouchi, 1979).

Type of Control	Social Requirements	Informational Requirements
Market	Norm or Reciprocity	Price
Bureaucracy	Norm or Reciprocity Legitimate Authority	Rules
Clan	Norm or Reciprocity Legitimate Authority Shared values, Beliefs	Traditions

Hennart (1993) distinguishes between methods of organizing (the price system and hierarchy) and economic institutions (markets and firms). "Pure hierarchy" can be more efficient than "pure market" but a mix of the two will be the most efficient solution. The methods have different strength and weaknesses, see table 3.3. The choice between the methods depends on the cost of measuring and the residual of cheating (e.g. lower quality) or shirking. According to Akerlof (1970, p.495) the cost of cheating can be more severe than the amount the principal is cheated since cheating "tend to drive honest dealings out of the market". Both Hennart (1993) and Foss (2002) discuss the limits of using intrafirm markets as an additional control to hierarchies, the major problem is that intrafirm markets can result in sub-optimisations due to lack of decision power and problems with price settings.

Table 3.3: Control systems (Hennart, 1993).

Methods of Organising	Price system	Hierarchy
Reward based on	Output	Input
Encourage	Cheating	Shirking
Minimise	Shirking	Cheating

With critical knowledge (not just information) the power relation shifts to the agents' advantage and the traditional roles of principal and agents collapse (Sharma, 1997; Foss, 2002). According to Sharma (1997) profound knowledge

of the principal is lagging compared with the professional (with critical knowledge) agents causing a collapse of market conditions. To control the lack of critical knowledge different control strategies can be applied:

Self-Control. A presence of altruism and intrinsic motivation lessens the opportunistic behaviour (Sharma, 1997), while a too high degree of rational control from the principal excessive can encourage the agents to opportunistic behaviour (Ghoshal and Moran, 1996).

Community Control. Reputation is believed to affect the agent outside the single principal-agent relationship (Hennart, 1993). However the cost and possibility of an advertising reputation that will severely affect the agent is considered to be limited (Sharma, 1997). Still, community control is practiced by Japanese firms (Hagen and Choe, 1998).

Bureaucratic Control and Client Control. The properties of the firm's internal structure and control systems will most likely reduce opportunistic agent when equivalent knowledge is present in the control system. The firm might hire an expert to control the agent. (Sharma, 1997)

3.4 Value

Value is a word commonly used to emphasise importance and enhance the expression within several different fields. Examples of use are: value chain, value creation, value-added, value delivery, value improving systems, value streams. Somehow the meaning of value is too often taken for granted, either stating the obvious or avoiding the definition.

Understanding value is complex due to its multitude of dimensions. Sheth et al. 1991 consider value to have several dimensions functional value, social value, emotional value, epistemic value, and conditional value. Value includes both tangible and intangible attributes that stem from factors ranging from production processes to brand image (Levitt, 1980; Hines et al., 2004; Oliver et al., 2007). Pitelis (2009) concludes that ‘value’ is an elusive term. Its meaning is multi-faceted with various meaning to different stakeholders (Bowman and Ambrosini, 2010). Value evolves over time (Woodall, 2003). To make things worse, the term 'value' is used to describe different phenomena (Bowman and Ambrosini, 2000). Keynesian economist Joan Robinson (1964, cited in Pitelis, 2009) considered value to be ‘one of the great metaphysical ideas in economies’. James C. Bonbright writes: "When one reads the conventional value definitions critically, one finds, in the first place, that they themselves

contain serious ambiguities, and in the second place, that they invoke concepts of value acceptable only for certain purposes and quite unacceptable for other purposes" (Fishman, 2013). According to Fishman, value is a more general concept of worth that correlates to transactional price or cost in various degree. However, an imprecise definition might hinder the theory development (Priem, 2001).

The English word 'value' came in use around 1300 with the meaning: "price equal to the intrinsic worth of a thing". Some 100 years later under the influence from the old French language the meaning was: "degree to which something is useful or estimable". The meaning of the French word was: "worth, price, moral worth; standing, reputation". The origin of the word can be traced to the Latin word *valere* (be strong, be well; be of value, be worth). (Online Etymology Dictionary)

Over the years the nature of value has been of interest to philosophers in different societies. The Aristotlean view of value incorporated use value and exchange value (Dixon, 1990; Fleetwood, 1997) but emphasised use value over exchange value (Smart, 1891; cited in Woodall, 2003). The perception of value is linked to the 'use' of a commodity (Woodall, 2003). Use value is subjective and demand is a function of use value where demand and exchange value is influenced by rarity (Gordon, 1964). Aristotle could not solve the nature of exchange value and money as the standard of measurement due to commensurable issues (Fleetwood, 1997). Aristotle rejects money as a measurement since a measure "... does not create the property which it measures. Measures of length do not create spatial extension" (Meikle, 1995, pp. 22-23, cited in Fleetwood, 1997). The view of wealth consisted of two variants, natural wealth (life necessary commodities) and artificial wealth (other types of wealth such as money, riches and property) (Neves, 2000). While the natural wealth had a limit it was considered that the artificial wealth had no limit. In the middle ages (e.g. Pierre de Jean Olivi; Thomas Aquinas , value was still linked to use, with the addition production and marketing issues such as creation of form, time and place (Dixon, 1990).

Even if Aristotle did not develop the concept of exchange value, others considered the concept. Ibn Khaldûn, a fourteenth-century economist and historian, identifies three sectors of the economy: production, exchange, and public services (Boulakia, 1971). Furthermore, exchange value was used in practice. In the early 13th century Gutalagen law (from a part of what later would become Sweden) states that the slaying of an individual had a price that relatives or slave owner could claim, A free Gotlander was valued to 4.8 kg

silver, a free non-Gotlander was valued to 2 kg silver and a slave to 225 grams silver (The Swedish History Museum).

The seminal work of Smith (1776) has a number of contradictions concerning value, wealth, luxury and productive power (Wilson et al., 1994; Brewer, 1998; das Neves, 2000; Marshall, 2000). Smith (1776, p. 34) considers value to have two different meanings, 'value in use' linked to the utility and 'value in exchange' linked to the purchase, the transaction. He regards the two types to be quite different. Smith (1776, e.g. pp. 34, 402, 404) recognises that what lacks exchange value may still be of greatest value in use. Exchange value has its limits as an objective measure. He states that:

"The things which have the greatest value in use have frequently little or no value in exchange; and, on the contrary, those which have the greatest value in exchange have frequently little or no value in use. Nothing is more useful than water; but it will purchase scarce any thing; scarce any thing can be had in exchange for it. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it." (Smith, 1776, p. 34)

There is an echo from the Arestotelian view of wealth in Smith's reasoning of luxury. While the desire of food is limited, the desire of conveniences (e.g. buildings, clothing, etc.) has no limits (Smith, 1776, pp. 205-206). A reason for this standpoint is luxury consumption inhibits factor growth (Marshall, 2000). Even if there is a resemblence in the view of luxury concerning Smith and the Arestotlean view of wealth. But would Smith deviate from the Arestotelian view considerebly concerning the important exchange value in order to create the wealth of a nation.

According to Smith (1776, pp. 400-402) the creation of value occurs in the transformation performed by the labour. Besides transformation, the output must be tangible and a permanent object. Smith made a distinction between productive and unproductive labour. Some of the non-productive professions were churchmen, lawyers, physicians, buffoons, musicians and opera-singers. This was exemplified with:

"They are the servants of the public... Their service, how honourable, how useful, or how necessary soever, produces nothing for which an equal quantity of service can afterwards be procured. The protection, security, and defence, of the commonwealth, the effect of their labour this year, will not purchase its protection, security, and defence, for the year to come." (Smith, 1776, p. 401)

The division of labour was of great importance to achieve high volume production. Smith (1776, pp. 7-8) marvelled over the production capacity with the division of labour that had been in use for approximately 100 years in Britain. One example of the division of labour was the British gun manufacturing in Birmingham in the late 1600s with at least 30 different sub-trades (Williams, 2005).

With division of labour, the output could be increased, which in turn increased the sum of exchange value, which in turn increased the stock of wealth. Wealth comes from exchange value not the use of a commodity. Also, with division of labour followed the necessity of exchange (Vargo and Morgan, 2005). The industrialisation separated the producer from the user. As a result production and consumption decisions were separated, both in time and space (Wikström, 1996).

Smith (1776, pp. 21-27) argues that the market will limit the extent of the division of labour. A small market does not allow an extensive division of labour. Later economists consider organisational matters (e.g. coordination, communication and knowledge) the main reasons, not the market (Becker and Murphy, 1994). Still, the end to the early success of Ford in the first half of the 1900s was the limited demand compared to the production capacity (Porter, 1984).

The exchange value became more important than use value. Smith (1776) considers ‘real value’ to be related to production and the exchange value. The emphasis on exchange value was largely accepted by the Smith's successors (e.g. David Ricardo, Karl Marx) within the field of economic research and led to an increased focus on tangible and measurable things (Dixon, 1990; McKnight, 1994; Vargo and Morgan, 2005). The value of the produced commodities could be measured and represented in precise economical terms. Since transformation carries a value also the cost for the total labour, material and overhead represents a value. Both Marx and Ricardo discussed this type of value (Wilson et al., 1994).

The use value was not forgotten. In the mid-nineteenth century, the Austrian School, proposed an integrated theory of value that avoided the ‘exchange’/’use value’. The economic value had two different, complementary, components, one subjective (personal) and one objective (generalisable) value. (Smart, 1891, cited in Woodall, 2003; McKnight, 1994)

The definitions in marketing and strategy overlap each other (Ramsay, 2005). Strategic management has regarded value as a creation of the producers, similar to Marx's labour theory of value, where a finished good is filled with

value from the production at the time it reaches an end user (Priem, 2007; Heinonen et al., 2013). For instance, Porter (1985) and Brandenburger and Stuart (1996) are both strategy related and focus on the monetary part, they define value as "what buyers are willing to pay". Marketing has developed the concept of value over the years. In the early 1970s, Kotler (1972) considers the exchange of values between two parties, the transaction, as the core concept of marketing.

A purely economic take on value demands only a scientific response to observed phenomena, but to understand the nature of value fully, a philosophical, or abstract perspective must also be adopted (Woodall, 2003). Traditionally, economics have tended to refer to utility theory and marginal utility when investigating value and consumer behaviour based on the assumption of the rational, economic man (Bowman and Ambrosini, 2000). However, the judgement of the utility of a product or a service is based on a combination of beliefs, needs, experiences, wants, wishes and expectations. (Bowman and Ambrosini, 2000).

To regard everything as consumption may result in subjects too broad for useful analysis (Trentman, 2004). Behaviour and decisions is not just a question of values, preferences, needs and wants but rather inflicted necessities. Many of the daily activities are linked to established systems based on various policy decisions that are beyond the control of individuals (Trentmann, 2004; Söderholm, 2013). Value is not only a matter of functional and economic benefits, the importance of social ethical and environmental values are increasing (Nordin and Kowalkowski, 2010).

Also, markets have their limits concerning value. Value definitions tend to reflect the presence of market and monetary dimensions (Pitelis, 2009). Not everything that has intrinsic value has market value. Pitelis (2009, p. 1118) defines value as: "perceived worthiness of a subject matter to a socio-economic agent that is exposed to and/or can make use of the subject matter in question". Frondizi (1971, cited in Woodall, 2003) consider every product to have ‘qualities’ which remains to be qualities even if it is not valued. There are also values beyond the market. Loyalty, trust and reputation are examples of values that have real economic value but they cannot be traded on a market (Dierickx and Cool, 1989).

3.4.1 operationalisation of value

Value as a multidimensional construct are used and discussed both in both marketing related literature (e.g Lehmann and O'Shaughnessy, 1974; Levitt, 1980; Band, 1991; Grönroos and Voima, 2013) and strategy related literature (e.g. Wheelwright, 1984; Brandenburger and Stuart, 1996; Yung and Chan, 2003). Some of the dimensions are: quality (Band, 1991; Yung and Chan, 2003), service, cost, time, non-monetary sacrifice (Zeithaml, 1988; Grönroos, 1997), and emotional values (Mattsson, 1990; Sheth et al., 1991; Ravald and Grönroos, 1996; Patnaik, 2004). The emotional values can be related to a product (Mattsson, 1990).

Value can be defined differently and linked to the competion as well as customers. Wheelwright (1984) considers competitive priorities dimensions to be: price (of the product); quality (higher quality than competitors or unique performance characteristics); dependability (work as specified, delivered on time, failures are corrected immediately); flexibility (product flexibility and volume flexibility). Johansson et al. (1993, cited in: Mason-Jones et al., 2000; Christopher and Towill, 2000: Christopher and Towill. 2001) define value as the quotient of a set of dimensions. They propose the following model:

$$\text{Value} = \frac{\text{Quality} \times \text{Service}}{\text{Cost} \times \text{Lead Time}} \tag{3.2}$$

The total lead time is defined as: "the time taken from a customer raising a request for a product or service until it is delivered" (Mason-Jones et al., 2000; Christopher and Towill, 2000: Christopher and Towill. 2001). Regarding cost all three articles refer to Fisher (1997) where the total costs for the Product Delivery Process (PDP) are given by the formula showing that: (Supply chain: Total PDP costs) = (Physical PDP Costs) + (Marketability Costs). Physical costs include all production, distribution, and storage costs, and marketability costs include all obsolescence and stockout costs.

Service is the "customer service level, i.e. availability in the right place at the right time" (Mason-Jones et al., 2000). (Originally the term "service level" is used. Quality is mentioned (not defined) as "high levels of product quality" (Mason-Jones et al., 2000; Christopher and Towill, 2000: Christopher and Towill. 2001).

Zeithaml (1988) discusses the consumer value and the trade-offs (what is received and what is given) which allows value to be described as a ratio between benefits and sacrifices, see eq. 3.3. Instead of being multiplicative, the benefits and sacrifices can be described with function based on addition and subraction (Heinonen, 2004).

$$\text{Value} \propto \frac{\text{Benefits}}{\text{Sacrifices}} \tag{3.3}$$

An organisation should consider to measure every aspect of their operations that will affect customers' perception of value, which is not the same as measuring everything (Band, 1991, p. 79). However, to make it workable, an organisation must find the most influential dimensions of value (Band, 1991, p. 79; Woodruff, 1997). In marketing, the focus is the interface between the organisation and the customer (Band, 1991, p. 73).

Hill (1993) and Berry at al. (1999) link value dimensions with the internal production with the concept of ‘order winners’ and ‘order qualifiers’. Even if a certain criteria wins an order, other criteria (order qualifiers) will influence the possibility to win orders (Voss, 1995). Different criteria have different weights and the weights and criteria will change over time (Hill, 1993). Also, different markets and customers have different preferences. Mason-Jones et al. (2000) consider cost to be the market winner for lean while service, quality and lead time are order qualifiers. A low price will not be sufficient unless service, quality, and lead time are perceived to meet the criteria, the value dimensions (see eq. 3.2).

3.4.2 Identifying and securing value with focus on quality and needs

One dimension of value is quality (Band, 1991; Yung and Chan, 2003). Juran (1992) defines quality matters as "fitness for use", which is linked to the Aristotelian perspective on value. In the quality movement one method that has been used is the Quality function deployment (QFD) (Hauser and Clausing, 1988; Matzler and Hinterhuber, 1998; Schonberger, 2007). QFD was developed by Mizuno and Akao in the late 1960s (Schonberger, 2007) and has been in use since the introduction at the Kobe Shipyards in 1972 (Govers, 1996). The QFD matrix combines customer requirements with product design criteria and competitive considerations (Ip and Jacobs, 2006; Kahraman et al., 2006; Schonberger, 2007). The approach consist typically of four phases:

strategy and concept definition, product design, process design, manufacturing operations (Govers, 1996; Matzler and Hinterhuber, 1998). The requirements from one phase is the input of the characteristics in the next phase. It enables a deeper understanding of customer's requirements and problems (Matzler and Hinterhuber, 1998). The concept of value (here: the quality dimensions) is the input to the QFD. Reeves and Bednar (1994) are hesitant to define quality as value. To regard quality as value decreases the reliability of and increases the complexity of understanding quality since value is linked to internal efficiency, external effectiveness, and individual judgement.

However, despite the quality movement aspiration to fulfil customer needs, the movement has been criticised for being too limited to reflect the dimension of the customer (Sharman, 1984; Woodruff, 1997). Woodruff (1997) consider the internal focus within the organisation as a major obstacle to success. For an organisation to be successful, the organisation must be externally orientated.

Patnaik and Becker (1999) discuss on a strategy level the importance of finding the needs of the customer. Needs have a longer lifespan than a specific technical solution. Therefore the focus should be on needs of the customers, but a need may not be obvious until after the need has been discovered. Patnaik (2004) evolves the concept of needs in a hierarchical model implying different weights on the different needs. The customer needs are divided into four types: qualifier needs, activity needs, context needs, and common needs, see table 3.4. Even if there is a need, there are a number of influencing factors that will affect whether the need will be fulfilled or not.

Table 3.3 Types of needs and their characteristics based on Patnaik (2004) concerning the user and energy savings from Ståhlbröst et al. (2012).

	Qualifier Needs	Activity Needs	Context Needs	Common Needs
Stem From	Are a results of problems with existing solutions	Result from specific activities a person perform	Result from the situation in which people live, work, operate, are goal-oriented	Needs of nearly everyone
Existence	The same need exists for everyone using the same solutions in similar ways	Needs are the same for all who want to do the same thing	The same need exist for people operating in the same context	Most fundamental and universal need
Usually Solved By	Disappear if current solution is redesigned	Disappear if current solution are made obsolete	Changes in the context or change context	Met by more immediate needs
Awareness	People are aware of them	People are aware of them	People may not perceive or immediately articulate the needs	People are aware of them
Described By	Can be describe in terms of changes	Described in terms of existing product or service solutions	As long as context and conditions remains the same the needs will continue	
Satisfied By	New Features New Offerings	New Offerings New Families	New Families Systems of Solutions	Systems of Solutions

3.4.3 Stakeholders and non-monetary value

Ramsay (2005) addresses the narrow view of value just concerning customers in a business, therefore he proposes that suppliers should be included. Lepak et al. (2007) and Pawar et al. (2009) go even further when they propose that value concerns several types of different stakeholders, which might lead to conflicting value definitions. To create value is complex due to the competing interests and different viewpoints among stakeholders that result in different views of what is valuable (Lepak et al., 2007; Pawar et al., 2009). Firms act in the interest of its owners and the creation of profit (Barney, 1986; Makadok, 2001, Priem, 2007). The maximisation of shareholder value is a part of the corporate law in many countries (Emiliani, 2003a). Hence, the producer

orientation becomes strong (Priem, 2007). To maximise shareholder value, the easiest procedure is to minimise the interest of other stakeholders (Emiliani, 2003b). The compensations to the management are linked to the maximisation of shareholder value. In some countries, stakeholder-centered business is practiced (Emiliani, 2001). However, the success of the US economy in the late 1990s has increased the use of US-style business practices in other countries.

The monetary value is prioritised in favour of utility since Smith (1776) initiated the prioritisation (Pawar et al 2009). However, there are other types of value. There are types of non-monetary values (e.g alturistic values, egoistic values and traditional values) that will influence how groups and individuals act in certain matters (Stern et al., 1999). Carroll (1979) recommend other dimensions to the corporate organisation with proposal of the pyramid of corporate social responsibility to increase the influence of organisational stakeholders. The pyramid has four levels: economic, legal, ethical and philanthropic. Brundtland's report adds the social and environmental dimensions to the economic dimension, and future stakeholders with definition of what is sustainable: “development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs” (Brundtland, 1987, p. 43).

A combination of monetary and non-monetary relations

One example of both monetary and non-monetary values are energy issues. Energy is of extreme importance to the society. E.F. Schumacher (cited in Goldthau and Sovacool, 2012: p.232) states that energy is: "not just another commodity but the precondition of all commodities". Dimension of causes and effect concerning the use and efficiency of energy differs depending on the discipline. Economic papers tend to focus on monetary issues and tended to be based more on theoretical reasoning or a combination of mathematical models and theoretical reasoning (e.g. Zerbe and McCurdy, 1999, Wickman and Lingle, 2004; McCann et al., 2005; Delbeke at al., 2009). The economic approach is criticised for the sole focus on economy and avoiding other structural dimensions such as organisation, information, and acceptance of new technology (Stern, 1986; DeCanio, 1998; Brown, 2001; Löschel, 2002).

A part of the problem is the optimising of the short term cost and different views of what is value among the stakeholders. Firms and consumers do not always chose the most cost efficient solution (DeCanio, 1998; Brown, 2001) due to insufficient or incorrect information (Stern, 1986; Hirst and Brown, 1990; DeCanio, 1998; Brown, 2001), asymmetric information (Nässén et al.,

2008, Mundaca et al., 2010), and agents acting in self-interest (DeCanio, 1998; Brown, 2001; Nässén et al., 2008, Mundaca et al., 2010). The influence of intermediaries limits the ultimate consumer's role in the decision making in the purchase of energy technologies, which leads to an under-emphasis on long-term costs and higher energy consumption (Hirst and Brown, 1990; DeCanio, 1998; Brown, 2001; Nässén et al., 2008; Mundaca et al., 2010). The strength relationship between different actors influence the energy efficiency. Strong building companies and weak contractors benefits short term cost and not long term costs which lowers the energy efficiency (Nässén and Holmberg, 2005).

The concept of the customer is not trivial in energy matters. New car purchasers may not be representative of the driving public but have a dominant influence on the design decisions of the car (Brown, 2001). On average the Swedish buildings on the investment market changed owners every 6 to 7 years which does not lead to long term commitment (Ejdemo and Söderholm, 2010). The initial capital cost of a new building and the short-term profits outweighs the operational costs. Even if there are long-term ownership involved economic life cycle cost analysis are rarely done (Brown, 2001; Nässén et al., 2008).

3.4.4 Value in resource-based view

The resource-based view (RBV) has, since its introduction in the 1980s, been influential in the strategy literature (Eisenhardt, 2000; Priem and Butler, 2001a; Lavie, 2006). With the publication of *Competitive Strategy* by Porter in 1980, the focus shifted toward external, industry-based competitive issues (Priem and Butler, 2001a). RBV is an extension of the framework of Porter (1980, 1985) and the concept of competitive advantage (Hart, 1995) related to products (Wernerfelt, 1984; Barney, 1986), and the view of competition as the dominant state of the world rather than cooperation (Lavie, 2006).

The extension of RBV is the internal perspective with emphasise on resources (Wernerfelt, 1984; Barney, 1991; Squire et al., 2005). Wernerfelt (1984, p. 172) defines resources as "... (tangible and intangible) assets which are tied semi-permanently to the firm". Barney (1991) considers that resources are different types of assets, organisational processes, knowledge, capabilities, and other sources of competitive advantage. He also adds two conditions for what is a resource. A resource must be rare (not widely available) and be of value to the firm by contribute to the efficiency or effectiveness. A resource must be owned or controlled by the focal organisation (Wernerfelt, 1984; Barney, 1991). To become successful resources of an organisation must be able to raise "barriers to imitation" (Hart, 1995). RBV has been criticised for lack of ability to consider the influence of resources outside the control of an organisation

(e.g. alliance partners) that will affect the profitability (Squire et al., 2005; Lavie, 2006).

Use value and exchange value

Based on contributions made by classical economists, Bowman and Ambrosini (2000) agree that value has two main components, use value and exchange value. Use value is a subjective valuation by an individual customer based on the perception of needs and a set of qualities concerning the good that will meet those needs. This is valid to all purchases and not only the end customer (Bowman and Swart, 2007). Use value for a firm provides utility to create value that allows the monetary reward (Bowman and Ambrosini, 2000; Bowman and Swart, 2007; Bowman and Ambrosini, 2010). Exchange value is the price paid by the customer to the seller for a product or a service (Bowman and Ambrosini, 2000, Bowman and Ambrosini, 2010). Exchange value occurs only when the sale takes place in a single point in time and is a function of perceived user value (Bowman and Ambrosini, 2000, Bowman and Ambrosini, 2010). At the point of sale, two types of value exist: exchange value and perceived user value (Bowman and Ambrosini, 2010).

The judgement of use value, perceived use value, is made before the transaction and the consumption (Bowman and Ambrosini, 2000). Perceived use value is defined by the individual customer and is a subjective judgement of the usefulness based on the customer's perception. The selection system will influence what is considered to be value, especially in innovative or hard-to-value situations (Wijnberg, 1995; Wijnberg and Gemser, 2000; Priem, 2007). The selection of what is value or not, is commonly done by a market selection (Priem, 2007). Other selection methods are experts and critics (Wijnberg, 1995; Wijnberg and Gemser, 2000). Experts can decide which good will reach a market and critics can influence the perceived use value for a good.

The perceived use value in the transaction can be translated into monetary terms while the non transactional related use value cannot be translated into monetary terms due to its individual, subjective and non transactional features (Bowman and Ambrosini, 2000, 2010).

It is only when monopoly supplier exist that the price paid by the customer is equal to the price the customer is prepared to pay, the total monetary value. Otherwise, the price paid will be less than the user value creating a consumer surplus (value for money). Customer will chose the product that will give them the largest consumer surplus within their economic reach (Bowman and Ambrosini, 2000; Priem, 2007; Bowman and Ambrosini, 2010).

At the time of sale, the product/service has both an exchange value and a perceived use value (Bowman and Ambrosini, 2000). They consider that the consumer surplus can only be assessed at the point of sale. However, everything cannot be assessed at the point of sale. Use value is experienced by the consumer during use, where the experience will differ for the same good between different individuals (Priem, 2007). An industry's average offerings may be fulfilling the consumer to various degrees, since the average consumer might not exist in reality (Wijnberg, 1995).

According to Bowman and Ambrosini (2000) customers can only value what they perceive which make it virtually impossible for the customers to value the inputs of the production. What creates value is a matter for the management to decide. Value is something that is created by people from purchased inputs that has user value for the firm (Bowman and Ambrosini, 2000; Bowman and Swart, 2007; Pitelis, 2009; Bowman and Ambrosini, 2010).

The amount of exchange value added can only be determined after the point of transaction (Bowman and Ambrosini, 2000). The producer value for a good is, before the transaction, a potential (exchange) value (Kim and Mahoney, 2002; Ramsay, 2005; Pitelis, 2009). The actual exchange value is a realised value which may or may not be equal to the potential exchange value.

Regardless of the business, in the end firms contribute to benefit of the end customer, who is the source of all payments, even business-to-business (Band, 1991, p. v; Bowman and Ambrosini, 2000; Priem, 2007) The exchange value is distributed to a number of parties or stakeholders (Lepak et al., 2007). The seller's cost and profit is partly a result of earlier transactions upstream (Priem, 2001; Bowman and Ambrosini, 2010). This will affect the margin of the firm. However, it will not affect the use value in the produced product or service. To the customer the selling firm's margin is not of interest, just the creation of use value (Priem, 2001). In the long run the exchange value must exceed the producer's costs and the buyer (user) must perceive the user value large enough to buy the good or service (Lepak et al., 2007).

Value creation and value capture

A main objective of a firm is the capturing of value from the creation of value (Brandenburger and Nalebuff, 1995; Teece et al., 1997; Pitelis and Teece, 2009). Value creation and value capture differs. The value capture is linked to the profits of a firm, but it can not create product value (Priem and Butler, 2001a and 2001b). Value is created by the members of an organisation for the use value of the customer/buyer/user (Bowman and Ambrosini, 2000; Lepak et al. 2007; Priem 2007). The outcome of the value creation is not deterministic

(Bowman and Ambrosini, 2000). The exchange value is uncertain for different use values that has been created. Value capture concerns the proportion of the exchange value that a unit (e.g. department, firm. society) can retain from the customers' payments (Bowman and Ambrosini, 2000; Lepak et al. 2007; Priem 2007). Among organisations in a system, value created is only realised as value captured (Pitelis, 2009).

The total value creation equals the value capture for a system, a zero-sum transaction: (Priem, 2001). In a system where firms add production factors in order to create value, the firms strive to capture at least user payments proportional to their contribution (Priem, 2007). Value can be created and captured on and between different levels: individual, organisations, and society (Lepak et al., 2007). Together with Bowman and Ambrosini (2007) they recommend to view value capture and value creation as separate processes. Creation of value is a collaboration between consumers and producers (Priem, 2007).

Value capture is determined by the perceived power relationships and the bargaining positions different stakeholders have on the market, and the organisation and the employees (Bowman and Ambrosini, 2000; 2010). Some stakeholders will capture more than their share of value creation (even if the stakeholders have no part in the value creation), while the opposite are true for other stakeholders. A brand loyal customer have less bargaining power and is therefore prepared to pay more (Bowman and Ambrosini, 2010). The employees usually capture only a portion of their produced exchange value (Bowman and Ambrosini, 2000). The bargaining strength is a function of the capital structure (Bowman and Ambrosini, 2007). Embedded capital is a mix of human and separable capital, the separable capital, the less bargaining power of the employees.

There is a balance between value creation and value capture. Too much concern with value creation might drain an organisation of its ability to compete, while too much concern with value capture may result in insufficient development of competitive products/services (Pitelis, 2009) or maintenance (Bowman and Ambrosini, 2010). Also, the value slippage, when an actor create more value than what is retained, will in the long term result in no or little incentive to continue to produce value (Lepak et al., 2007). For example, employees perceive the firm as aggressively trying to capture all or nearly all of the value generated by the human resources, the result may affect productivity and innovation negatively (Bowman and Ambrosini, 2007). Another example is the bad will a perceived unjust value capture can result in

(Lepak et al., 2007). Value capture may improve profit for a firm, but it will not create or produce a good since value creation is a precondition for value capture (Priem, 2001, Priem 2007).

Stakeholders

Bowman and Ambrosini (2010) apply the exchange and use value to describe the primary stakeholders (customers, employees, suppliers, investors). The action taken by a firm is to create exchange value for the investors. To do that use value for the customer must be created. The use value for a produced good is most likely almost zero. The value for a supplier is the inverse of what is value for a customer. The use value for a producer can be found in the goods from the producer's supplier. In a supply chain, among firms, there is a transformation from user value to exchange value. The two exceptions are customer, exchange value is traded for use value, and investors where exchange value is the only value type, see table 3.5.

Table 3.4 Summary of primary stakeholder and the relations between use and exchange value (Bowman and Ambrosini, 2010)

Primary stakeholders	Meaning of value
Customer	Optimise the ratio between use value and exchange value
Employees (or human suppliers)	Optimise the ratio between exchange value and use value
Suppliers	Optimise the ratio between exchange value and use value
Investors-Owners	Optimise the ratio between invested exchange value and return exchange value

3.4.5 Value in marketing

Compared to RBV, marketing has a longer history. The view of marketing, with its origins in the distribution of goods, has evolved over the years from the start in the early 1900s (Vargo and Lusch, 2004). The early years was dominated by the justification, differentiation and classification of the discipline. When Coase (1937) discussed transaction throughout The Nature of the Firm, he did not use the term "transaction costs" (the cost of using the price mechanism) that is used now. The "transaction cost" was called "marketing cost" by Coase (1937) (Webster, 1992). In the 1940s an issue was how to measure the productivity in marketing when marketing lacked a traditional production (Cox, 1948). Marketing was seen as a function to facilitate "the flow of goods and services from producer to consumer or user" (Alexander,

1948, cited in Webster, 1992). As the role of marketing changed from distribution to sales, marketing became a matter of optimisation (Webster, 1992; Matthyssens and Johnston, 2006). With focus on sales, the role of marketing became to influence the presumtive customer to become a customer. Kotler (1972, p.50) describes marketing as "... an approach to producing desired responses in another party that lies midway between coercion on one hand and brainwashing on the other. Coercion involves the attempt to produce a response in another by forcing or threatening him with agent-inflicted pain. ". Kotler (1972) also concludes that marketing is a matter for both business and nonbusiness.

The theoretical foundation in marketing is based on the view from economics regarding the exchange of goods (Vargo and Lusch, 2004). With a transaction view, value is embedded in the product (good or service) which is too simplistic (Grönroos, 1997). Several researchers have raised the question regarding a more suitable theoretical foundation for marketing (Alderson and Cox, 1948; Bagozzi, 1984; Tzokas and Saren, 1999; Grönroos, 2006). Concerning value two areas have been influential in the theory development within marketing, the questioning of exchange (value) and goods versus services.

Marketing has changed during the 1900s from a goods-dominant view based on classical and neoclassical economics towards a service-dominant view, where marketing is viewed as an economic and social process. This has led to a change from a focus on exchange value with goods embedded with value to value in use as well as a change from operand resources (resources that are acted on) to operant resources (resources that do the acting). (Vargo and Lusch, 2004)

There has been an agreement regarding the multidimensional properties of value in marketing (e.g. Lehmann and O'Shaughnessy, 1974; Evans, 1980; Zeithaml, 1988; Woodruff, 1997; Woodall, 2003; Heinonen et al., 2013). The examples from 1970s to the 1990s represent the objective, economic view where the producer is in control of value. The latter two, 2003 and 2013, represent the research where concept of value is more complicated than a set of properties for a product due to its subjective and individual nature.

Exchange value and service

The work of Alderson (1957) concerning the exchange value became a major construct in marketing research where exchange concerns receiving or giving

one thing in return for another (Anderson et al., 1999; Sheth and Uslay, 2007). According to Kotler (1972) the transaction (exchange) is the the core concept in marketing. Bagozzi (1975 and 1979) suggest that the exchange should be the foundation in the marketing research. In 1985 the word "exchange" became a part of the official definition of marketing by American Marketing Association (Sheth and Uslay, 2007).

Even if the concept of exchange value is based on Smith (1776), the concept is regarded as more complex than an act between two parties. Bagozzi (1975) describes three types of exchange with several stakeholders and relations: restricted, generalised, and complex. A pure exchange is rare, the majority of the transactions are linked to a relation (sellers, buyers and other stakeholders), wanted or unwanted (Bagozzi, 1975; Grönroos, 1997; Vargo and Lusch, 2004; Payne et al., 2008).

While the exchange value was investigated, the use value was never investigated to the same degree (while the exchange was the main concern). Grönroos (1979, p. 86, cited in Grönroos, 2008) separates use value and exchange value, where a service has use value and a product has exchange value for the consumer. The prime concern, for a customer, is what can be achieved from a purchase and not the purchase itself (Houston and Gassenheimer, 1987; Grönroos, 2008). Grönroos (2008) conclude that with value-in-exchange the focus becomes the resources used to achieve value-in-use for the customer. The emphasis is on the exchange partner to the seller, the customer, not the user.

Marketing has been overshadowed by value-in-exchange, a construct that focus on the supplier (Sheth and Uslay, 2007), Tzokas and Saren (1999) conclude that the research of value has been lacking in marketing. Marketing has moved from an exchange focus to broader focus of relations and partnership (Tzokas and Saren, 1999; Lusch et al., 2010) as well as service and value-in-use (e.g. Grönroos, 1982; Vargo and Lusch, 2004; Grönroos, 2006; Heinonen et al., 2013). The focus on exchange as a fundamental construct is no longer valid (Sheth and Uslay, 2007; Grönroos, 2008; Vargo and Lusch, 2004). With the change from exchange to value creation there is a change from self-interest (win–loss) to mutual interest (win–win) (Sheth and Uslay, 2007).

The separation of value for products and services by Smith (1776) and his followers has been questioned in marketing related research. The division between goods and service hinders the understanding of value. The research in service has developed the concept and understanding of value within the

marketing field. According to Vargo and Lusch (2011) the service-dominant logic, instead of the goods-dominant logic, broadens the perspective of exchange and value creation. From the marketing perspective, goods is just as perishable as services, especially standardised goods without customer involvement (Vargo and Lusch, 2004; Vargo and Morgan, 2005). Very few offerings can be viewed as either product or service (Normann and Ramirez, 1993). The service logic is more suitable for the good producing business today than the goods logic (Grönroos, 2006). The role of goods can be understood applying a service perspective, but the reverse is not possible (Dixon, 1990). Hence, service should not be regarded as a special case since there are no fundamental differences from a value creation perspective (Edvardsson et al., 2005; Grönroos, 2008). However, there is not a uniform view of the service concept. The service-dominant logic is still production focused and lacks a customer focus (Heinonen et al., 2010).

Value-in-use, other types of value and customers

The transfer from economic theory and its value concept to management and marketing has led to competing logics and misunderstandings (Normann and Ramirez, 1993; Vargo and Lusch, 2004; Grönroos, 2006). The traditional view of value is based on models and assumptions from the industrial economy, where value is added similar to the assembly line (Normann and Ramirez, 1993; Heinonen et al., 2013). The consumer has been regarded as a passive target with the primary activity to consume the provided goods or services in the exchange (Vargo and Lusch, 2011). To regard the producer as the value creator and the consumer as the value destroyer is too simplistic, and distort the concept of value creation since all social and economic actors are resource integrators (Gummesson, 1998; Tzokas and Saren, 1999; Vargo and Lusch, 2011).

The transformations and activities in a product are not sufficient to create value without the good is used by the customer (Grönroos, 1979, p. 79, cited in Grönroos, 2008). The good itself has a potential value that is transformed to real value in the use (Grönroos, 2011). Gummesson (1993, p. 250, cited in Vargo and Morgan, 2005) argues that customers do not buy goods or services: they buy offerings which render services which create value. Grönroos (2008) take a similar view, for customers the purchase is not as important as the use of what the customers have obtained. The enterprise can only make value propositions (Vargo and Lusch, 2004 Grönroos, 2011). However, this is a sign of an organisation dominant position regarding value creation (Strandvik et al., 2012). Also, the high information asymmetry is in favour of the seller, makes

the customer's (consumer's) evaluation of options limited within the exchange paradigm (Sheth and Uslay, 2007).

With a wider set of dimensions, value becomes more difficult to define and measure (Wilson and Jantrania, 1994; Grönroos, 2008; Grönroos and Voima, 2013). For example, value-in-exchange is a function of value-in-use, but usually value-in-exchange occurs before the value-in-use (Ravald, 2001, cited in Grönroos, 2008). The fulfilment of exchange value from potential value is not the same as value. Value-in-use is just as important for the supplier as it is for the customer, but value-in-use is harder to observe and measure (Grönroos, 2008). Especially, when considering that the value-in-use is dependent of the customer's context (Heinonen et al., 2010). The value-in-use is more than the actual use and emerges also before the use in form of anticipation and after the use in form of memories (Heinonen et al., 2010). However, Grönroos and Voima (2013) regard it impossible that value-in-use can exist before it is created in usage.

The attention on value-in-exchange leads to a short-term focus with less consideration for value creation and limits the perceived roles and responsibilities of the involved parties. This hinders the value creation since value cannot be created in isolation of the stakeholders. Apart from the sellers and buyers involved in the exchange, multiple stakeholders are involved, for example community, and society at large that will facilitate the value creation. (Sheth and Uslay, 2007)

Other dimensions that are proposed are time and trust. Value does not occur in a point of time, it is developed over time (Ravald and Grönroos, 1996; Grönroos, 1997; Woodall, 2003; Heinonen, 2004). Organisational trust is an important part of value (Wilson and Jantrania, 1994).

Woodall (2003) takes a holistic approach when he discusses both object and subject based on views of value. Objects have physical and nonphysical dimensions related to value. Regardless of the value, an object has properties that have a quality. If the object is valued, it will also have an intrinsic value. He considers exchange value to be object-based (affected by the nature of the object and the market) while use value is subject-based (percieved in the interaction between the subject and the object). Woollard (2003, p. 5) concludes that value is: "... neither use, nor exchange; it is neither object-based, nor subject-based; it is neither my view, nor your view, it is all of these things.". This conslusion is not in line with part of the research within marketing that has gone from exchange focus to use focus.

The concept of the customer has not gone unchallenged since value creation became a part of the marketing research. The customer concept has been taken for granted, where the customer is defined by the provider (Heinonen et al., 2010). Customer value goes beyond the individual and subjective, value is a part of collective and intersubjective context (Heinonen et al., 2010). For the customer, value has social dimensions such as acceptance and appreciation (Grönroos, 2008). Part of the value for the customers might be to communicate status, social position and taste (Tzokas and Saren, 1999). Measurements of customer value tend to focus on operational variables which are a momentary and fragmented measure of a higher construct (Tzokas and Saren, 1999). They warn for reducing the higher construction of customer value to just low-level operational measurement with a minor understanding of the concept. This means that value has a limit to how far it can be decomposed.

Hence, value-in-use is not only linked to the service process, but extends beyond the interactive process. For example, when thinking about a holiday trip, customer value can emerge before the trip, value is created during the holiday, but also after the holiday in terms of memories. The role of companies would thus be to understand the customers' value creation processes embedded in customers' practices and contexts. (Heinonen, 2010)

Value Creation

From the 1990s value creation and where it take place has been of interest in the marketing literature (Grönroos, 2008). Grönroos (2011) warns for viewing value creation as an all-encompassing process including everything since it will result in no explaining power. The creation of value cannot occur without the user is involved in the value creation (Grönroos and Voima, 2013; Heinonen et al., 2013). It is formed in use where value emerges through behavioral and mental processes and not limited to the resource frame controlled by the producer (Heinonen et al., 2013). But value is still to a degree based on the resources of the provider. Value creation is related to value-in-use and it improves something for the user (Grönroos, 2008). In the value-in-use concept, customers are the main creators of value (Grönroos, 2006).

Normann and Ramirez (1993) consider value to be co-produced by different actors (e.g. suppliers, business partners, and customers). According to Grönroos and Voima (2013) value can be created in three ways: by the provider (production of potential value), in cocreation by the provider and the customer (real value), and by the customer with the provider as a value facilitator (real value). Sheth and Uslay (2007) consider the cocreation as the

general case and the cases, where a single agent is the major value creator while the stakholders are enablers, are the special cases. Grönroos (2008) has a similar view, value creation and cocreation are distinct. On the other hand, Vargo et al. (2008) argue that since the roles of producers and consumers are not distinct, value is always cocreated. According to Vargo and Lusch (2011) actors cannot create value for other actors but actors can make offers with potential value (Vargo and Lusch, 2011). This resembles the view taken i RBV, where a firm transforms use value with resources required in exchange value transactions to create new exchange value and use value for the customer/user. Vargo and Lusch (2011) suggest that the notion of 'actor-to-actor' or 'business-to-business' to create a systems perspective of the market. Customer practices may be performed in an unconsious manner which makes 'emerging value' more suitable than 'creating value' (Korkman, 2006 cited in Grönroos, 2011; Grönroos, 2008; Heinonen et al., 2010; Heinonen et al. 2013).

3.4.6 Value in a lean context

Lean, like RBV, has a shorter history than marketing. The term "lean" originates from a generic description of Toyota Production System (TPS) (Karlsson and Åhlström, 1996; Hines et al., 2004; Emiliani, 2006; Näslund, 2008; Samuel et al., 2015). In the 1980s there was a belief in the power of the Japanese production and the Japanese economy (Södahl, 1984; Flood, 1993; Schonberger, 2007; Huxley 2015). With the decline in Japanese economy the interest turned from the general Japanese company to a specific, successful company, Toyota (Huxley, 2015). Krafcik (1988) presented the term lean to describe TPS and used the word "buffered" to describe mass production system. This typology was built on earlier work by Haruo Shimada and John Paul MacDuffie, who used the terms "fragile" (for lean) and robust (for buffered) (Krafcik. 1988). Milgrom and Roberts (1990) called TPS "modern manufacturing", but their term did not became popular. Instead, it was Womack et al. (1990) that popularised both the term and lean itself (Schonberger, 2007; Stentoft et al., 2013; Huxley, 2015). Both advocates and critics accepted the term (Williams, 1992; Huxley, 2015).

Lean can now be found in a variety of fields beyond the automobile industry (Stentoft et al., 2013; Huxley, 2015; Samuel et al., 2015). The concept is applied in contexts outside large-scale manufacturing operations and production, such as in small to medium-sized manufacturing organisations (e.g. Enoch, 2013) and in a variety of industries ranging from construction (cf. Hicks, 2007; Gao and Low, 2014) to healthcare (cf. Kim et al., 2006; Young and McClean, 2008). From the 1990s and forward, lean has become a major

paradigm in both research and practice, (Katayama and Bennett, 1996; Emiliani, 2006; Stone, 2012; Bhamu and Sangwan, 2014; Samuel et al., 2015).

Lean is in many cases regarded as the solution for organisations (e.g Womack et al., 1990; Womack and Jones, 1996; Bicheno, 2004; Samuel et al., 2015). The Company of choice to describe the success of lean is still Toyota (e.g Womack et al., 1990; Womack and Jones, 1996; Jasti and Kodali, 2015; Samuel et al., 2015). To describe the success of Toyota different measures have been used over the years, usually without any connection to the user/customer. Some of the measures Womack et al. (1990, pp. 81, 83, 118, 157, 202-203) use are: assembly plant productivity, assembly plant quality, resources used, output in numbers, setup times, number of JIT deliveries, and hours/vehicle. Womack and Jones (2005, p. 3) draw the conclusion that Toyota is one of the few successful Japanese car manufacturers. New (2007) used among the measures average profit margin (Toyota: 8.2 percent; Ford: 3.9 percent) and average gross profit (Toyota: 27.0 percent; Ford: 20.8 percent) for the period 1996-2005. Womack et al. (1990) use assembly plant productivity and assembly plant quality plus som other additional measures.

Despite the popularity of lean, there are a number of theoretical and methodological concerns regarding the actual competitive impact of the lean production model (Williams et al, 1992; Lewis, 2000). Stentoft et al. (2013) find little evidence of positive effects in the majority of the reviewed articles. According to Ivarsson (2013) the failure of lean implementation is partly the focus on customers instead of the system. Schonberger (2007) use inventory turnover (a ratio between annual cost of sold goods and the value of inventory) to indicate how lean Toytota is. The measure is an indication of the flow in the whole company (Williams et al., 1992). In article by Williams et al, (1992), where lean is criticised, Toyota performs better than the other car manufacturer in the period 1982-1991. The lowest ratio is 22.1 in 1986 and the highest ratio 27.2 in 1991. According to Schonberger (2007) the turnover has not improved in 17 years and has been halved to 11.1 turns in the last 12 years which is in the region of GM. (In the period 2007-2016 the yearly turnover has varied from 10-12.86 (http://www.gurufocus.com/term/InventoryTurnover/TM/Inventory-Turnover/Toyota-Motor-Corp)).

Narashimhan et al., (2006, p.443) consider fast response to uncertain and changing demands not to be a part of lean. They propose the following definitions of lean: Production is lean if it is accomplished with minimal waste due to unneeded operations, inefficient operations, or excessive buffering in operations. However, a definition of lean is lacking (Hines et al., 2004; Pettersen, 2009; Stentoft et al., 2013). Bhamu and Sangwan (2014) discuss the

numerous views concerning both definitions and goals in lean manufacturing, e.g. lean as a concept, a philosophy, an approach, a practice, a set of tools and techniques, a system etc. further, the goals of lean can be; removal of waste from the system, reducing cost/produce more with less, reducing lead time, etc.. For example, Emiliani (2011) discuss "true" lean and "fake" lean. This becomes a problem in the evaluation of a lean effort similar to TPS as New (2007, p. 3547) concludes: " ... nearly all of the claims made by TPS and lean advocates are in the Popperian sense unscientific; they are immune from falsification". (This is not to incriminate Emiliani, who is one of the few that has gone beyond TPS and describe the work of Woollard who implemented a flow production system in the 1920s, see Woollard and Emiliani, 2009; Emiliani and Seymour, 2011).

Two of the main concepts in lean are value and waste. Value is the starting point of lean and is defined by the ultimate customer (Womack and Jones, 1996, p. 16). Despite this statement, Browning (2003) and Hines et al. (2004) argue that the emphasis has shifted away from customer to waste. A hallmark of lean is the systematic elimination of waste (Katayama and Bennett, 1999; Andersson et al., 2006; Hallgren and Olhager, 2009; Stone, 2012; Stentoft et al., 2013; Jasti and Kodali, 2015; Wittrock, 2015). In practice, this is equal to minimise the use of resources within the production contexts (Katayama and Bennett, 1999; Christopher, 2000; Bruce et al., 2004; Agarwal et al., 2006). Hence, lean focus on the input.

Toyota has been and still is the company of choice to describe a lean company (e.g Krafcik, 1988; Womack et al., 1990; Jayaram et al. 2010; Samuel et al., 2015). Toyota and lean are different (Towill, 2007; Jasti, 2015; Wittrock, 2015). According to Wittrock (2015, p. 98): "even Toyota is not yet a full-blown lean enterprise as Womack and Jones envision it".

From value added to value creation

The early lean or TPS related literature emphasise productivity and efficiency over value. None of the Japanese authors who describe TPS define value explicitly (e.g. Sugimori et al., 1977; Shingo, 1984; Ohno, 1988; Monden 1998). Sugimori at al (1977) discuss added value without defining the term. The other authors consider that value is created in production processes that involve some kind of transformation (Shingo, 1984, p. 103; Monden, 1998, p. 179; Ohno, 1988, p. 57). From a consumer perspective the price is important, the price must be in proportion to the value of the car (Ohno, 1988, pp. 85-86). This can be regarded as a form of benefits and sacrifice and relates to the value quotient, see eq. 3.3.

The lean related literature is similar, Krafic (1988) focus on productivity related topics. According to Womack et al. (1990, pp. 78 and 99) value is added in processing that changes the shape or character of a product or assembly in which workers add value to a product. The customer is by large absent not the producer. However, Womack et al. (1990, pp. 183) consider that a customer buys a car that fit the customer's needs.

In 1996 Womack and Jones published Lean thinking: Banishing waste and creating wealth in your corporation. There is less focus on productivity and efficiency compared to the previous book from 1990. Value is no longer added. It is created (e.g. Womack and Jones, 1996, p. 16). Value becomes a key concept in lean as Womack and Jones (1996) declare value as the starting point of lean thinking. According to Womack and Jones (1996, p. 16) value is:"only meaningful when expressed in terms of a specific product (a goods or a service, and often both at once) which meets the customer's needs at a specific price at a specific time". Neither the concepts of customer or needs are defined or elaborated further. The customer is a recipient of value. The customer pulls value from the producer (Womack and Jones, 2005, p. 2). Value is created by the producer and the parts of value are traceable and measurable in the production (Womack and Jones, 1996, pp. 16-28; Hines and Rich, 1997; Hines et al., 2002). This view is similar to Marx's labour theory of value as a part of strategic management described by Priem (2007) and Heinonen et al. (2013).

Womack and Jones (1996) also identify three types of activities: value-adding activities (Type 1), necessary activities for the value production but not value-adding (Type 2), and activities that are not necessary to create value (Type 3). Browning (2003) considers that three types are sensitive to the resolution. The value of a process is more than the value of its individual activities. A decomposition ad infinitum of the value-adding activities, will in the end result with only one value adding activity, the overall process. The notation of "value-added activities" leads to a focus on individual activities without consider the waste caused by the structure of the overall process,

Value as the starting point of lean thinking has been recognised by numerous authors without further addressing value (e.g. Hines et al., 2002; Arbulu et al., 2003; Bhasin and Burcher, 2006; Wan and Chen, 2008; Samuel et al., 2015). In some cases the recipient of value is identified (e.g. Karlsson Åhlström, 1996; Nightingale and Mize, 2002; Braglia et al., 2006). In a few cases value is addressed further. Wan and Chen (2008) consider value to be a combination of finished products, functionality, customer satisfaction (quality, on-time delivery, service level, etc.). Hines et al. (2004) define value to be "a wider and

more complex range of tangible and intangible attributes such as brand, image, environmental issues and local production". Quality, cost and delivery are not considered to be strategic aspects of value apart from mature industries. Also, Oliver et al. (2007) have discussed the individual perception of value among the customers. Debates between different authors regarding their different views of value are hard to trace. Browning and Heath (2009) regard value is an emergent property of a complex process, more than the sum of the values provided by its activities. Also, they consider value as a dynamic quality linked to the outputs instead of being an intrinsic property. The proposal of Hines et al. (2004), Oliver et al. (2007) and Browning and Heath (2009) has not influenced the view of value like Womack and Jones (1996) have (see also paper III, appendix A).

Stakeholders

Customers and Employees are the most frequent stakeholders mentioned. According to Womack et al. (1990, pp. 248-249) workers share their faith with the lean company instead of being unemployed. Hines et al. (2004) suggest that there must exist a plan for the redundant workers in lean improvement project which is not elaborated further. It is debatable whether lean provide a better work life or not (Huxley, 2015).

3.5 Waste

Just like value, waste can have a number of different meanings. A very common meaning of the word relates to disposals. Unlike value, waste is not a main concern for a majority of the cited authors concerning value. According to Koskela et al. (2012) the concept of waste is not present in the mainstream literature within several fields of research such as economics, operations management.

The first use of the English word was around 1200 meaning "desolate regions" (Online Etymology Dictionary, citied in Koskela et al., 2012). The word originates from the Latin word vastum that was used in the Domesday Book (1086) meaning "desolate regions" (The Domesday Book Online, citied in Koskela et al., 2012). The Domesday Book had several purposes: assessments of taxes and to estimate the annual value of the land (The Domesday Book Online). Clark and Clark (2002) investigate the common land in England during 1475-1839. The landless poor had only access to the land that was the common waste. Meaning land that was: " used only for rough grazing and fuel gathering, and to which generally all members of the village had access". In

this context, described by Clark and Clark (2002), value and waste are each other's opposites describing the state of a similar type of unit (land), where waste was used in the meaning no or little use (value).

According to Koskela et al. (2012) the concept of waste can be divided into a number of periods: the birth of the concept in the 18th century, the classical notation and the expansion during the scientific management, the decline in the second quarter of the 20th century and the revival in the last quarter of the same century. Johansson et al. (2013) consider two periods from a production perspective: the start with Adam Smith's division of labour in 1776 followed by Frederick Winslow Taylor's 'The principles of scientific management' in 1913. Ever since the introduction of scientific management, industrial production has: "...continually been on a diet, but its character has varied over time..." (Johansson et al., 2013, p.448).

In Taylor's *Shop Management* (1911a) and *The Principles of Scientific Management* (1911b), the view of waste is linked to efficiency and output. The goal is the greatest prosperity which requires "the highest state of efficiency". Two necessary conditions to achieve this prosperity is working with the "fastest pace and with the maximum of efficiency". Taylor (1911b) stress the fact that planning of work is a prerequisite to efficient production and not a waste of money if the methods are scientific.

A hallmark of lean is the elimination of waste (Benders and van Bijsterveld, 2000; Browning and Heath, 2009; Stone, 2012). While lean, in a majority of the literature, has a similar view of what waste is, the quality movement lacks this similar view and instead has a general definition of poor-quality-costs (Pettersen, 2009; Sörqvist, 1997a, 1997b). Waste is in Japan much larger than a relation between a producer and a customer. It is a part of the Japanese society and history (Wittrock, 2015).

Grünberg (2004) considers the concept of loss/waste (from the Toyota Production System) as a focus on the input side of the different types of ratios. The concept of losses can reveal information that are hidden in the measurements of performance, productivity and profitability.

The concept of waste can also be viewed from a holistic perspective as an unwanted outcome of a system (Saunders and Preston, 1994; Dalu and Deshmukh, 2002), see figure 3.6. The reduction of waste is a result of processes and products that are dependent of a number of working prerequisites and fundamentals. The valuable outcomes are quality and reduced

variation. Waste is an output and waste reduction is dependent of a working infrastructure that can support the improvement work of reducing the waste (Saunders and Preston, 1994).

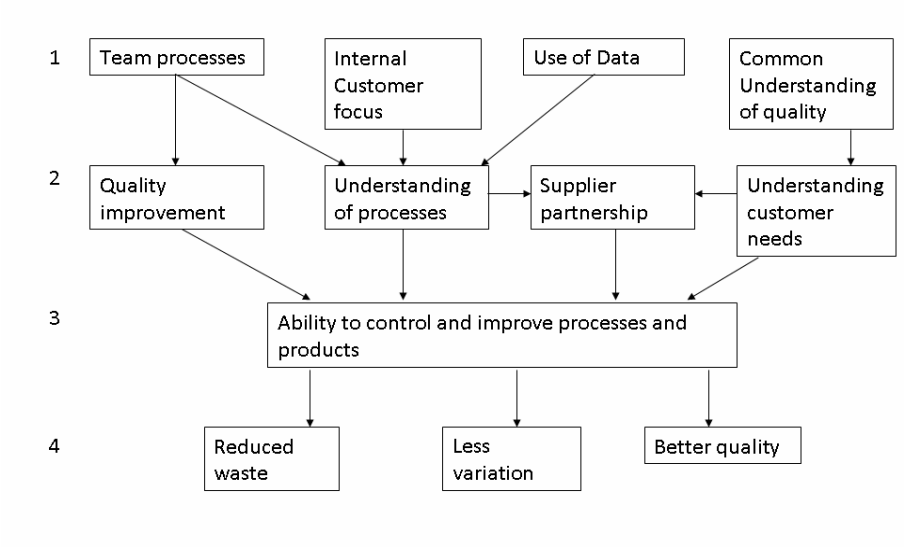

Figure 3.6: S-P model.

The work of Taguchi is related to waste by his loss function, see eq 3.4. The loss concept goes beyond the customer and regard the lifespan of a product (e.g. Kethley et al., 2002; Liao and Kao, 2010; Celano et al., 2014). According to Tachuchi (1986) quality can be defined as: "... the loss a product causes to society after being shipped, other than losses caused by its intrinsic functions". He considers that quality and value are different since value is subjective and matter for the marketing department. Also, the matter of taste and fashion will affect value. One exception, according to Taguchi (1986), is when better quality can offer the same function with less loss such as the transition from vacuum tubes.

The equation, see eq 3.4, describes the magnitude of loss, L(y) caused by the difference between the target value for a certain characteristic (y) and the nominal value (m). According to the function it is not sufficient to be within the control limits. The variation should be reduced to be as equal as possible to the target value. (Liao and Kao, 2010)

$$L(y) = (y - m)^2 \quad (3.4)$$

3.5.1 Waste in resource-based view and marketing

The research in RBV is focused on value and waste has not been a topic in the articles used in this thesis. Waste is also largely missing in marketing apart from the oldest articles when distribution was a concern for marketing. Waste or efficiency is linked to productivity (Alderson and Cox, 1948; Cox, 1948).

3.5.2 Waste in a lean context

Waste in TPS

Cost is of great importance in TPS. The developer of TPS, Ohno (1988), regard the "total understanding", identification, elimination of waste and its causes, as fundamental part of the production system. TPS is a method to: "thoroughly eliminate waste and enhance productivity" (Ohno, 1988, p. 54). In 1945 the president of Toyota gave the company three years to reach the levels of American productivity in order to be competitive, a tenfold increase of productivity (Ohno, p.3). Waste is related to production and refers to elements of production that: "only increase cost without adding value" (Ohno, 1988, p. 54). According to Shingo (1984, pp. 96-104, 192) the non-cost-principle requires the reduction of cost which in turn requires the elimination of waste. According to the non-cost-principle an increased profit is a result of lowering the cost, not raising the price (Shingo, 1984, pp. 100-102). Efficiency is not a goal unless it is linked to a cost reduction (Ohno, 1988, p. 18). TPS is a low cost production system through the elimination of waste (Sugimori et al., 1977) where the ultimate goal is increasing profit by reducing waste or improvement of productivity (Monden, 1998, pp. 1 and 63).

The definition of waste are more specific than the value definitions. Waste occurs when more than the minimum amount of resources is used (Sugimori et al., 1977); loss (waste) is something that is unnecessary (Shingo, 1984, pp.103 and 183; Ohno, 1988, p. 19). Monden (1998, pp. 2-3) categorise four types of waste: excessive resources, overproduction, excessive inventory and unnecessary capital investment. Reasons for waste are insufficient standardisation and rationalisation (Ohno, 1988, p. 41). There are seven wastes that also can be referred to muda which means waste (Womack and Jones,

1996; Pettersen, 2009). The seven wastes are (Shingo, 1984, pp.103 and 183; Ohno, 1988, p. 19):

1. Overproduction: production without a customer order, which creates inventory. The worst type of waste according to Sugimori et al. (1977) and Monden (1998, pp. 2-3).

2. Waiting: goods or employees that cannot actively be used or participate in production due to a lack of available work or process time.

3. Transportation: moving materials, parts etc., that require transformation.

4. Waste of processing itself (inappropriate processing or over-processing): waste of processing itself by doing more work than the customer expects.

5. Inventory: an excess of raw materials, work in progress (WIP) and finished products

6. Movement: excessive movement of workers during production.

7. Defective products: the production or correction of defective work.

Capacity is of great importance when waste is considered. Ohno (1988, p.19) links waste with capacity (Present capacity = work + waste). The available capacity is not always used to its full potential. According to Shingo (1984, pp. 95-98) since workers are more costly than machines, TPS focuses on high utilisation of workers while the machines can be idle depending on the demand. Hampson (1999) describes two other types of waste: muri and mura. Muri translates to overburden, when man and machine are used beyond their capacity. Mura is irregular or inconsistent use of man and machine. Sugimori et al. (1977) regard levelling of production as a cornerstone of TPS and thereby avoiding mura.

The view of waste in TPS tends to be described quite colourful (e.g. Ohno, 1988 and Womack and Jones, 1996). Ohno (1988, p. 59) considers that success is not possible unless all sources of waste are "detected and crushed". The seven wastes are overproduction, waiting, transportation, waste of processing itself (inappropriate processing), inventory, movement, defective products (Shingo, 1984, pp.103 and 183; Ohno, 1988, p. 19). However, according to Shingo (1984, p.148) Ohno did not recommend waste reduction in every single case. For example, inventory was allowed if it had a lower cost than the alternative.

Waste in lean

The start of waste in lean was humble before it became a major topic. Similar to the modest discussion regard value, waste is not a major topic for Womack et al. (1990). Waste (muda) is exemplified as rework and waste is regarded from the view of the producer (Womack et al., 1990, p. 105). Waste is not present in the index either. The discussion of waste is not necessary a must in the early lean related literature (published in the first part of the 1990s) where waste may not be mentioned at all (e.g. Cusumano, 1994; Warnecke Hüser, 1995). The seven types of wastes, described in the previously, had yet not made its mark in lean despite several authors describing the wastes (Shingo, 1984; Schonberg, 1986, cited in Shah and Ward 2003; Ohno, 1988).

In the sequel to Womack et al. (1990), waste is a central theme. Efficiency is not a central theme compared to the previous book. Womack and Jones (1996, p. 15) criticise the process reengineering for destroying jobs to increase efficiency. In the early 1990s business process reengineering was popular a popular management concept (Näslund, 2008). Womack and Jones Womack and Jones (1996) describe also another view of waste compared to TPS. Waste is a: "human activity which absorbs resources but creates no value" (Womack and Jones, 1996, p.16). In addition, the authors consider that waste is when the needs of the customer is not fulfilled and also the seven types of waste is present. The seven types of wastes are more frequently mentioned post 1996 than pre 1996 (e.g Hines and Rich, 1997; Arbulu et al., 2003; Ballard and Howell, 2003; Kollberg et al., 2006; Chen et al., 2010; Pool et al., 2011).

Womack and Jones (1996, pp.38-48) also divide a process into three categories: value-adding activities, necessary activities for value production but not value-adding (Type 1 waste or muda), and activities that do not add value (Type 2 muda). Waste is linked to value and the customer. Cost and capacity is not explicitly discussed. Definition that relates waste to value as "non-value" is also used (e.g. Åhlström and Karlsson, 1996; Braglia et al. 2006; Moyano-Fuentes and Sacristán-Díaz, 2012).

The link between value and waste is addressed by Hines et al. (2002) and Hines et al. (2004). Hines et al. (2002) consider that the understanding of customers, processes and costing is linked to operational level. Hines et al. (2004) regard the understanding of value as a strategic matter while the elimination of waste is an operational matter. According to Hines et al. (2002 and 2004) if waste is decreased value is created when the wasteful activities and its costs are reduced. Value is increased if waste is decreased, in addition

value can be increased if additional features are presented to the customer, which the customer values (Hines et al., 2002 and 2004), see figure 3.7.

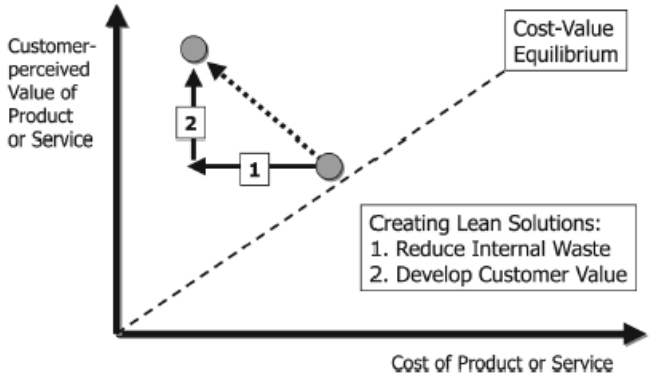

Figure 3.7: Relation of value, cost and waste from Hines et al. (2004).

3.5.3 Identifying waste

The tools used in lean are basically the same tools that previously were considered to be just-in-time tools (Schonberg, 2007; Näslund, 2008). While tools like 5S (5S's (Sort – seiri, Set – seiton, Shine – seiso, Standardise – seiketsu, and Sustain – shitsuke) can reduce cost and improve efficiency it is mainly a tool for securing the infrastructure of the production (Browning and Heath, 2009; Näslund 2008). 5S is a tool used by Toyota but its origin is unknown (Schonberg, 2007). Two lean tools for identifying waste are ''five whys'' and value stream mapping (VSM). ''Five whys'' is a method to find the relations between causes (Bamford and Greatbanks, 2005) used by Toyota to eliminate waste (Shingo, 1984, p. 192). The five whys might be insufficient to find the root causes (Browning and Heath, 2009).

VSM is regarded as a suitable tool for identifying waste and improve performance by removing waste (e.g. Hines & Rich, 1997; Braglia et al., 2006; Domingo et al., 2007, Chen et al., 2010). A value stream is all materials and information required to produce a particular product and the flow through the production system. VSM is a holistic tool to map the present state in order to create the ideal state (Braglia et al., 2006; Chen et al., 2010). According to Braglia et al. (2006) one of the advantages with VSM is that it links 'Product

Planning' and 'Demand Forecast' to 'Production Scheduling' and 'Flow Shop Control'.

However, since VSM was first developed in the automotive industry with its focused factories and narrow family of products, the standard VSM is suitable for linear, deterministic high volume situations with little variability (Braglia et al., 2006; Braglia et al., 2009). Hines et al. (1998) warn for the lack of link to corporate strategy and non evaluated key processes in different business and supply chain environments. VSM is dependent of how it is performed. Forno et al. (2014) conclude that the despite the advantages of VSM, it can produce poor results that in turn might lead to bad decisions technically as well as financially. They classified prerequisites that must be fulfilled. Some of these prerequisites are: integration between processes, clarity of procedures, competence among the involved people, process stability, measuring data in processes.

4 ANALYSIS OF THEORY

This chapter is an analysis of the frame of reference. The different production systems are analysed from an internal and external perspective. Value and waste are discussed and a conceptual model concisting of four types of value are proposed.

4.1 Productions systems and their context

The different production systems have their different strengths and weaknesses depending on the perspective. Based on the internal performance objective, linked to efficiency (doing things right), it is questionable if Singer should have continued with their mix of men and machines, see table 4.1. The production was not error-free, reliable or had a fast throughput. The files and workers could compensate for processes and operations but not increase the throughput. The arms manufacturing of the American system of manufacturing (ASM) performed better concerning the performance objectives. Both Ford and Toyota did improve on performance objectives and increased both efficiency and productivity. Toyota did not try to improve the productivity and efficiency in isolation. The utilisation of the machines was not a major concern. It was lowering the cost.

Table 4.1: Summary of the different production systems based on performance objectives. The evaluation is based on contemporary alternatives.

Internal performance objectives	ASM	Singer	Ford	Toyota
Error-free processes	Improving	Improving	Yes	Yes
Ability to change	No		No	Yes
Reliable operation	Improving	Improving	Yes	Yes
Fast throughput	Yes	No	Yes	Yes
High total productivity	Yes	No	Yes	Yes

If the analysis is based on external properties, different dimensions of value, Singer performed better, see table 4.2. The workers with their files added the quality that was lacking. The interchangeability from ASM was not good enough. The machines added the efficiency and the skilled workers the effectiveness in form of quality. Also, the education of the users provided a service that increased the use value. ASM produced sufficient quality for its clients, the American government, providing the interchangeability that did not render arms useless if one part broke. The flexibility in the products was lacking, hardly any custom choices. This was a forerunner to the later Ford system. The Toyota production system (TPS) has a flexibility when a specific car should be manufactured in order to increase the utilisation of the system, efficiency. But the system lacks a volume flexibility that was shown during the decline in demand during 2008 (e.g. Emiliani and Seymor, 2011).

Table 4.2: Summary of the different production systems based on value, volume. The evaluation is based on contemporary alternatives.

	Quality	Service	Lead time	Cost	Volume	Flexibility
American system of manufacturing	**+**	**--**		**+?**	**+**	**--**
Singer, craft-oriented industry	**+**	**+**	**--**		**--**	
Ford, mass production	**+**	**--**	**+**	**+**	**+**	**--**
Toyota, Flow production	**+**	**+**	**+**	**+**		**+ --**

TPS has been considered as a change of paradigm from mass production (Milgrom and Roberts, 1990; Womack et al, 1990; Koskela, 2000). Why did not the first flow production system, a predecessor to TPS, by Woollard become a success or at least being recognised? The success of a system also relies on external factors. The environment surrounding the system and the time it was in use may influence the perception. The system did not immediate offer enough perceived advantages for the organisation, if that would have been the case, the flow system would have been in use and not vanished. Whether the flow system worked satisfactory from the start or needed more development might also be a reason for the vanishing of the system.

In the production of Ford, several technical problems had been solved (e.g. interchangeable parts, machinery with sufficient quality) and some new inventions were added. By now, the Jacquard loom and small batch production were largely forgotten. Instead, high volume and large batches were the norm to reduce frequency of the non-productive setups instead of reducing the setup time. The high sales volume and efficient production created resources to further improve the efficiency. But the order winner cost was changed when competition started to offer alternatives changed yearly. The importance of short setup times that the textile "industry" recognised in the first two decades of the 1800s made a comeback in the mid-1950s when Japanese industries including TPS started adopting the concept.

Part of what is regarded old school mass production is still a prerequisite to other types of production while others are not. Interchangeable parts are just as important for manufacturers today as it was in the early 1900s. Another, more debatable subject is whether economics of scale is no longer valid. TPS requires an infrastructure that provides a set of conditions such as constant improvements which are in conflict with production, the 5S, preventive maintenance, and the extensive demand forecasting. The infrastructure leads to high fixed cost and a low variable cost. In order to make a profit, the total volume of sold variants must support the infrastructure. A low total volume would be a financial disaster for TPS. Mass production is considered to focus on volume to reach economics of scale instead of considering the quality, costs and flexibility of TPS. In TPS the quality and costs are preconditions to become flexible and productive, which in turns is a precondition to reach a high total volume (of course the products must be perceived by the customers as worthy to buy). In a sense, a high total volume is just as important for TPS as for a mass producer, but the ways to reach the volumes are different. TPS offer product variations to a higher degree than the original mass producer.

Conditions for improvement

Stable conditions, such as demand and funding, are of great importance. The different production systems are a result of development over time. ASM achieved its goal of interchangeable parts 50 years after the start. Therefore it is uncertain if the cost was lower per produced small arms if the development cost is incorporated during the 50 years of development. No total cost data was available. Singer developed their system for more than 30 years. The time span is similar to TPS. To develop a system over such a length of time demand financial resources. ASM was politically sponsored. Singer and Ford could self-finance their development.

The ASM with its standardised parts developed new types of machinery and governance under long-term contracts, long-term stable demand. The British government never intervened to secure the demand and the British craft based system lacked the production capacity of its US counterpart. The "stability" of an increasing demand over a long time was valid for Singer. The demand increased more or less from 1853-1880. The Japanese production increased 1950-1989 with a dip for the oil crises in 1974. Ford also experienced increasing demand but not for the same length as Singer or Toyota.

Toyota can to a certain degree influence both customer and suppliers. Suppliers to buffer for uncertain demand and customers (not end customer) to decrease the variation in their orders. The use of forecasting facilitates the planning. The slow reaction of the demand decline in 2008 and 2009 is a sign that stability is of great importance. If only customer orders were produced, the adaptation to the demand decline would be faster. Pull is a virtue that don't fully exist. At least for end demand, for internal demand in the system it is another story.

The decoupling point between real demand and production also improves the stability. This is important in the improvement work when buffers are reduced. Shingo describes the buffers and progress in work as the level of water in a pond. If the level is decreased, hidden problems will be revealed which is an opportunity to improve and shorten lead times. Noteworthy is that Shingo use the word pond, not sea as in the "Japanese sea model" often used to describe the same procedure as Shingo. There is a difference between a pond and a sea. The waves in the sea are bigger. If the height of the wave represents the real demand, the lowering of the water in the sea will not result in a smooth level with revealed problems but rather problems that are visible and non-visible from time to time. The decoupling point works like a breakwater or locks in a canal (e.g. the Panama Canal etc.) that hinders the waves to be transmitted into the system.

The emergency buffers have the advantage of a buffer without the disadvantage of buffers in the flow. The advantage is that it will reduce uncertainty, for instance if material fail to arrive, the buffered material can be used. At the same time when the emergency buffer is separated from the flow it will not increase the lead time.

4.2 Value and waste

Even if there is no consensus on a definition of lean in the examined literature, from the 1990s there has been, and currently is, a general acceptance of the definition of waste. The majority of articles are based on the seven forms of waste or a variant. In several cases waste is defined as non-value or value as non-waste. Waste is usually more explicitly defined than value. In several articles the concept of value is, more or less, taken for granted without discussing value further (e.g. Arbulu et al., 2003; Bhasin and Burcher, 2006; Wan and Chen, 2008; Samuel et al., 2015). Sometimes, value for the customer is of concern (e.g; Nightingale and Mize, 2002; Braglia et al., 2006) which is really not a definition of value, it is more a definition for whom value is considered. Value is not clearly defined by Womack and Jones (1996) instead value is related to the needs of the customer without elaborating the term “need”. Need has several dimensions, see Ståhlbröst et al., (2012) table 3.4.

The presentations and weights of value and waste in the lean literature, do not give the impression that value is of greater importance or even of equal importance to waste. For instance, in the book "Lean Thinking: Banish Waste and Create Wealth in Your Corporation", Womack and Jones (1996) explain the importance of value. Waste is a part of the book title. Value is not. Liker (2004) defines value in the chapter "The Heart of the Toyota Production System: Eliminating Waste". Bicheno (2004) states that "Lean is Value" after stating "Lean is Waste Prevention". Ohno (1988) recommends that: "To implement the Toyota Production System in your own business there must be a total understanding of waste. Unless all sources of waste are detected and crushed, success will always be just a dream".

In earlier use of waste, the word was linked with what was unproductive, first a wasteland. In that sense what is of value and what is waste is highly correlated and each other’s opposite. Both valuable and land of waste share the same dimension, land. Ohno (1988) links the dimensions of waste to capacity (Present capacity = work + waste). The greater use of the resources the efficiency and productivity will increase. The wastes are also linked to cost. The less resources used, the less cost. The purpose is to decrease the cost. It is

not only important to identify waste, it is also necessary to quantify waste in monetary terms in order to take the appropriate measures.

When waste is linked to value the relationships become more complex depending on which research field that is used. There is no obvious counterpart to the seven wastes in value. The value quotient has four dimensions. According to lean and Womack and Jones (1996 and 2005) value is provided by the firm to the customer. User is hardly ever used (or exchange and use value). Therefore the value creation is in the firm who is in control albeit based on the customer view of value. Value is also created if internal waste is reduced (Hines et al., 2004). With this logic value and waste can be linked into complementing phenomenon (value-adding activities, necessary but not value-adding activities, and non-value-adding activities). In the lean related literature it has been concluded that value is a difficult property to trace and therefore to measure, especially in certain parts of the production (e.g. Browning, 2003; Browning and Heath, 2009). The development of the value construct has occurred in marketing and RBV to a larger extent than in lean According to both research in resource-based view (RBV) and marketing, creation of value is a collaboration between consumers and producers (e.g. Wikström, 1996; Priem, 2007; Heinonen et al., 2013). However, value creation can be beyond control of the firm when the user is involved in the creation (e.g Bowman and Ambrosini, 2000, 2010; Grönroos, 2008). The exchange value can be measured but the use value (or value-in-use) is more complicated due to its subjective nature (e.g. Bowman and Ambrosini, 2000, 2010; Woodall, 2003).

In RBV Bowman and Ambrosini among others criticised the ambiguous use of value creation. The term was used whether the intention was creation or capture. There is a similarity with the discussions in lean. In lean, the lack of value components or consider value capture lead to ambiguity. The title "Lean Thinking: Banish Waste and Create Wealth in Your Corporation" use the word ‘wealth’ instead of value. To create wealth in a corporation might be to create value for the customer, but the value creation must be transformed into an exchange value and also be captured by the corporation (e.g Bowman and Ambrosini, 2000; Vargo and Morgan, 2005; Pitelis, 2009). Hines et al. (2004), see figure 3.7, consider that reduction of internal waste results in increased value since the costs are reduced. There a couple of conditions that must be fulfilled for this to be true. The producer is willing to decrease the price to the customer instead of increasing the profit. If the price is decreased this must be of interest to the customer. Ford decreased the price of the model T when the customers were interested in other types of value than a lower price. Hence, no

value creation or value capture. If the price is not lowered value is captured by the firm.

Another scenario that can occur is when an organisation reduces the internal waste to cut the cost but at the same time lower another value dimension, for example quality or the long-term cost. If the customer does not have the ability to control this behaviour, value has been captured. This is not discussed in (the cited) RBV literature. This cheating behaviour is linked to the principal-agent relationship where the reward is based on output (e.g. Hennart, 1993).

When Toyota is described it is usually referred to as value creation, but Toyota also capture value. Value is captured when price reductions of suppliers are shared with Toyota. The inventory turnover is not better or worse than for some of the competitors, but the profit margin was 8.2 percent compared to 3.9 percent for Ford. Instead of keeping the high profit margin, the profit margin could be lowered to the level of other companies to create value for the customers (assuming that the customers are interested in a lower price). Value capture is a central part in long-term survival of a company and can therefore create a conflict with value creation.

4.3 A conceptual, multidimensional model of four types of value

In this section, user and buyer will be used interchangeable since in the examples it is assumed that the user, the customer and the buyer are one and the same. Also the term "use value" will be replaced with "user value" to emphasise that the perceived value is a mixture of the properties in the product and the value creation by user discussed in marketing (e.g. Heinonen et al., 2013; Grönroos and Voima, 2013) and resource-based view (e.g. Bowman and Ambrosini, 2000; Priem, 2007; Bowman and Ambrosini, 2010).

From Adam Smith in the late 1700s to lean in the late 1900s, value is seen as a creation of the producer while the customer consumes the value. This view is somewhat problematic. If two identical cars are produced and sold; one of the customers will use the car as a taxi, the other customer for personal use. If the taxi transports a customer then value will be created since there is an exchange value present. But if there is no exchange value involved is it equal to that no value is created? If the person who uses the car in a non-commercial context has a passenger. Is value created? Or if that person drives alone, is no value created? Or is value is created for and by the person in the use of the car? What about the passenger/customer in the taxi, is that person creating any value? Or if a person chooses to take the bus to be a bit more environmental friendly instead of taking a taxi or driving herself/himself? Is value created in all of the

examples? Is the value co-created by user and producer? Value creation can be as ambiguous as the word value.

Value capture is to what degree the seller/producer can keep the exchange value in the organisation. Value creation, regarding the producer, occurs when the organisation creates a set of properties that are important for the user. A potential value that may or may not be equal to the potential exchange value (RBV related issue, e.g. Kim and Mahoney, 2002; Ramsay, 2005; Pitelis, 2009). The potential value also has a potential for the use (e.g. Grönroos, 1979, p. 79, cited in Grönroos, 2008; Grönroos, 2011).

In the discussion of use value (subjective valuation by an individual customer) and exchange value (price paid by the customer in the transaction), the time of the transaction was previously a major topic in marketing. (e.g. Bowman and Ambrosini, 2000; Priem, 2007; Bowman and Ambrosini, 2010). The lowest perceived value by the customer that will trigger a transaction, is the total monetary value, see figure 4.1. This point is regarded to only be valid when the customers do not have any choice, for example a monopoly situation. However, the choice of the customer may be the result beyond the chosen supplier and the competion by inflicted necessities beyond the control of individuals (e.g. Trentmann, 2004; Söderholm, 2013).

Since the evaluation of use value is individual and subjective there will be a variation between the users. Therefore, it is assumed that the variation among customers can be described by what resembles a probability distribution. Figure 4.1 exemplifies a distribution of customer perceived value. The further to the left on the y-axis, labelled "User value" and "Exchange value", the higher is the perceived value according to the customer. The further to the right on the y-axis, the lower is the perceived value according to the customer. The curve is a variant of a probability density function, where the total area under the curve equals all customers.

The height of the curve is dependent of how many customers that have a similar perception of the value. The higher a specific point of a curve is, the more customers/users have a similar view of the percieved value. The range among the customers differs from excellent value for the product intended purpose of use (the left part, to quite good value for money (the peek) and decent value for money (the area closest to the total monetary value), see figure 4.1. For the transaction to take place the buyer must perceive that the product/service is worth its money, the benefits outweighs the sacrifices (considering that the buyer has different options), see eq 4.1 (originally eq 3.3). At the point of the exchange, no customer should consider the value to be

lower than the total monetary value. The value However, in practice the buyer might not make the choice reflecting only the total monetary but other concerns. Hence the dotted line in figure 4.1. The curve is not necessary continuous even if figure 4.1 gives that impression.

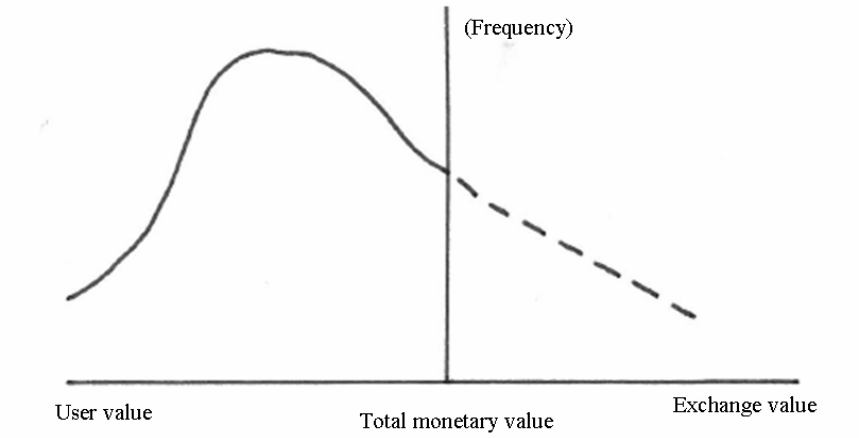

Figure 4.1: Point of transaction, the distribution of the perceived user value by the customer described as a probability density function. The area under the curve equals 100 percent of the population (users).

$$\text{Value} \propto \frac{\text{Benefits}}{\text{Sacrifices}} \tag{4.1}$$

One disadvantage of only considering the transaction moment and the exchange value, is that the moment lacks the development of the value perception. When in use, value does not occur in a point of time, it is developed over time (e.g. Ravald and Grönroos, 1996; Grönroos, 1997; Woodall, 2003; Heinonen, 2004). The value potential becomes actual user value in the interaction between the product (as in good or service) and the user. Some users will be more pleased or less pleased than at the point of transaction. The further to the right the peak of the curve is, the less user value is perceived by the highest frequency of users. In the right tail of the curve, only the exchange value that benefits the seller has been fulfilled. The curve to the right of the total monetary value represents the users that are dissatisfied

with the value. The further to the right, the more dissatisfied are the users. If the perception of value changes among the users over time, the distribution will also change. If the area under the curve is to the left of "Total monetary value" the user perceive that the value is good, see figure 4.2. Even if curves have been used, in practice there is no certainty that a curve is the best description. The curve is used for demonstrative purposes.

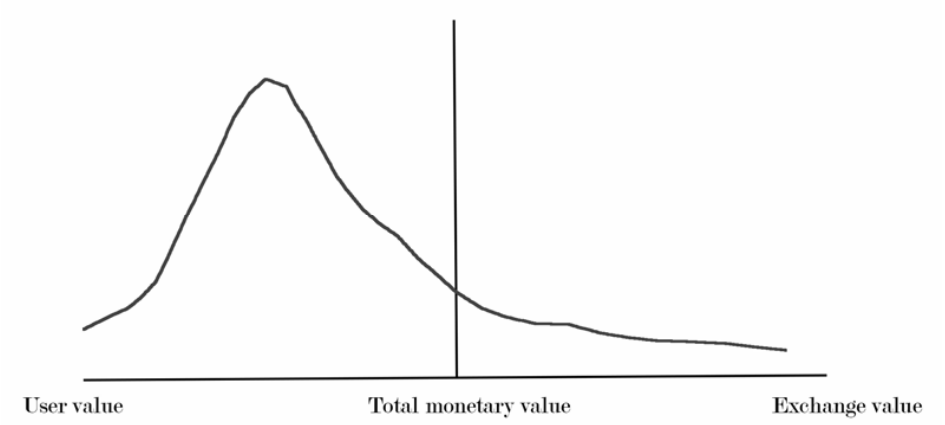

Figure 4.2: Perceived user value at a point in time after the transaction, user value vs. exchange value. The majority of users are pleased.

The value quotient (e.g. Mason-Jones et al., 2000; Christopher and Towill, 2000: Christopher and Towill. 2001), see eq 4.2 (originally 3.2), can be linked to the distribution between user value and exchange value. Quality, service and lead time represent user value and cost is linked to exchange value. Besides exchange value, cost contains additional costs that occur during the use. These costs will be a part of the judgement by the customer whether the buy proved to be value for money or not.

$$\text{Value} = \frac{\text{Quality} \times \text{Service}}{\text{Cost} \times \text{Lead Time}} \tag{4.2}$$

The user value and exchange value represent the buyer-seller dimension. Value capture relative to value creation is the relation between what value a firm has created and what it can capture and concerns suppliers, employees etc. If an organisation is positioned somewhere on the y-axis, the organisation capture as much value as it creates, see figure 4.3. If the position (in the x dimension) is in

the vicinity of the end of the positive x-axis the organisation will most likely make a loss. The relation between value capture and value creation, and the transactions with the suppliers can also be described with a distribution. However, in the examples it is assumed that the relations between an organisation and the suppliers are more deterministic than user value and exchange value. However, it is likely that the bargaining power between an organisation and its supplier will differ from supplier to supplier and perhaps from time to time. There might even be circumstances that will influence the bargaining power in an individual relation between two parties, see figure 4.4 for the multivariate distribution version of figure 4.3. For the sake of clarity over complexity the following examples will only use a point instead of showing a multidimensional distribution.

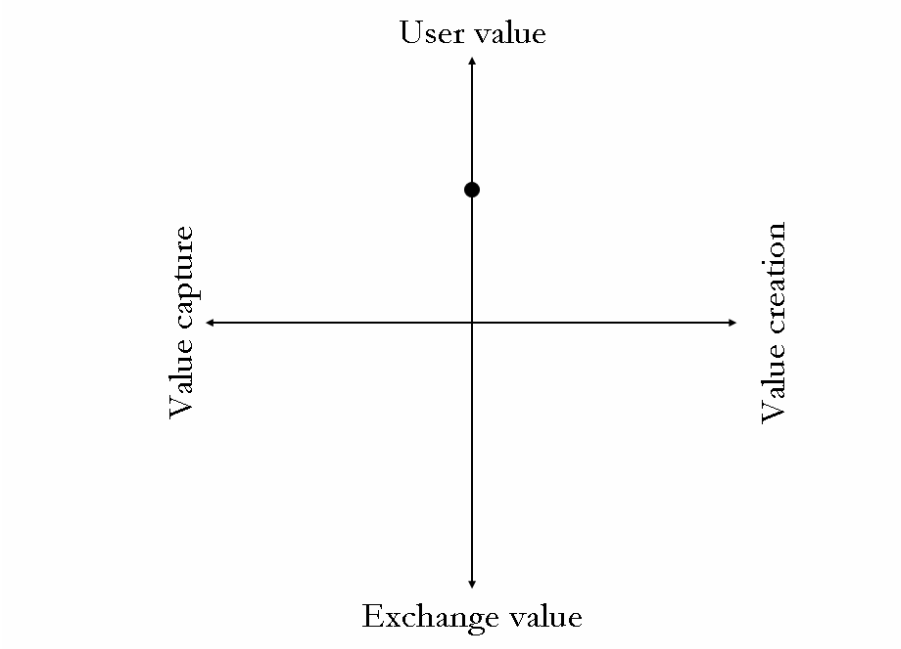

Figure 4.3; Example of an organisation, the point on the y-axis that captures as much value as it creates.

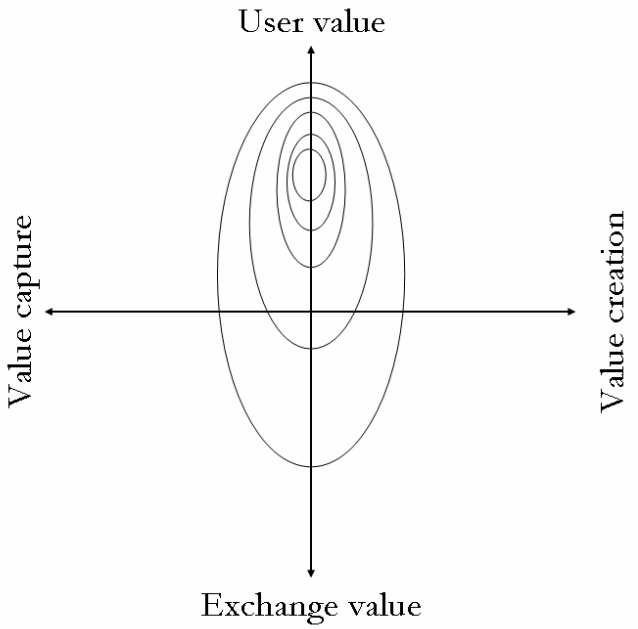

Figure 4.4; Example of an organisation that capture as much value as it creates in a multidimensional setting. The variation is larger for user value - exchange value that for value capture - value creation.

In figure 4.5, user value is determined (by the user) at some point in time after the transaction. The different point's position for user value/exchange value and value capture/value creation are represented by a letter. The points represent the center of gravity for the distribution of the perceived value. A is the position where the customers generally are very pleased, and the organisation can capture most of the exchange value without passing it on the suppliers, employees or to the society (e.g. taxes, fees etc.). Over time the suppliers and the employees will seek for alternatives. If there are alternatives for suppliers and employees, the A position will be difficult to sustain for the organisation.

The B position is the position an organisation might want their suppliers to have. The B position also has generally pleased customers and the firm creates value that it cannot be compensated for. In the long run the something-for-nothing-corner (from the organisation's point of view) might lead to bankruptcy or at least poor financial results. Reasons for the B position can be unstable internal processes that require more production resources. It might

also be a result caused by the bargaining positions for other stakeholders. Improved processes and alternative suppliers might improve the value capture.

Another reason might be the lack of control of a supplier which might lead to opportunistic behaviour from the supplier side. The possibilities of bureaucratic control depend on measurability and knowledge of the transformation process. If both measurability and knowledge of the transformation process are low, community control will degrade the reputation of a supplier with an opportunistic behaviour. However, community control is linked to the cost and possibility of advertising the opportunistic behaviour to affect the supplier in question. In reality this possibility is considered to be limited. (e.g. Hennart, 1993; Sharma, 1997)

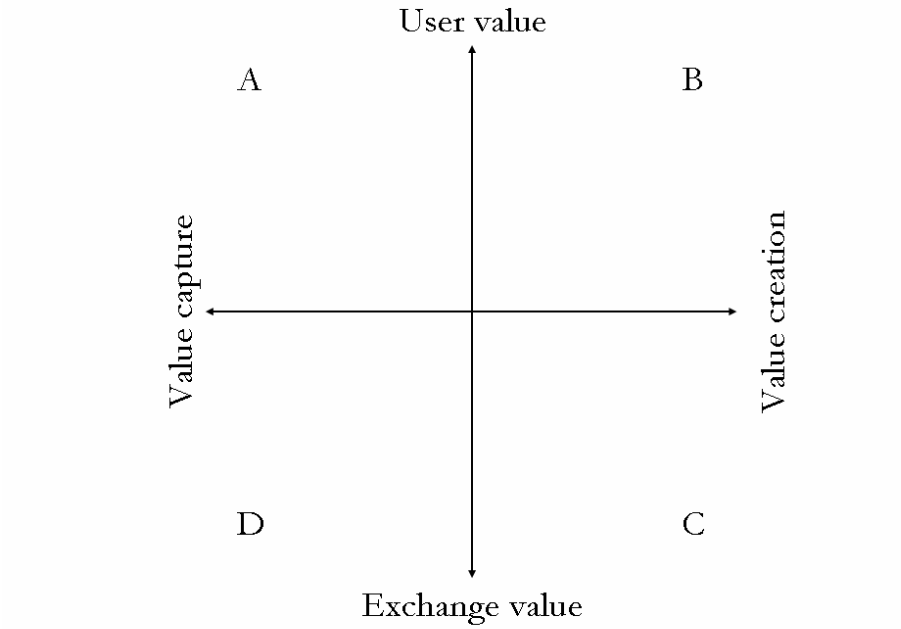

Figure 4.5: Four extreme positions (A to D) of the relations user value-exchange value and value capture-value creation. The extreme positions represent the peak of a distribution rather than every transaction.

Position C is worse than B concerning an organisation since it has very dissatisfied users and also little value is captured. In the long run the organisation will go out of business unless the customers can be satisfied

and/or more value can be captured. If the customers somehow are tied to the organisation, the customers will not be able to change to another alternative immediately. For the organisation, it might be a question of poor internal processes, failing to identify value dimensions of the users, misinformation to presumptive customers, quality issues, poor bargaining power etc.

Point D has very dissatisfied users who perceive they are getting nothing for something. The emperors's new clothing corner, as the customers would have regarded the transaction as fair at least at the point of the exchange. The firm is capturing the majority of the value, which might lead to dissatisfied employees and/or suppliers in search of an alternative. The customers will also search for alternatives unless they are somehow tied to the organisation for a longer period of time.

5 SUMMARY OF PAPERS

The four apppended papers are summarised.

5.1 Summary of Paper I

Title: Evaluation of forecasting error measurements and techniques for intermittent demand

Authors: Peter Wallström, Anders Segerstedt

Journal: International Journal of Production Economics

Status: Published in 2010

Research question in focus: How can value and waste be measured? (RQ 3)

Keywords: Forecasting Intermittent demand, Forecasting accuracy, Croston's method, exponential smoothing, Supply chain control

Introduction: The type of forecast error to analyse the performance is just as important as the forecast method. The best forecasting method is a question of the chosen error type according to earlier studies. Part of the literature recommends the use of more than one type of forecast accuracy measure. Earlier studies have examinee the underlying dimensions of the error measurements and conclude that there are common error dimensions regardless of type.

Purpose: To examine and evaluate different forecasting error measurements.

The objective is to find complementary error measures and an increased understanding of the relationship between different forecasting techniques and forecasting errors. Understanding of multidimensional aspects of a certain phenomenon and measures.

Method: Literature study, stratified sampling from a real demand data set containing approximately 20000 items, different statistical methods: regression analysis, principal component analysis (PCA), binary logistic regression.

Summary of main contents: The comparison between four forecasting techniques, when the demand does not occur in every period. Two of the additional errors are based on the standard variance errors with absolute or squared values but with the addition of only updating the error when an observation occurs. Three of the additional errors are based on bias errors. Two errors keep the maximum and minimum value of the cumulated forecast error. The third error, periods in stock (PIS) measures the fictitious stock caused by the forecast and considers when the error occurred. In addition the number of shortages is measured. The error measure the number of times the forecast cannot satisfy the demand, number of stockouts (NOS), which is the number of times the cumulative forecast error is larger than zero.

The relations and dimensions of the forecast errors is evaluated with principal component analysis (PCA). The parameters used to describe a time series are mean, standard deviation, coefficient of variation (the quotient between mean and standard variation) and the scaled version mean absolute change. These measures of descriptive statistics are applied to the demand, the inter-demand periods and the demand rate variation (the quotient between demand rate and inter-demand periods) to trace pattern of increasing or decreasing errors with increasing smoothing constant (the level of negative feedback to the forecasting technique).

Results and contributions: Performance of a forecasting technique is dependent of the chosen measurement of forecast errors. The proposed general error dimensions from another study, can not be confirmed. The dimension patterns for the different techniques are individual. The multidimensional loading plots for the different techniques are each technique's "finger print". Therefore, multidimensional analyses of the error should be examined when multiple errors are used. This should be done in order to confirm that the errors' have a unique contribution. Multiple errors do not automatically result in multiple dimensions.

New methods and measures are proposed, together with new suggested error and bias measurements (PIS). The additional measure, mean absolute change scaled (MACs), measures the change between two adjacent observations through the whole time series. The mean value between the changes is scaled with the mean value of the whole time series. The sequence dependence of the measure gives an indication of how difficult it is to forecast the time series. The lower the value, the less difficult to forecast.

The studied forecast errors are relatively straightforward. The forecast accuracy is a measure of the amount of uncertainty that a chosen forecasting technique has. The accuracy, the error, is a variant of the observation minus the forecast. The problem is decently defined. Still, the different mathematical treatments of the basic error can result in conflicting results. There is an uncertainty present in measures. Which forecasting error is best suited to determine the appropriate forecasting technique? Generally, there is an uncertainty present in every measure and the lack of alternative measures reduces the chance of detecting problems with the chosen measures. But how does one measure a measure, and to what extent can this be done?

If there are problems when there are only two dimensions present, the forecast and the outcome, that are fairly easy to define and measure. What will the measurement difficulties be and result in when there are a multitude of dimensions present that lacks a clear definition?

5.2 Summary of Paper II

Title: A cooperative study of the design and construction of energy-efficient buildings in Germany and Sweden

Authors: Jutta Schade, Peter Wallström, Thomas Olofsson, Ove Lagerqvist,

Journal: Energy Policy

Status: Published in 2013

Research question in focus: How is value and (waste) perceived by different stakeholders? (RQ 1)

Keywords: Building sector, Energy efficiency, Energy policy instruments

Introduction: One of the most important issues for the prosperity of a society is the access to energy. In the European Union, the building stock account for more than 40 percent of the energy consumption (European Commission, 2011). The performance goal for buildings in the European Union is a reduction in energy consumption of 20 percent by 2020 (European Commission, 2011). The estimated energy-saving potential for residential and commercial buildings is up to 30 percent (European Commission, 2006).

European countries have been adopting different strategies for energy conservation in the building sector. Traditionally, Sweden has applied a more socially responsible framework compared with other European countries (Jordan and Lenschow, 2010). In later years, Sweden has implemented a more client-driven energy policy for new buildings and renovation, making the construction sector rely more on market conditions than on regulations for energy conservation. Germany, on the other hand, has traditionally relied on a more technological problem-solving approach (Jordan and Lenschow, 2010), and continues along that line with regulations for new buildings and renovations.

Is the change in Swedish policy an indication that the drivers (motivators) for energy conservation are stronger in the Swedish market compared to the German market? Or is it that the political ambition to save energy in the building sector is higher in Germany compared to Sweden? Does this difference in the political governance and regulation in Sweden and Germany affect how architects and engineers consider energy performance requirements in the building process?

Purpose: To investigate how the key policy instruments, related to energy conservation, have developed over time in Germany and Sweden. Also, to investigate similarities and differences between architects and engineers in both countries and thereby explore how the key policy instruments affect the management of energy performance in the current design and construction process.

Method: Literature study, questionnaire survey. For the analysis of the questionnaire sent to architects and engineers in the two countries, three different statistical analyses were used: binary logistic regression, the Mann-Whitney test and the 2-sample t-test. Calculations of the heat demand.

Summary of main contents: The longitudinal comparison between Swedish and German key energy conservation policy instruments (regulations, ordinances, taxes and voluntary agreements) shows a difference in the results of the different developments. Sweden has gone from emphasis on regulations to a more market driven approach to improve the energy performance. Sweden had in the 1970s a strict regulation, which was developed during the 1980s and changed into a more moderate regulation before stagnating in the 1990s until the present time. Germany has focused more on frequent updates of the regulations to improve the energy performance. German regulation was less strict in the 1970s but has been continuously amended since then. At present, the German regulation stipulates approximately half of the energy consumption for heat demand than the Swedish regulation for the south of Sweden.

The analysis of the questionnaire indicates that there are no significant differences concerning where in the design process the energy consumption is determined. However, the role of the architects is different in Germany as the architect is more involved in the whole design and construction process compared to the Swedish architect.

Results and contributions: The results from the questionnaire show no significant difference between Germany and Sweden concerning the energy design process. The two countries are similar regarding customer orientation to the construction sector in respect of energy efficiency.

Energy analysis is not a part of a competitive offer, according to the questionnaire, regardless of country. Hence, energy is neither an order winner nor a qualifier. If the market should serve as a developer of energy efficiency, energy should be of interest to the market (the customers).

Unlike the study of policy development in Germany and Sweden, the questionnaire was neither longitudinal or had a macro perspective. Instead it was one survey with a micro perspective reflecting the respondents' opinions in the end of the longitudinal policy study. The added theory of order winners and order-qualifiers suggested by Hill (1993) and Berry et al (1999) made it possible to use the questionnaire since the order winners and order qualifiers theory has a micro economic perspective and therefore the analysis and conclusions could be done with less regard to theoretical macro economic theories. Also, the literature review introduced the concept of principal-agent to describe a situation where the actors do not share the same goal of what is value.

For some reason table 7 that is referred to the article is missing. Therefore, the table 7 is presented as table 5.1.

Table 5.1: Combined ranking of the mean values from table 5 and table 6.

Reasons to/not to do analysis	German ranking	Swedish ranking	Combined ranking
fulfil client demand	1	1	2
fulfil regulations	2	2	4
fulfil company's own quality system	3	5	8
not necessary, small projects with standard solutions	6	4	10
no request from clients	7	3	10
compare different alternatives	4	7	11
fulfil classification system (LEED, BREEM, GreenBuildings etc.)	5	8	13
rules of thumb estimation sufficient	*10*	*6*	*16*
too expensive	*8*	*9*	*17*
produces competitive offers	9	10	19

5.3 Summary of Paper III

Title: Exploring waste and value in a lean context

Authors: Diana Chronéer, Peter Wallström

Journal: International Journal of Business Management

Status: Submitted

Research question in focus: How are value and waste perceived by different stakeholders? (RQ 1), How are value and waste related? (RQ 2), How can value and waste be measured (RQ 3)

Keywords: Lean, Waste, Value, Order-winner, Order qualifier.

Introduction: In the last 25 years, Lean has influenced many aspects beyond how companies structure, operate and organise themselves (Samuel et al., 2015). Lean has been applied in contexts outside large-scale manufacturing operations and production. As lean has progressed, both its definition and goal has developed to encompass, e.g. lean as a concept, a philosophy, an approach, a practice, a set of tools and techniques, a system etc. (Bhamu and Sangwan, 2014).

Looking at the approaches and tools in lean, two main key concepts are value and waste (cf. Pavnaskar et al., 2003). Value is the starting point of lean and is defined by the ultimate customer (Womack and Jones, 1996, p. 16). They consider that value is created in the different parts of the production. Waste is what does not add value to a product, process or a service (Åhlström and Karlsson, 1996; Naylor et al., 1999; Hines et al., 2004). Companies must understand customers' needs to improve customer satisfaction (Woodruff, 1997; Christopher and Towill, 2001). Meeting customer demands and providing good value to customers is of great importance (Green et al., 2010), i.e. to balance cost reductions and at the same time satisfy specific customer requirements (Panwar et al., 2015). But this can be problematic since it is difficult to separate waste from value in activities (Browning and Heath, 2009).

Purpose: The purpose of this paper is to take a critical, analytical approach to explore the concepts of waste and value in the lean literature and how the concepts are applied in organisations' lean efforts and the ambiguity surrounding the concept of value.

Method: Literature study, a multi-case study. In the analysis of the different cases the concept of value has been simplified to four dimensions where cost is regarded as the order winner and the other three dimensions as order qualifiers (quality, service level and lead time). By using four dimensions it is possible to trace dependence between different dimensions. Also, the analysis of waste is performed on the output rather than the input (the resources) in order to trace the consequences.

Summary of main contents: In the literature waste has a more explicit definition than value. Waste tends to be related to the seven or eight wastes (Ohno, 1988; Womack and Jones, 1996; Liker, 2004, pp. 50-51) while value is defined more implicit as depending on the customer's perspective (Arbulu et al., 2003), customer satisfaction (Bhasin, 2008) or as "non-value" as things the customer does not perceive as added value (Moyano-Fuentes and Sacristán-Díaz, 2012). The relation between value and waste are, in the cases where it is mentioned, related as reduction of waste improves the value, see table 5.2. A more complex analysis of the relation of value and waste could not be found.

Table 5.2: Summarise of the projects' aims and the customers' value.

Cases	Inventory	Production	Administration	Distribution
Industrial project aim	Standardised inventory management	Shorter throughput time-in production	Coordination and standardisation of sub-processes	Coordinated and joint loading
Consequences of measures taken in the projects	Longer lead times to customers	Quality defects at customers, expensive re-work	Decreased cost but longer lead times for the product changes	Longer lead times, decreased production flexibility
Mismatch project result and customer value	Standardisation vs. Short lead time	Short throughput time vs Quality.	Cost vs. Short lead time	Cost vs. Short lead time and flexibility

Results and contributions: The cases are focused on waste reduction, which can result in a loss of value. The case studies were internally oriented and generally disregarded the identification of customer values other than cost. Cost was not always measured. The construction related case, distribution, had

problem to establish the cost. It is generally easier to identify waste than value in the improvement work. The case studies also showed that when eliminating waste the focus of the improvement work is often on making sub-processes more efficient rather than the total value flow, see table 5.3. One reason for the focus on waste elimination is that waste is easier to relate directly to resources than order qualifiers such as customers' demands for flexibility and the required properties that a product or service.

Table 5.3: Wastes identified in the case studies.

Case	Identified and adjusted waste	Created waste	Affected value	Affecting
Inventory	Inappropriate processing Unnecessary inventory	Waiting	Lead time, service - *order entry to delivery*, Cost	External customers
Production	Waiting, Unnecessary inventory	Inappropriate processing Defects	Quality - *Fitness for use and minimum variances*	External customers
Admini-stration	Inappropriate processing	Waiting,	Lead time - *order entry to delivery, response to market forces* Quality	Internal and external customers
Distribution	Transport	Inappropriate processing Waiting	Cost, Service - *lost production* Flexibility	Internal customers

5.4 Summary of Paper IV

Title: The difficulties to operationalize value and waste: A case study of Value Stream Mapping.

Authors: Peter Wallström, Anders Vennström, Diana Chronéer,

Journal:

Status: To be submitted

Research question in focus: How are value and waste perceived by different stakeholders? (RQ 1), How are value and waste related? (RQ 2), How can value and waste be measured (RQ 3)

Keywords: Lean, Waste, Value, Order-winner, Order qualifier.

Introduction: Value stream mapping (VSM) is a mapping tool used to redesign a process, a production system, or value streams. In using VSM, organisations can develop an overview of the key features. As a result, the waste is reduced. One of the major drawbacks is that VSM originally was developed to improve processes for high production volumes and low product variety.

Purpose: The purpose of the paper is thus to identifying advantages and limitations in the VSM approach and give recommendation on how VSM can generate value and improvement in an organisation. The aim is to explore the relations between value and waste.

Methods: Literature study, single case study, survey, nonparametric statistical methods.

Summary of main contents: The performed VSM is more based on Taylorism than Lean teamwork. Also, focus was only on the activities supporting the kitchen assembly which can lead to sub-optimisation. The correlation between value and waste is leading to ambiguous conclusions: cleaning is waste and at the same time a lack of cleaning creates waste, planning is waste but a lack of planning creates waste, sawing is waste but sometimes sawing creates value.

In general the definition of waste and value was based on industry practice (e.g. this is how we always done it before, and therefore it should be

considered as value) rather than an understanding of what the (end) customer consider as value.

Results and contributions: Waste and value, as considered from the practitioners' point of view, in the VSM study are ambiguous. The negative correlation between what was identified as value and waste could not be confirmed since resources is are a part of creating value or value potential, not pure waste. Waste is the main interest, not the root causes of waste. Waste is a symptom for a root cause, an output. The internal value for the practitioners' is regarded the as customer value. This can lead to misleading conclusions for the organisation performing the VSM study. Especially since cost was not measured.

The survey confirmed the findings from the earlier case studies in paper III. To identify what is waste and what is value is not trivial. Also, the used value definitions in the VSM were too limited to be of use. The measurement in the VSM study was focused on waste. The statement in the VSM report also indicates that only the symptoms not the root causes of waste were measured. Therefore, the lack of studied and document root causes limits the practical use of the VSM in order to improve work practices.

6 DISCUSSION AND CONCLUSIONS

This chapter presents the answers to the research questions as well as the conclusions and a discussion.

6.1 Addressing the research questions

The three research questions from the first chapter will be answered individually in the following pages in this section.

Research question 1:

How are value and waste perceived by different stakeholders?

The answer is based on paper II-IV and the analysis of the frame of reference.

For a society value might not be the same as what customer and producers regard as value. The oil crises in the early 1970s and the awareness of the oil depended society (Bjereld, 1989, pp. 197-201) triggered different Swedish energy regulations to lessen the oil dependency. The long-term energy security for a whole society has another time scale than transaction related to the exchange value. Sweden later introduced more of a market approach while Germany has increasingly relied on regulations to increase the energy efficiency. The German approach has increased the energy efficiency to a higher degree. The problem with the Swedish approach is that energy issues are not part of the most important value dimensions (order winner or order qualifier). In the survey the bottom reason to conduct an energy analysis was to win a contract regardless of country. To win a contract is a recognition of the customer/client of what they perceive as the best value (use value and/or exchange value) among the present alternatives. Among the customers there will probably exist differences between what is value. If the customer/client

does not have any intentions of keeping the building, why pay for something that cannot improve exchange value? The conclusion, that the Swedish market approach for energy issues has not been successful compared with the German approach, is not the same as that self-regulating market will never work. But in order for a market strategy to work, what the policy makers deem as important must reflect what is perceived as value for the customer/user. Also, the customer/user must have sufficient influence and information over the decision making chain that affect what is of interest for the policy makers, in this case energy efficiency (e.g. Hirst and Brown, 1990; Sharma, 1997; Foss, 2002; Nässén et al., 2008).

To increase the profit, the wealth in the organisation, a couple options are available. The exchange value can be increased which decreases the value quotient for the customer/user. With no additional sales or increase of the price for the product, the value capture must be increased. As long as the user value is not tampered with the user will not detect any difference. The value capture might be a process improvement that lessen the amount of rework and use less resources, decrease the waste. The proportion of value capture will increase, see figure 6.1. This will affect other stakeholders. Less use of resources might result in fewer employees and less material from suppliers. This might be a conflict of interest as well as if the value capture is degrading the user value dimensions. One possible scenario of this might be when there is a limited external control, no self-control of the agent, and the reward is based on the production (output) which encourage cheating (e.g. Hennart, 1993; Sharma, 1997).

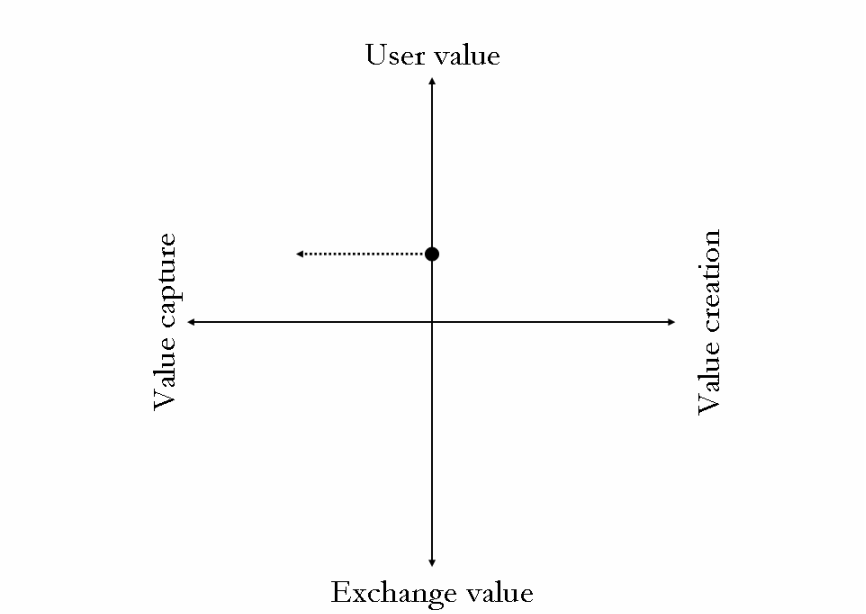

Figure 6.1; Increasing of value capture without degrading the user value.

Waste, in the sense of production efficiency, is generally an internal matter if the value for the user is not tampered with. In the survey related to the VSM-study (paper IV) the respondents generally did not estimate the maximum time allowed for certain less value-adding activities in the kitchen assembly. The most common comment in the survey, was that these types of questions was a matter for the organisation that assembled the kitchen, not the customers. This is in line with what the resource based view research literature states (e.g. Priem, 2001).

In the four cases (paper III), waste were regarded in a single, detached process. What was waste was based on the examined process, the customer/user perspective was lacking. A similar procedure was used in the kitchen assembly (paper IV) of the value definition was linked to the activities studied task not the outcome of the task other than the number produced and hours used, more a matter of efficiency. Also, when a department (paper III), defined what was value and waste, it was not defined from the whole organisation's perspective. It was defined from the department's perspective which can result in sub-optimisations when the whole flow and the stakeholder are not taken into account. The local waste definition and the measures taken can result in effect

similar to the internal markets and problems with internal price settings, sub-optimisation (e.g. Hennart, 1993; Foss, 2002).

What is waste is a question of decision power, one man's waste is another man' value (in a non-gender meaning). In the inventory project (paper III), the customers and employees would like to continue with the present procedure of using second hand spare parts to minimise the production stops for the customers, when new parts were not directly available. The management considered the eventual production stops for the customers to be less important than a standardisation so every warehouse had similar stock keeping units. The standardisation was regarded as reducing the waste (but not for the customer/user). The drying time in the production project (paper III) was waste, according to the company, since no transformation took place but value for the user since it increased the quality of the product.

The internal view of waste is linked to efficiency but not to a sufficient degree linked to effectiveness or value. In the VSM-study, several classified wastes were according to the survey part of what were considered to be important for the customer, hardly waste. Cleaning, non-damaged modules (regardless the position of damage), mounting of doorknobs are examples that will lower the efficiency for the company, if performed, but the not value for the customer.

What is regarded as waste can more easily be determined by the producing organisation, but the tempation of waste reduction beyond user value for the sake of value capture is a case of cheating. Also, it is questionable if a very local decision of what is value and waste is aiding the own organisation. Especially if it is not possible to determine cost since value capture is a likely reason for the waste reduction.

Research question 2:

How are value and waste related?

The answer is based on paper III and IV and the analysis of the frame of reference.

Value and waste have multi-dimensional properties and these dimensions are related. However, the relations between value and waste are not trivial. The reduction of what is considered to be waste in one of the seven dimension will, if large enough, decrease at least one value dimension and also create waste in at least one waste dimension, see table 6.1. A major problem is that the seven waste dimensions are dependent. The dimensions of waste can therefore not be

minimised in isolation since waste is also an output that will affect the value dimensions.

Table 6.1: Wastes and the relation to other waste and value dimensions from paper III.

Case	Identified and adjusted waste	Created waste	Affected value	Affecting
Inventory	Inappropriate processing Unnecessary inventory	Waiting	Lead time, service - *order entry to delivery*, Cost	External customers
Production	Waiting, Unnecessary inventory	Inappropriate processing Defects	Quality - *Fitness for use and minimum variances*	External customers
Admini-stration	Inappropriate processing	Waiting,	Lead time - *order entry to delivery, response to market forces* Quality	Internal and external customers
Distribution	Transport	Inappropriate processing Waiting	Cost, Service - *lost production* Flexibility	Internal customers

In none of the four cases has the user value increased while reducing waste (paper III). The inventory (I) case has decreased the user value (lower service level) while reducing the internal cost. Therefore the value capture is increased, see figure 6.2. The administration (A) case has postponed improvements in the product which might only have consequences for the value capture, while the user value is intact (in figure 6.2, this is assumed). The production (P) case has lowered the quality that has reduced the user value and at the same time additional resources that had to be added to correct the quality problems. After the correction of the quality problems, the user value is at least partly restored (e.g. trust, limited access during the repair). At the same time the resources used to correct the quality issues will decrease the value capture in order to increase the value creation to a satisfactory level, see figure 6.2. The

distribution case has no external customer and is not presented in the figure 6.2.

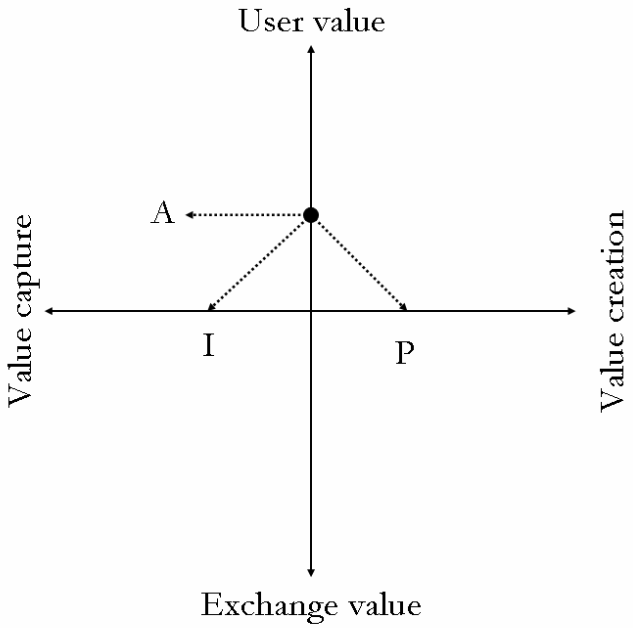

Figure 6.2: The changes of different types of value concerning the administration case, the inventory case and the production case (all cases in paper III). The actual positions before and after the change are not known. What is important in the figure is the direction of the change.

In the VSM-study (paper IV), the result is similar to the four cases regarding that waste dimensions are internally related and related to value dimension. However, value lacks the same multidimensional properties of value that was assignable to the four cases (quality, service, cost, lead time). There was no documentation of the result in the VSM-study similar to the four dimensions of value in paper III (quality, service etc.). It can be observed are the correlations between the different waste and value dimensions. The value dimensions were related to transformation activities. The different forms of waste correlated to both other waste and value dimensions. None of the waste dimensions had a negative correlation with value. What is regarded as waste is a part of resources that produce what is regarded as value.

If we could reduce all wastes, all overproduction, all waiting, all transportation, the entire inventory, all movement, and all defective products, would we maximise value? Probably not. When waste dimensions are seen in isolation, all eliminations of waste make sense. Seen in isolation, waste is closer related to the input and resources (apart from overproduction and defective products). In the Toyota production system waste was originally related to capacity. But waste will affect the value (e.g. shorten the drying time, resulted in quality problems in the production case). Especially if the value capture is of interest and a limited feedback concerning affected value However, waste should not be considered in isolation because wastes are interrelated with both other waste dimensions and value dimensions. The meanings of waste and value, and their interrelations, are also dependent on the specific context. Focusing solely on waste will not improve value with the exception of temporary value capture.

Furthermore, relations of value and waste have a time component. Value (user value and value capture) and waste may occur in different points in time. Waste and the value capture are to a certain degree visible within the company or within a process. Part of the value capture may be reduced after the transaction due to guarantee issues. But a less than successful waste reduction may affect user value dimensions.

Research question 3:

How can value and waste be measured?

The answer is based on paper I, III, IV, and the analysis of the frame of reference.

The measuring of forecasting accuracy seems to be quite straightforward at first or at least in comparison with defining and measuring value. The majority of used errors are based on the difference between an observation and a forecast (Forecast error = Observation – Forecast). For many situations the data collection (observations and forecast) is not an issue since the data is available in data-systems (it might be an issue, if the data is registered haphazardly). Despite the simplicity, the evaluations of forecast performance are not simple. The combination of the chosen forecast errors, forecasting methods and observation data will lead to different answers regarding the “best” method. The recommended error measures differ between authors and occasions. No type of forecast error is universally suitable, especially on its own.

The relationships between different types of errors differ between the different types of forecasting methods. The underlying dimensions depend on the forecasting method and the type of forecast errors that are used. Therefore it is not enough to evaluate the types of errors used. The dimensional relationship

between the errors must also be evaluated (e.g. if several types of errors share mainly one dimension, the errors will probably not complement each other to any higher degree).

Even if the original accuracy is well defined and it is possible to measure a phenomenon with accuracy, it is not sufficient. The type of mathematical operation that is applied will also influence the measurement. This measurement might distort the result, the perception, and thereby the decision. If there are problems when measuring something that is "easier" to define and closer related to research within the positivistic field, like forecasting errors. What will be the outcome when dealing with something that is not as easily measured (e.g. user value)? Probably, the problems of validity and reliability will be higher when applied to a measurement that is most likely less well defined, more difficult to measure, and might not even be suitable to a numeric identification. The problems with the definitions of value and waste in the VSM-study are reflected by the conclusions drawn in the analysis. Planning was waste but if something occurred that was caused by lack of planning, there should have been more planning. Cleaning was a waste at the same time when the lack of cleaning caused other types of waste, the workforce should have cleaned earlier.

Still, the real problem might be waste, since it is often related to resources that are (usually) easier to measure than value. However, waste and resources are not one and the same. If waste should be measured the output of waste must be defined and measured, as well as value in order to determine whether a waste reduction has occurred and not a value reduction and to avoid sub-optimisation, similar to the concepts of efficiency and effectiveness (e.g. Grünberg, 2004; Tangen, 2005) While Toyota has its least cost principle, the studied cases focus more on waste than cost, at least the realistic cost. In the distribution case, the cost of transportation could not generally be obtained from the invoices. Therefore, the non-business private parcel rates of the Swedish post office were used. This will most likely inflate the cost of the transport and increase the risk of decisions that may not reduce the cost for the company but rather for the department.

Concerning value, is it even possible to measure, especially the value creation? There are types of values before the transaction, in the transaction, and after the transaction. The presumptive “customers” find it difficult to determine specific points of production that creates value and the companies have difficulties measuring the value that is created during the use. In the cases where value is created, at least in parts by the user, the producers are more enablers of value than creators of value. What has been produced may not be filled with value as

it has advocated by Adam Smith and his later peers (including lean). Instead, the product has a value potential that the customer/user will increase or decrease when in use. For a producer the question should rather be what enables value for the user that is at the same time possible to realise as an exchange value that is satisfactory to the stakeholders.

There is a lack of understanding of the difference between value creation and value capturing. In the examined cases, capturing was of primary interest of the two value concepts. Value capturing can be done by reducing the resources used. Waste and value capturing are closer related within the examined organisations than waste and value creating. However, in the cases waste reduction is regarded as value creation regardless of who is the beneficiary (the user/customer, the own organisation, the own department). It is recommended that value creation and value capturing should not be performed simultaneously (e.g. Bowman and Ambrosini, 2007; Lepak et al., 2007). The measuring should reflect whether it is value capturing or value creation that is the purpose.

Even if it is not possible to decide every aspect of user value, some decisions must be made. The question is who should make these decisions. In the cases value has been decided locally and related to individual projects. There is no evidence of market research related to the customers. If value is defined in every separate project within an organisation, the risk is that there will be no consensus of which dimensions that are of importance (unless only cost is of interest). Otherwise, different production stages may work with different views. User value, based on research not opinions, should be defined linked to the customers/user and what can generate a transaction and future orders, the order winner and order qualifier dimensions. These dimensions should be understood in the organisation. In the administration case, the “leanest mature” company and with a successful production, the personnel seem to have very limited ideas of what the value dimensions were apart from lowering the cost. How can one improve the value potential if the relevant dimensions are a secret or at least unknown in the organisation, apart from exchange value?

It is not only a question of appropriate measures, it is also a question of an infrastructure to measure value and waste. The original dimension related to the customer must probably be transformed into sets of dimensions that must be met by the different production units as in QFD. These dimensions are substitute to value that can be measured. These dimensions should also establish the prerequisites of internal customers to avoid the sub-optimisation that can occur when what is value and waste is defined to locally reduce the cost. The "reduction of waste" without any conditions that must be met, becomes trivial in the extreme case. No resources, no waste. The uses of

resources are enablers of a production. The sole focus on waste not linked to a set of conditions that must be fulfilled can encourage cheating. The improved internal process may produce a product/service which is inferior to the "old" product/service in some aspects.

To have the ability to improve require that the conditions of the two previous layers must be met, see figure 6.3. In the first layer, "Cross functional teams" lessen the risk of a number of locally defined and competing dimensions of value (or rather pre-value) and waste. "Internal and external customer focus" wil also lessen the risk of sub-optimisation.

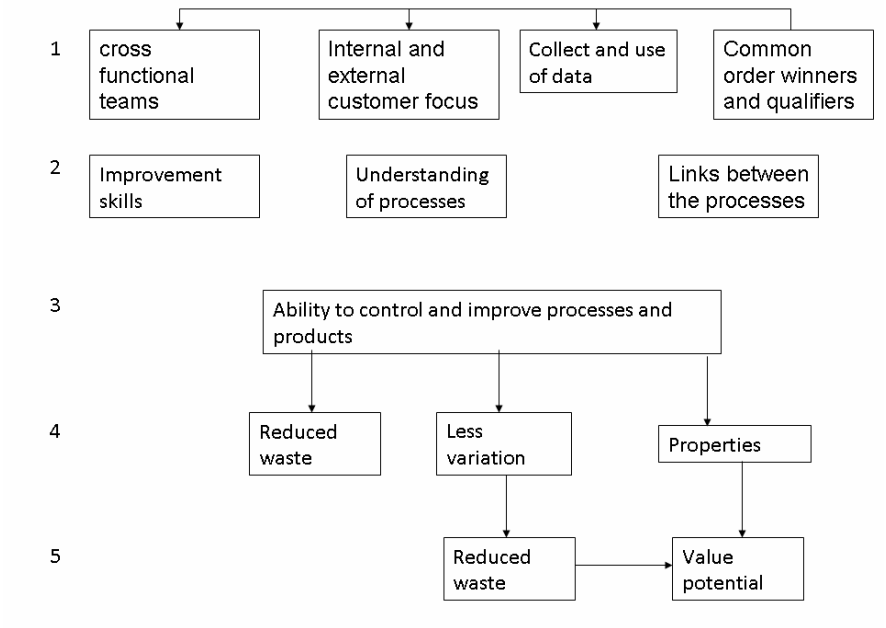

Figure 6.3: An overview of preconditions to reduce waste adopted from Saunders and Preston (1994). A product can be a good, a service or both.

To locally meet the external customer dimensions while failing the internal customer dimensions may not lead to the indented improvements. "Collect and use of Data" is to measure and analyse (e.g. market research, QFD etc.). "Common order winners and qualifiers" are the link between the internal potential exchange values and the user values. This implies a knowledge of stakeholders as well as the internal infrastructure (e.g. production system,

suppliers, distribution). "Order winner and qualifiers" is an unfortunate expression since it implicates the focus of the transaction and the exchange value. Here the expression is used in a wider sense.

Without the prerequisites it is questionable if the the improvement can take place. "Improvement Skills" (the ability to perform the changes). "Understanding of processes" and "links between the processes" are necessary to avoid isolated improvements. The links to other processes are just as important as the process itself (especially if the processes have no buffers). There are preconditions that must be met in order for the process to work as stable (time and outcome) as possible while at the same time fulfilling a set of conditions for internal and external stakeholders. The links to other processes are missing in all the cases.

With understanding and ability there is a possibility of reducing waste, decrease the process waste and decrease the variation. The outcome of the product is set of pre-values that will leave the organisation in the form of potential value that later will be transformed to user value by the user.

There are two types of waste. The waste on the fourth level is an outcome of the direct improvement of the process. For example, a better quality may lead to less defective outcome and increase the yield of the production. Less resources will be used for the same output. The waste on the fifth level is the waste that will be reduced on a system level. An increased stability (e.g. quality, time) will make the system more deterministic and buffers might be reduced. The link to value potential may not be fulfilled in every case since it is possible that the whole waste reduction will be captured internally.

To measure dimensions of value and waste is not only a question of quantifying a phenomena and transformation of the different form of value. It is a question of understanding a system. Based on the S-P model, see figure 6.3, the studied cases has focused on layer 3, the ability to improve (reduce waste). The problem is that waste has been regarded only as an input and not outcome based on local definitions of what is value and waste.

However, the answer to the third question is a propasal where further studied are needed to fully answer the question, if possible.

6.2 Conclusions

The purpose of the research was to explore how value and waste are perceived, related, measured, and the consequences of that perception, relation, and

measuring. The focus of the research has been the improvement work in the different organisations from different industries. To increase the understanding, the limits within the cases have been supplemented with additional research, the multidimensional forecast accuracy, the addition of resource-based view and marketing, and the historical background of different production systems to find a context for the improvement work. The aim (to deepen the understanding of the relations between value and waste) has been addressed both in the literature analysis and in the empirical studies.

A main problem is to define value. First, value might not always be possible to define due to the properties of value in time (pre-exchange, exchange, in use), stakeholder perspective and available information. Value is regarded as one dimensional in one point in time; the exchange. Even if exchange value is related to a specific moment in time, user value is not.

To use value as a confirmation of improvements is a problem. Value, as a whole might have other dimensions than improvement work and efficiency. In the cases, value has been defined in a single cost-related dimension, which leaves several value dimensions out of focus.

Also, the differences in value between different stakeholders (e.g. the external customer, the internal customer) are important. The exchange between buyer and seller might be several processes away. This can result in an internal value capture in the "improved process" and negative outcomes for the following processes and in the end customers/users. Also, the notion of value and waste becomes harder to define and trace as the resolution and detailing of the studied process increases.

The imprecise use of value. The way value is addressed it is not clear if the purpose is to create or capture value. In the cases as well as lean literature they talk/discuss creating value at the same time the behaviour/discussion is value capturing. To avoid mixed messages it is better to use the concept of value creation and value capture.

Several measures are needed to cover different aspects of waste and value related issues (e.g. cost, time, flexibility, quality etc.). The concept of order winners and qualifiers can be used to link the internal processes to the external use.

The concept of waste as anti-value is too simplistic. Reduction of waste without considering the value can create new waste. Waste is "easier" to measure than to define precisely. Also, waste is generally a part of the

resources used to create value. To determine waste (when a resource is idle or used in aboundance) is difficult. The apparent waste, waste not linked to output but only to resources, is what seems to be easier to measure. But this type of waste is a symptom and not a root cause. The reduction of waste may lead to new types of waste since waste is also an output of a process and related to other waste dimensions. Without the ability to measure costs, waste cannot be reduced properly. Which wastes should be reduced if there is no cost information regarding an improvement?

6.3 Discussion

The improvement work using VSM with value and waste can work. The problems that have been addressed in the presented cases are not the only outcome. But there are some interesting aspects worth mentioning. To understand what the user wants is not easy even with the best intentions. Taguch, for instance, who considers that if better quality can offer the same function with less loss, it should be used. He exemplifies this with the transition from vacuum tubes. Some thirty years later, Valves (vacuum tubes) are still highly regarded within certain fields (high fidelity equipment, studio recording equipment, guitar amps etc.). What the customer wants may not be what the engineer thinks the user wants.

In lean mass production is regarded more or less as a closed chapter since, among other things, the production is more suited to the producer than the customer. Therefore, it is interesting that the concept of value, where the producer is the value creator and the customer the recipient, is firmly rooted in the "1800s view of value" (Smith, Marx, Ricardo etc.). Will this view of value suit all possible fields or will this view be more successful in situations with passive customers instead of value creating customers?

Also, the view value reflects whether value is regarded from a positivistic perspective or not. In lean value can be defined and measured. It might not be easy but it is possible. In RBV and marketing the epistemology is not equally positivistic which reflects in the more complex view of value.

The different views within the different fields may also be influenced by the context of the research. RBV focuses on strategy related issues (value), marketing has developed from distribution to its current state where the customer/user relation is of great importance (from waste and efficiency to value). Lean on the other hand is the only one of the three that considers production from an operative focus. Furthermore, the view of resources influences the view of waste. Both in the research of marketing and RBV the focus is resources that are capabilities of an organisation and not consumed in

the production process, operant resources. Hence, waste is not a key issue. In lean, consumed resources are of importance, operand resources.

The view in TPS and lean differ despite the slogans of Ohno. Toyota has gone to great lengths to stabilise the conditions for its production system. For example, market research and forecasting are inputs to be able to plan in advance, and the possibility of decouple and freeze production schedules increases the production stability and allows the decreasing of buffers. Would it have been possible to develop the system if waste was blindly reduced?

In the multidimensional model of four types of value, it is assumed that the customers have a reasonable possibility to detect poor value or a degrading value if the producer changes a product (good or service) for the worse. In reality this is not always the case. Waste/cost reductions are not immune to the principal-agents dilemma. Toyota was not the first and not the last to have been caught cheating. A product may be defective but not improved due to the fact that the customer/user does not have the ability to control whether an improvement has been implemented or not. The perceived user value and the trust for the company allow an increased value capture and at the same time the perceived user value.

Suppose a car manufacturer presents a new or improved model promising a fuel consumption that is lower, an improved acceleration, and lower emissions. The position in the multidimensional value model is moved further in the north direction, improved user value. If the development and the production of this model have been performed in an effective manner and the organisation has sufficient bargain power, the value capture can increase. Now suppose that none of the promises were altogether true. Has this degraded the user value before the facts are known? Probably not, there is a component of user value linked to trust that can be used to create an apparent user value. The apparent user value occurs when a seller/producer implies something that is not true and the customer/user believes it to be true in accordance with the seller's/producer's intention. There is a conflict between value capture and value creation and what can be measured linked to the principal-agent dilemma.

In 1948 Reavis Cox discussed that even if it was problematic to measure the input, the most difficult problem is the measuring of the meaningful concept of the output. In 1948 new types of vacuum tubes were still introduced to the market. The transistor was more of a concept than a reality. Far from the technological leap that would come. Many years later the technology from 1948 is replaced but the conclusion of Reavis Cox is still valid.

6.4 Generalisation, limitations and future research

Are the studies included in this thesis possible to generalise? Geographically there is a limitation; all the cases are Swedish (with the exception of the German part of the survey). To lessen the impact of industrial specific contextual factors, several different types of industries have been studied, which should reduce the influence of unique contextual factors. Regardless of industry the problems encountered concerning value and waste and the perception of value and waste in the organisations were similar in the five cases. All the studied cases had problems to determine what waste was, something Toyota also had a problem with that caused the settlement described in the introduction.

The concept of value is simplified in the analysis to four dimensions (quality, service, cost and lead time). These four dimensions will not fully describe value. It is a case of clarity over complexity. The loss of nuances to describe the consequences of the waste reduction of the value dimensions is also a loss of noise. As bystander, it is questionable if all the customer dimensions of value can be captured without marketing research. However, the four dimensions is a manageable compromise between the cases value definition that consider cost and value from their own production perspective and a large number of value dimensions.

The methods used in the studies differ. The qualitative studies in the four cases (paper III) are complemented with quantitative data from the VSM-case. The method in the study where the uncertainty can influence the result is the use of the surveys. A questionnaire reflects the respondents' opinions and the interpretation of the questions that might differ from the intention. In both questionnaires, the results were in agreement with previous literature (in the energy paper it was in agreement with the non-macro-economic theory). Another issue with questionnaires is whether the sampling is representative for the population or not. If the cases in this study instead had been performed with questionnaires the sampling would have been an issue. But the cases are built on logic reasoning rather than statistical correlation which is partly used in paper IV. Also, it is highly questionable if the problems of determine waste would have been captured by a questionnaire. Partly because questionnaires measures opinions but also whether my understanding of value-waste relationship was at the time sufficient to construct a questionnaire. The case studies allowed a gradual development of the understanding.

The studied cases wanted to increase the performance, to decrease the waste. The improvements were measured mainly within the waste dimensions. Value

dimensions were hardly considered, or at least had a narrow definition that considers part of what is value. If a multidimensional problem is solved by focus on one or a fraction of the dimensions and ignoring others, it is not unlikely that the outcome will negatively affect some of the ignored dimensions, in these cases, value. The fewer measurements, the more likely that the measurements will distort the decisions and the outcome.

Future research can be conducted in a number of fields. First, the historical and current descriptions of production systems have some contradictions. This is understandable considering that the available data might be insufficient and interpretations become a necessity. The problems arises when the interpretations starts to glorify certain systems. The discussion becomes more of a description of what is consider to be perfect, instead of what is appropriate in a certain context.

Second, the agents' focus of waste might be in conflict with the principals' view of value. This conflict of value, the same word is used to describe different phenomenon. Value capture has been the major interest for the producers (the agents) not value creation. To what degree is can this conflict be reduced so that value is not destroyed for the sake of waste?

Third, how to expand the view of an improvement. The focuses in the cases are methods and processes. The fragmentation in the cases removes the links to other processes which increases the risk of sub-optimisation. The system is more important than the current methods. After all, Toyota named it a system and not a philosophy. The figure in the answer to research question 3 (figure 6.3) is a map based on the cases and the literature study. However, this figure is a start and not a perfect solution. In practice further research is needed. Especially, how to achieve the links in the system to allow improvement without sub-optimisation.

REFERENCES

Abernathy, W. J., Corcoran, J.E., 1983. Relearning from the old masters: Lessons of the American system of manufacturing. Journal of Operations Management, 3(4), pp. 155-167.

Agnew, K., 1993. The spitfire: legend or history? An argument for a new research culture in design. Journal of Design History, 6(2), pp. 121-130.

Akerlof, G.A., 1970. The market for" lemons": Quality uncertainty and the market mechanism. The quarterly journal of economics, pp. 488-500.

Akerlof, G.A., Shiller, R.J., 2009. Animal spirits: How human psychology drives the economy, and why it matters for global capitalism. Princeton University Press, New Jersey.

Alderson, W., Cox, R., 1948. Towards a theory of marketing. The journal of Marketing, 13(2), pp. 137-152.

Alderson, W. (1957). Marketing behavior and executive action. Homewood, IL: Richard D. Irwin, Inc.

Alexander, R.S., 1948. Report of the definitions committee. Journal of Marketing, 13(2), pp. 202-210.

Alford, L. P., 1927. Laws of Manufacturing Management. Trans. ASME 48, pp. 393-418.

Ames, E., Rosenberg, N., 1968. The Enfield Arsenal in theory and history. The Economic Journal, pp. 827-842.

Anderson, W.T., Challagalla, G.N., McFarland, R. G., 1999. Anatomy of exchange. Journal of Marketing Theory and Practice, 7(4), pp. 8-19.

Andersson, R., Eriksson, H., Torstensson, H., 2006. Similarities and differences between TQM, six sigma and lean. The TQM magazine, 18(3), pp. 282-296

Ansari, S. M., Fiss, P.C., Zajac, E.J., 2010. Made to fit: How practices vary as they diffuse. Academy of Management Review, 35(1), pp. 67-92.

Arbulu, R., Tommelein, I., Walsh, K., Hershauer, J., 2003. Value stream analysis of a reengineered construction supply chain. Building Research & Information, 31(2), pp. 161-171.

Argyrous, G., (2011). Statistics for research: with a guide to SPSS (3rd Edition). Sage Publications, .London.

Azadegana, A., Patel, P.C., Zangoueinezhad, A., Lindermand, K., 2013. The effect of environmental complexity and environmental dynamism on lean practices. Journal of Operations Management, 31, pp. 193–212.

Bagozzi, R.P., 1979. Toward A Formal Theory of Marketing Exchange, Conceptual and Theoretical Developments in Marketing, OC Ferrel, Stephen W. Brown, Charles, W. Lamb, Jr., eds, Chicago: American Marketing Association. pp. 431-447.

Bagozzi, R.P., 1984. A prospectus for theory construction in marketing. The Journal of Marketing, 48(1), pp. 11-29.

Ballard, G., Howell, G., 1998. Shielding production: essential step in production control. Journal of Construction Engineering and management, 124(1), pp. 11-17.

Ballard, G., Howell, G., 2003. Lean project management. Building Research and Information, 31(2), pp. 119-133.

Bamford, D.R., Greatbanks, R.W., 2005. The use of quality management tools and techniques: a study of application in everyday situations. International Journal of Quality & Reliability Management, 22(4), pp. 376-392.

Band, W.A., 1991. Creating value for customers: Designing and implementing a total corporate strategy. John Wiley & Sons, New York.

Barney, J. 1991. Firm resources and sustained competitive advantage. Journal of management, 17(1), 99-120.

Barney, J.B. 1986. Strategic factor markets: Expectations, luck, and business strategy. Management science, 32(10), pp. 1231-1241.

Barratt, M., Choi, T.Y., Li, M. (2011). Qualitative case studies in operations management: Trends, research outcomes, and future research implications. Journal of Operations Management, 29(4), pp. 329-342.

Becker, G.S., Murphy, K M., Tamura, R., 1994. Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education (3rd Edition). The University of Chicago Press. pp. 299 - 322.

Bellah, R.N., 1985. Tokugawa Religion: The Cultural Roots of Modern Japan. Free Press, Collier Macmillan. New York.

Bello, W., 2006. The capitalist conjuncture: over-accumulation, financial crises, and the retreat from globalisation. Third World Quarterly, 27(8), pp. 1345-1367.

Benders, J., Van Bijsterveld, M., 2000. Leaning on lean: the reception of a management fashion in Germany. New Technology, Work and Employment, 15(1), pp. 50–64.

Berry, W.L., Hill, T., Klompmaker, J.E., 1999. Aligning marketing and manufacturing strategies with the market. International Journal of Production Research, 37(16), pp. 3599-3618.

Bhamu, J., Sangwan, K.S., 2014, Lean manufacturing: literature review and research issues. International Journal of Operations & Production Management, 34(7), pp. 876-940.

Bhasin, S., 2011. Performance of organisations treating lean as an ideology. Business Process Management Journal, 17 (6), pp. 986-1011.

Bhasin, S., Burcher, P., 2006. Lean viewed as a philosophy. Journal of Manufacturing Technology Management, 17(1), pp. 56-72.

Bicheno, J., 2004. The New Lean Toolbox: Towards Fast, Flexible Flow, 3rd ed., PICSIE Books, Buckingham.

Bjereld, U., 1989. Svensk Mellanösternpolitik: en studie av Sveriges agerande och ställningstaganden gentemot konflikterna i Mellanöstern 1947-1985. Carlsson förlag, Stockholm.

Bonney, M., Jaber, M.Y., 2011. Environmentally responsible inventory models: Non-classical models for a non-classical era. International Journal of Production Economics, 133(1), pp. 43–53.

Boulakia, J.D.C., 1971. Ibn Khaldûn: a fourteenth-century economist. The Journal of Political Economy, 79(5), pp.1105-1118.

Bowman, C., Ambrosini, V., 2000. Value creation versus value capture: towards a coherent definition of value in strategy. British Journal of Management, 11(1), pp. 1-15.

Bowman, C., Ambrosini, V., 2007. Firm value creation and levels of strategy. Management Decision, 45(3), pp. 360-371.

Bowman, C., Ambrosini, V., 2010. How value is created, captured and destroyed. European business review, 22(5), pp. 479-495.

Bowman, C., Swart, J., 2007. Whose human capital? The challenge of value capture when capital is embedded. Journal of Management Studies, 44(4), pp. 488-505.

Braglia, M., Carmignani, G., Zammori, F., 2006. A new value stream mapping approach for complex production systems. International Journal of Production Research, 44(18-19), pp. 3929-3952.

Braglia, M., Frosolini, M., Zammori, F., 2009. Uncertainty in value stream mapping analysis. International Journal of Logistics Research and Applications: A Leading Journal of Supply Chain Management, 12(6), pp. 435-453.

Brandenburger, A.M., Nalebuff, B.J., 1995. The right game: Use game theory to shape strategy. Harvard business review, 73(4), pp. 57-71.

Brandenburger, A. Stuart, H. 1996, “Value-based business strategy”, Journal of Economics and Management Strategy, Vol. 5 No. 1, pp. 5-24.

Brewer, A., 1998. Luxury and Economic Development: David Hume and Adam Smith. Scottish Journal of Political Economy, 45(1), pp. 78-98.

Brown, M.A. 2001. Market failures and barriers as a basis for clean energy policies, Energy Policy, 29, pp. 1197-1207.

Browning, T.R., 2003. On customer value and improvement in product development processes. System Engineering 6 (1), pp. 49–61.

Browning, T.R., Heath, R.D., 2009. Reconceptualizing the effects of lean on production costs with evidence from the F-22 program. Journal of Operations Management, 27(1), pp. 23–44.

Brundtland, G. H., 1987. Report of the world commission on environment and development: our common future, New York: United Nations General Assembly.

Burrell, G., Morgan, G., 1979. Sociological Paradigms and Organizational Analysis, Heinemann, London.

Carroll, A.B., 1991. The pyramid of corporate social responsibility: Toward the moral management of organizational stakeholders, Business Horizons, Volume 34, Issue 4, pp. 39–48

Celano G., Faraz, A., Sanigac, E., 2014. Control Charts monitoring Product's Loss to Society. Quality and Reliability Engineering International, 30(8), pp. 1393–1407.

Chandler Jr, A.D., 1977. The visible hand: The Managerial Revolution in American Business. Harvard University Press. Cambridge, Massachusetts.

Chen, J.C., Li, Y., Shady, B.D., 2010. From value stream mapping toward a lean/sigma continuous improvement process: an industrial case study. International Journal of Production Research, 48(4), pp. 1069-1086.

Christopher, M., Towill, D.R., 2000. Supply chain migration from lean and functional to agile and customised. Supply Chain Management: An International Journal, 5(4), pp. 206-213.

Christopher, M., Towill, D.R., 2001. An integrated model for the design of agile supply chains. International Journal of Physical Distribution & Logistics Management, 31(4), pp. 235-246.

Clark, G., Clark, A., 2002. Common Rights to Land in England 1475-1839The Journal of Economic History, 61(4), pp. 1009-1036.

Coase, R.H., 1937. The nature of the firm. Economica, 4(16), pp. 386-405.

Cole, R.E., Scott. W.R., 2000. The Quality Movement and Organization Theory, edited by Cole, R.E. and Scott, W. R. Sage, Thousand Oaks, CA. pp. xiii–xxix.

Cox, A., Ireland, P., 2002. Managing construction supply chains: the common sense approach, Engineering Construction and Architectural Management, 9 (5-6), pp. 409–418.

Cox, R., 1948. The meaning and measurement of productivity in distribution. The Journal of Marketing, 12(4), pp. 433-441.

Cressie, N.A.C., Whitford, H.J., 1986. How to Use the Two Sample t ‐ Test. Biometrical Journal, 28(2), pp. 131-148.

Cusumano, M.A., 1988. Manufacturing Innovation: Lessons From The Japanese Auto Industry. Sloan Management Review, Fall, pp. 27-32.

Cusumano, M.A., 1994. Limits of "Lean". Sloan Management Review, Summer, pp. 27-32.

da Silveira, G.J.C., 2005. Market priorities, manufacturing configuration, and business performance: an empirical analysis of the order-winners framework. Journal of Operations Management, 23(6), pp. 662–675.

Dalu, R.S., Deshmukh, S.G., 2002. Multi-attribute decision model for assessing components of total quality management. Total Quality Management, 13(6), pp. 779-796.

das Neves, J.L.C., 2000. Aquinas and Aristotle's distinction on wealth. History of Political Economy, 32(3), pp. 649-657.

Das, T. K., & Teng, B. S. 2001. Trust, control, and risk in strategic alliances: An integrated framework. Organization studies, 22(2), pp. 251-283.

Davies, R.B., 1969. "Peacefully Working to Conquer the World:" The Singer Manufacturing Company in Foreign Markets, 1854–1889. Business History Review, 43(03), pp. 299-325.

De Chernatony, L., Harris, F., Riley, F., 2000. Added value: its nature, roles and sustainability. European Journal of Marketing, 34(1-2), pp. 39-56.

De Treville, S., Bicer, I., Chavez-Demoulin, V., Hagspiel, V., Schürhoff, N., Tasserit, C., Wager, S., 2014. Valuing lead time. Journal of Operations Management, 32(6), pp. 337-346.

DeCanio, S.J., 1998. The efficiency paradox: bureaucratic and organizational barriers to profitable energy-saving investments. Energy policy, 26(5), pp. 441-454.

Deif, A.M., ElMaraghy, H., 2014. Cost performance dynamics in lean production levelling, Journal of Manufacturing Systems, 33(4), pp. 613–623.

Delbeke J., Klaasen G., van lerland, T. , Zapfel P. 2009. The Role of Environmental Economics in Recent Policy Making at the European Commission. Review of Environmental Economics and Policy, 4(1), pp 24-43.

De Ruyter, K., Wetzels, M., Lemmink, J., Mattson, J., 1997. The dynamics of the service delivery process: a value-based approach. International journal of research in marketing, 14(3), pp. 231-243.

Dierickx, I., Cool, K., 1989. Asset stock accumulation and sustainability of competitive advantage. Management science, 35(12), pp. 1504-1511.

Dixon, D.F., 1990. Marketing as production: The development of a concept. Journal of the Academy of Marketing Science, 18(4), pp. 337-343.

Domingo, R., Alvarez, R., Peña, M., Calvo, R., 2007. Materials flow improvement in a lean assembly line: a case study. Assembly Automation, 27(2), pp. 141-147.

Dubois, A., Gadde, L-E., 2000. Supply Strategy and Network Effects - Purchasing Behaviour in the Construction Industry. European Journal of Purchasing & Supply Management, 6(3-4), pp. 207-15.

Dubois, A., Gadde, L.E., 2002a. Systematic combining: an abductive approach to case research. Journal of business research, 55(7), pp. 553-560.

Dubois, A., Gadde, L-E., 2002b. The Construction Industry as a Loosely Coupled System: Implications for Productivity and Innovation. Construction Management and Economics, 20(7), pp. 621-32.

Eccles, R. G., 1981. Bureaucratic versus craft administration: the relationship of market structure to the construction firm. Administrative science quarterly, 26(3), pp. 449-469.

Edvardsson, B., Gustafsson, A., Roos, I., 2005. Service portraits in service research: a critical review. International journal of service industry management, 16(1), pp. 107-121.

Eisenhardt, K. M., 1985. Control: Organizational and economic approaches. Management science, 31(2), pp. 134-149.

Eisenhardt, K. M., 1989. Building theories from case study research. Academy of management review, 14(4), pp. 532-550.

Eisenhardt, K. M., Martin, J. A., 2000. Dynamic capabilities: what are they?. Strategic management journal, 21(10-11), pp. 1105-1121.

Ejdemo, T., Söderholm, P. 2010. Ekonomisk analys av energi-effektivisering i bebyggelsen: [Bilaga 1 till ER 2010:37, Finansieringsinstrument för energieffektivisering]

Ejvegård, R., 2003. Vetenskaplig metod. Studentlitteratur, Lund.

Emiliani, M.L., 2000. The false promise of "what gets measured gets managed". Management Decision, 38(9), pp. 612-615.

Emiliani, M.L., 2001. A mathematical logic approach to the shareholder vs stakeholder debate. Management Decision, 39(8), pp. 618-622.

Emiliani, M.L., 2003a. Linking leaders' beliefs to their behaviors and competencies. Management Decision, 41(9), pp. 893-910.

Emiliani, M.L., 2003b. The inevitability of conflict between buyers and sellers. Supply Chain Management: An International Journal, 8(2), pp. 107-115.

Emiliani, M.L., 2006, Origins of lean management in America. Journal of Management History, 12(2), pp. 167-184.

Emiliani, M.L., Seymour, P.J., 2011. Frank George Woollard: forgotten pioneer of flow production. Journal of Management History, 17(1), pp.66-87.

Enoch, O., 2013. Lean six sigma methodologies and organizational profitability: a review of manufacturing SMEs in Nigeria. American Journal of Industrial and Business Management, 3(6), pp. 573-582.

Eroglu, C., Hofer, C., 2011. Lean, leaner, too lean? The inventory-performance link revisited, Journal of Operations Management, 29, pp. 356–369.

Evans, R.H., (1980). Choice criteria revisited. Journal of Marketing, 44(1), pp. 55–56.

Fagerberg, J., 1994. Technology and international differences in growth rates. Journal of economic Literature, pp. 1147-1175.

Fama, E. F., 1980. Agency Problems and the Theory of the Firm. The journal of political economy, 88(2), pp. 288-307.

Fearne, A., Fowler, N., 2006. Efficiency versus effectiveness in construction supply chains: the dangers of “lean” thinking in isolation, Supply Chain Management: An International Journal, 11(4), pp. 283–287.

Ferdows, K., De Meyer, A., 1990. Lasting improvements in manufacturing performance: In search of a new theory, Journal of Operations Management, 9(2), pp. 168-184.

Fisher, M.L., 1997. What is the right supply chain for your product?. Harvard business review, 75, pp. 105-117.

Fishman, J. E., 2013. Standards of Value: Theory and Applications (2nd Edition). John Wiley & Sons, Somerset, NJ, USA: (ProQuest ebrary. Web. 20 October 2014)

Flood, R.L., 1993. Beyond TQM. John Wiley & Sons Ltd, West Sussex.

Forno, A.J.D., Pereira, F.A., Forcellini, F.A., Kipper, L.M., 2014. Value Stream Mapping: a study about the problems and challenges found in the literature from the past 15 years about application of Lean tools. The International Journal of Advanced Manufacturing Technology. 72(5-8), pp. 779-790.

Foss, N.J., 2002. 'Coase vs Hayek': Economic Organization and the Knowledge Economy. International Journal of the Economics of Business, 9(1), pp. 9-35.

Gao, S., Low, S.P., 2014. The Toyota Way model: an alternative framework for lean construction. Total Quality Management and Business Excellence, 25(5-6), pp. 664-682.

Ghoshal, S., Moran, P., 1996. Bad for practice: A critique of the transaction cost theory. Academy of management Review, 21(1), pp. 13-47.

Gigerenzer, G., Marewski, J. N., 2015. Surrogate Science the Idol of a Universal Method for Scientific Inference. Journal of Management, 41(2), pp. 421-440.

Gil, N., 2009. Developing Cooperative project client-supplier relationships: How much to expect from relational contracts. California Management Review, 51(2), pp. 144-169.

Goldthau, A., Sovacool, B.K., 2012. The uniqueness of the energy security, justice, and governance problem. Energy Policy, 41, pp. 232–240.

Gordon, B.J., 1964. Aristotle and the Development of the Value Theory. The Quarterly Journal of Economics. 78(1), pp. 115-128.

Govers, C.P.M., 1996. What and how about quality function deployment (QFD). 46–47, pp. 575–585.

Green, J.C., Lee, J., Kozman, T.A. 2010. Managing lean manufacturing in material handling operations. International Journal of Production Research, 48(10), pp. 2975-2993.

Green, S.D., (1999). The missing argument of lean construction. Construction Management and Economics. 17(2), pp. 133-137.

Gummesson, E., 1998. Implementation requires a relationship marketing paradigm. Journal of the Academy of Marketing Science, 26(3), pp. 242-249.

Grünberg, T., 2004. Performance improvement: Towards a method for finding and prioritising potential performance improvement areas in manufacturing operations. International journal of productivity and performance management, 53(1), pp. 52-71.

Grönroos, C., 1979. Service marketing. A study of the marketing function in service firms. Swedish with an English summary). Diss. Hanken Swedish School of Economics Finland, Marketing Technique Centre and Akademilitteratur. Helsinki and Stockholm.

Grönroos, C., 1982. An applied service marketing theory. European journal of marketing, 16(7), pp.30-41.

Grönroos, C., 1997. Value-driven relational marketing: from products to resources and competencies. Journal of Marketing Management, 13(5), pp. 407-19.

Grönroos, C., 2006. Adopting a service logic for marketing. Marketing theory, 6(3), pp. 317-333.

Grönroos, C., 2008. Service logic revisited: who creates value? And who co-creates?. European business review, 20(4), pp. 298-314.

Grönroos, C., 2011. Value co-creation in service logic: A critical analysis. Marketing theory, 11(3), pp. 279-301.

Grönroos, C., Voima, P., 2013. Critical service logic: making sense of value creation and co-creation. Journal of the Academy of Marketing Science, 41(2), pp. 133-150.

Hair, J.F., 2010. Multivariate data analysis: a global perspective, 7th ed. Pearson Education, Upper Saddle River, N.J.

Hallgren, M., Olhager, J., 2009. Lean and agile manufacturing: external and internal drivers and performance outcomes. International Journal of Operations & Production Management, 29(10), pp. 976-999.

Hampson, I., 1999. Lean Production and the Toyota Production System or, the Case of the Forgotten Production Concepts. Economic and Industrial Democracy, 20(3), pp. 369-391.

Hart, S. L., 1995. A natural-resource-based view of the firm. Academy of management review, 20(4), pp. 986-1014.

Hauser, J.R., Clausing, D., 1988. The House of Quality, Harvard Business Review, May-June, pp. 83-91.

Heinonen, K., Strandvik, T., Mickelsson, K.J., Edvardsson, B., Sundström, E., Andersson, P., 2010. A customer-dominant logic of service. Journal of Service Management, 21(4), pp. 531-548.

Heinonen, K., 2004. Reconceptualizing customer perceived value: the value of time and place. Managing Service Quality: An International Journal, 14(2/3), pp. 205-215.

Heinonen, K., Strandvik, T., Voima, P., 2013. Customer dominant value formation in service. European Business Review, 25(2), pp. 104-123.

Hennart, J.F., 1993. Explaining the swollen middle: Why most transactions are a mix of “market” and “hierarchy”. Organization Science, 4(4), pp. 529-547.

Hicks, B.J., 2007. Lean information management: understanding and eliminating waste. International Journal of Information management, 27(4), pp.233-249.

Hill, T., 1993. Manufacturing Strategy: Text and Cases, 2nd ed., MacMillan Press, London.

Hillebrand, B., Kok, R. A., Biemans, W. G., 2001. Theory-testing using case studies: a comment on Johnston, Leach, and Liu. Industrial Marketing Management, 30(8), pp. 651-657.

Hines, P., Holweg, M., Rich, N, 2004. Learning to evolve: A review of contemporary lean thinking, International Journal of Operations & Production Management, Vol. 24 No. 10, pp. 994-1011.

Hines, P., Rich, N., 1997. The seven value stream mapping tools. International Journal of Operations & Production Management, 17(1), pp. 46 – 64.

Hines, P., Rich, N., Bicheno, J., Brunt, D., Taylor, D., Butterworth, C., Sullivan, J., 1998. Value Stream Management. The International Journal of Logistics Management, 9(1), pp. 25-42.

Hines, P., Silvi, R., Bartolini, M., 2002. Demand chain management: an integrative approach in automotive retailing. Journal of Operations Management, 20(6), pp. 707-728.

Hirst, E., Brown, M. 1990. Closing the efficiency gap: barriers to the efficient use of energy, Resources, Conservation and Recycling, 3, pp. 267-281.

Holweg, M., 2007. The genealogy of lean production. Journal of operations management, 25(2), pp. 420-437.

Hounshell, D., 1984. From the American system to mass production, 1800-1932: The development of manufacturing technology in the United States. John Hopkins University Press, Baltimore, MD.

Houston, F. S., Gassenheimer, J. B. (1987). Marketing and exchange. The Journal of Marketing, pp. 3-18.

Huxley, C., 2015. Three Decades of Lean Production: Practice, Ideology, and Resistance. International Journal of Sociology, 45(2), pp. 133-151.

Hüttmeir, A., de Treville, S., van Ackere, A., Monnier, L., Prenninger, J., 2009. Trading off between heijunka and just-in-sequence, Int. J. Production Economics, (118), pp.501–507.

Ip, B., Jacobs, G., 2006. Quality function deployment for the games industry: Results from a practical application. Total Quality Management & Business Excellence, 17(7), pp. 835-856.

Janoski, T., 2015. The New Division of Labor as Lean Production. International Journal of Sociology, 45(2), pp. 85-94.

Jasti, N. V. K., Kodali, R., 2015. Lean production: literature review and trends. International Journal of Production Research, 53(3), pp. 867-885.

Jayaram, J., Das, A., Nicolae, M., 2010. Looking beyond the obvious: Unraveling the Toyota production system. International Journal of Production Economics, 128(1), pp. 280-291.

Jick, T. D., 1979. Mixing qualitative and quantitative methods: Triangulation in action. Administrative science quarterly, pp. 602-611.

Johansson, H.J., McHugh, P., Pendlebury, A.J., Wheeler, W.A., 1993. Business Process Reeingineering: Breakpoint Strategies for Market Dominance, John Wiley and Sons, Chichester.

Johansson, J., Abrahamsson, L., Johansson, S., 2013. If you can't beat them, join them? The Swedish trade union movement and lean production, Journal of Industrial Relations, 55(3), pp. 445–460.

John, O.P., Benet-Martinez. V., 2000. Measurement: Reliability, construct validation, and scale construction. Handbook of Research Methods in Social and Personality Psychology, edited by H.T. Reis and C.M. Judd. Cambridge University Press, New York. pp. 339-369.

Johnson, D., 1998. Applied multivariate methods for data analysts. Duxbury Press, Pacific Groove.

Johnston, W. J., Leach, M. P., Liu, A. H., 1999. Theory testing using case studies in business-to-business research. Industrial Marketing Management, 28(3), pp. 201-213.

Jordan, A., Lenschow, A. 2010. Policy paper environmental policy integration: a state of the art review. Environmental Policy and Governance, 20(3), pp. 147-58.

Jorgensen, B., Emmitt, S., 2008. Lost in transition: The transfer of lean manufacturing to construction. Engineering, Construction and Architectural Management. Vol. 15 No. 4, pp. 383-398.

Juran, J.M., 1992. Juran on quality by design: The New Steps for Planning Quality into Goods and Services, The Free Press, New York.

Kadefors, A., 2004. Trust in project relationships—inside the black box. International Journal of project management, 22(3), pp. 175-182.

Kahraman, C., Ertay, T., Büyüközkan, G., 2006. A fuzzy optimization model for QFD planning process using analytic network approach. European Journal of Operational Research, 171(2), pp. 390-411.

Kanigel, R., 1997. The One Best Way: Frederick Winslow Taylor and the Enigma of Efficiency. Viking Penguin, NY.

Karlsson, C., Åhlström, P., 1996. Assessing changes towards lean production. International Journal of Operations & Production Management, 16(2), pp. 24-41.

Katayama, H., Bennett, D., 1996. Lean production in a changing competitive world: a Japanese perspective. International Journal of Operations & Production Management, 16(2), 8-23.

Katayama, H., Bennett, D., 1999. Agility, adaptability and leanness: A comparison of concepts and a study of practice, Int. J. Production Economics, 60-61, pp. 43-51.

Kethley, R.B., Waller, B.D, Festervand, T.A., 2002. Improving customer service in the real estate industry: A property selection model using Taguchi loss functions. Total Quality Management, 13(6), pp. 739-748.

Kim, J., Mahoney, J.T., 2002. Resource‐based and property rights perspectives on value creation: the case of oil field unitization. Managerial and Decision Economics, 23(4−5), pp. 225-245.

Kim, C.S., Spahlinger, D.D., Kin, J.M., Billi, J.E., 2006. Lean Health Care: What Can Hospitals Learn from a World-Class Automaker? Journal of Hospital Medicine, 1(3), pp. 191-199.

Kollberg, B., Dahlgaard, J.J., Brehmer, P.O., 2006. Measuring lean initiatives in health care services: issues and findings. International Journal of Productivity and Performance Management, 56(1), pp. 7-24.

Korkman, O., 2006. Customer Value Formation in Practice. A Practice–Theoretical Approach. Diss. Helsinki: Hanken School of Economics, Finland.

Koskela, L., 1992. Application of the new production philosophy to construction (No. 72). Stanford, CA: Stanford University.

Koskela, L., 2000. An exploration towards a production theory and its application to construction. PhD dissertation, VTT Technical Research Centre of Finland, Espoo.

Koskela, L., Sacks, R., Rooke, J., 2012. A Brief History of the Concept of Waste in Production, Proceedings of the 20th Annual Conference of the IGLC, San Diego, USA.

Kotler, P., 1972. A Generic Concept of Marketing, Journal of Marketing, 36 (April), pp. 46–54.

Krafcik, J. F., 1988. Triumph of the lean production system. MIT Sloan Management Review, 30(1), pp. 41-52.

Kvint, A., 1998. Thonet: en riktig wienervals. Elle Interiör, No 1, pp.28-30.

Kyriazidou, E., Pesendorfer, M., 1999. Viennese Chairs: A Case Study for Modern Industrialization. The Journal of Economic History, 59(1), pp. 143-166.

Lavie, D. 2006. The competitive advantage of interconnected firms: An extension of the resource-based view. Academy of management review, 31(3), pp. 638-658.

Lehmann, D.R., O'Shaughnessy, J., 1974. Difference in Attribute Importance for Different Industrial Products, Journal of Marketing, 38 (April), pp. 36-42.

Lekvall, P., Wahlbin, C., 2003. Information för marknadsföringsbeslut, IHM förlag, Göteborg.

Lepadatu, D., Janoski, T., 2011. Diversity at Kaizen Motors: Gender, Race, Age, and Insecurity in a Japanese Auto Transplant. University Press of America.

Lepak, D.P., Smith, K. G., Taylor, M.S., 2007. Value creation and value capture: a multilevel perspective. Academy of management review, 32(1), pp. 180-194.

Levitt, T., 1980. Marketing success through differentiation of anything, Harvard Business Review, January-February, pp. 83-91.

Liao, C.-N., Kao, H.-P., 2010. Supplier selection model using Taguchi loss function, analytical hierarchy process and multi-choice goal programming. Computers & Industrial Engineering, 58(4), pp. 571–577.

Liker, J. K. (2004). The Toyota Way: 14 Management principles from the world's greatest manufacturer. McGraw-Hill, New York, NY.

Liker, J.K., 2009. The Toyota Way. Lean för Världsklass. Liber AB, Malmö.

Lundahl, U., Skärvad P-H., 1999. Utredningmetodik för samhällsvetare och ekonomer. Studentlitteratur, Lund.

Lusch, R.F., Vargo, S.L., Tanniru, M., 2010. Service, value networks and learning. Journal of the academy of marketing science, 38(1), pp. 19-31.

Löschel, A., 2002. Technological change in economic models of environmental policy: a survey, Ecological Economics, 43(2), pp. 105-126.

Makadok, R., 2001. Toward a Synthesis of the Resource-Based and Dynamic-Capability Views of Rent Creation. Strategic management journal, 22(5), pp. 387-401.

Marshall, M., 2000. Luxury, economic development, and work motivation: David Hume, Adam Smith, and JR McCulloch. History of Political Economy, 32(3), pp. 631-648.

Mason-Jones, R., Naylor, B., Towill, D.R., 2000. Engineering the leagile supply chain. International Journal of Agile Management Systems, 2(1), 54-61.

Mason-Jones, R., Towill, D. R., 1998. Shrinking the supply chain uncertainty circle, IOM Control, 24 (7), pp.17–22.

Mattsson, J., 1990. Measuring Inherent Product Values. European Journal of Marketing, 24(9), pp. 25-38.

Matthyssens, P., Johnston, W.J., 2006. Marketing and sales: optimization of a neglected relationship. Journal of Business & Industrial Marketing, 21(6), pp. 338-345.

Matzler, K., Hinterhuber, H.H., 1998. How to make product development projects more successful by integrating Kano's model into quality function deployment, 18(1), pp. 25–38

McCann, L., Colby, B., Easter, K. W., Kasterine, A., Kuperan. K.V. 2005. Transaction cost measurement for evaluating environmental policies. Ecological Economics, 52(4), pp. 527– 542.

McKnight, D., 1994. The value theory of the Austrian school. The Appraisal Journal, 62(3), pp. 465-469.

Meredith, J., 1998. Building operations management theory through case and field research. Journal of operations management, 16(4), pp. 441-454.

Merriam, S. B. (1994). Fallstudien som forskningsmetod, övers. B. Nilsson. Studentlitteratur, Lund.

Milgram, S., 1963. Behavioral study of obedience. The Journal of Abnormal and Social Psychology, 67(4), pp. 371-378.

Milgrom, P., Roberts, J., 1990. The economics of modern manufacturing: Technology, strategy, and organization. The American Economic Review, 80(3), pp. 511-528.

Milgrom, P., & Roberts, J. (1995). Complementarities and fit strategy, structure, and organizational change in manufacturing. Journal of accounting and economics, 19(2), pp. 179-208.

Miller, C., Packham, G. and Thomas, B., 2002. Harmonization between main contractors and subcontractors: a prerequisite for lean construction?, Journal of Construction Research, 3(1), pp. 67-82.

Miltenburg, J., 1995. Manufacturing Strategy – How to Formulate and Implement a Winning Plan. Productivity Press, Portland.

Mishina, K., Takeda, K., 1994. Toyota Manufacturing USA, Inc. Case 9-693-019, Harvard Business School, Cambridge, MA, 22pp.

Misterek, S. D., Dooley, K. J., Anderson, J. C., 1992. Productivity as a performance measure. International Journal of Operations & Production Management, 12(1), pp. 29-45.

Mitnick, B.M., 1992. The theory of agency and organizational analysis. In Ethics and Agency Theory, edited by Bowie, N.E. and Freeman, R.E. Oxford University Press, New York. pp. 75–96.

Mollick, A.V., 2004. Production smoothing in the Japanese vehicle industry. International Journal of Production Economics, 91(1), pp. 63–74.

Monden, Y., 1981. What makes the Toyota production system really tick? Industrial Engineering, 13(1), pp. 36-46.

Monden, Y., 1998. Toyota production system: An integrated approach to just-in-time. Engineering and Management Press. IEE, Norcross, GA.

Moser, B.K., Stevens, G.R., 1992. Homogeneity of variance in the two-sample means test. The American Statistician, 46(1), pp. 19-21.

Moyano-Fuentes, J., Sacristán-Díaz, M., 2012. Learning on lean: a review of thinking and research. International Journal of Operations & Production Management, 32(5), 551-582.

Mundaca L., Neij L., Worrell E., McNeil M., 2010. Evaluating Energy Efficiency Policies with Energy-Economy Models, The Annual Review of Environment and Resources, 35, pp. 305-344.

Narasimhan, R., Swink, M., Kim, S.-W., 2006. Disentangling leanness and agility: an empirical investigation. Journal of Operation Management, 24(5), 440-457.

Naylor J. B., Naim, M.M., Berry D., 1999. Leagility: Integrating the lean and agile manufacturing paradigms in the total supply chain. International Journal of Production Economics, 62(1-2), pp. 107-118.

New, S.J., 2007. Celebrating the enigma: the continuing puzzle of the Toyota production system, International Journal of Production Research, 45(16), pp. 3545-3554. (Editorial)

Nightingale, D. J., Mize, J. H., 2002. Development of a lean enterprise transformation maturity model. Information-Knowledge-Systems Management, 3(1), pp. 15-30.

Nordin, F., Kowalkowski, C. (2010). Solutions offerings: a critical review and reconceptualisation. Journal of Service Management, 24(4), pp. 441–459.

Normann, R., Ramirez, R., 1993. Designing interactive strategy. Harvard business review, 71(4), pp. 65-77.

Näslund, D., 2008. Lean, six sigma and lean sigma: fads or real process improvement methods?, Business Process Management Journal, 14(3), pp. 269 - 287.

Näslund, D., Olsson, A., Karlsson, S., 2006. Operationalizing the concept of value: an action research-based model. The Learning Organization, 13(3), pp. 300-332.

Nässén, J., Sprei, F., Holmberg, J. 2008. Stagnating energy efficiency in the Swedish building sector – Economic and organisational explanations, Energy Policy, 36(10), pp. 3814-3822

Ohno, T., 1988. The Toyota Production System Beyond Large Scale Production. Portland, Oregon, Productivity Press

Oliver, N., Schab, L., Holweg, M., 2007. Lean principles and premium brands: conflict or complement? International Journal of Production Research. 45(16), pp. 3723-3739.

Ouchi, W., 1979. A Conceptual Framework for the Design of Organizational Control Mechanisms. Management Science, 25(9), pp. 833-48.

Panwar, A., Nepal, B.P., Jain, R., Rathore, A.P.S., 2015. On the adoption of lean manufacturing principles in process industries. Production Planning & Control, 26(7), pp. 564-587.

Pasquire, C., 2012. Positioning Lean within an exploration of engineering construction. Construction Management and Economics, 30(8), pp. 673–685.

Patnaik, D., 2004. System Logics: Organizing Your Offerings to Solve People's Big Needs, Design Management Review, 15(3), pp. 50–57.

Patnaik, D., Becker, R., 1999. Needfinding, The Why and How of Uncovering People's NeedsDesign Management Journal (Former Series), 10(2), pp. 37–43.

Pavnaskar, S. J., Gershenson, J. K., & Jambekar, A. B. 2003. Classification scheme for lean manufacturing tools. International Journal of Production Research, 41(13), pp. 3075-3090.

Pawar, K.S., Beltagui, A., Riedel, J.C.K.H. 2009. The PSO triangle: designing product, service and organisation to create value. International Journal of Operations & Production Management, 29(5), 468-493.

Payne, A.F., Storbacka, K., Frow, P., 2008. Managing the co-creation of value. Journal of the academy of marketing science, 36(1), pp. 83-96.

Pekuri, A., Haapasalo, H., Herrala, M., 2011. Productivity and Performance Management–Managerial Practices in the Construction Industry. International Journal of Performance Measurement, 1(1), pp. 39-58.

Peter, J.P., 1981. Construct validity: a review of basic issues and marketing practices. Journal of marketing research, pp. 133-145.

Petersen, P.B, 2002. The misplaced origin of just-in-time production methods. Management Decision, 40(1), pp. 82-88.

Pettersen, J., 2009. Defining lean production: some conceptual and practical issues. The TQM Journal, 21(2), pp. 127-142.

Pitelis, C.N., 2009. The co-evolution of organizational value capture, value creation and sustainable advantage. Organization studies, 30(10), pp. 1115-1139.

Pool, A., Wijngaard, J., Van der Zee, D.J., 2011. Lean planning in the semi-process industry, a case study. International Journal of Production Economics, 131(1), pp. 194-203.

Porter, G., 1984. Foreword. In: Hounshell, D., (Ed.), From the American system to mass production, 1800-1932: The development of manufacturing technology in the United States. John Hopkins University Press, Baltimore, MD.

Porter, M. E., 1980. Competitive strategy: Techniques for analyzing industries and competitors. Free Press, New York.

Porter, M.E. 1985. Competitive Advantage: Creating and Sustaining Superior Performance. The Free Press, New York.

Porter, M.E., 1990. The Competitive Advantage of Nations. The Free Press, New York.

Priem, R. L., 2007. A consumer perspective on value creation. Academy of Management Review, 32(1), pp. 219-235.

Priem, R.L., 2001. "The" Business-Level RBV: Great Wall or Berlin Wall? The Academy of Management Review, 26(4), pp. 499-501

Priem, R.L., Butler, J.E., 2001a. Is the resource-based “view” a useful perspective for strategic management research?. Academy of management review, 26(1), pp. 22-40.

Priem, R.L., Butler, J.E., 2001b. Tautology in the resource-based view and the implications of externally determined resource value: Further comments. Academy of Management review, 26(1), pp. 57-66.

Pruijt, H., 2003. Teams between neo-Taylorism and anti-Taylorism. Economic and Industrial Democracy, 24(1), pp. 77-101.

Ramsay, J., 2005. The real meaning of value in trading relationships, International Journal of Operations & Production Management, 25(6), pp. 549-565.

Ravald, A., 2001, May. A View of Value–The Customer Value Process Approach. In Proceedings from the 30th EMAC Conference" Rethinking European Marketing.

Ravald, A., Grönroos, C., 1996. The value concept and relationship marketing, European Journal of Marketing, 30(2), pp.19 - 30.

Reeves, C.A., Bednar, D.A., 1994. Defining Quality: Alternatives and Implications. Academy of Management Review, 19(3), pp. 419-445.

Remenyi, D., Williams, B., Money, A., Swartz E., 1998. Doing Research in Business and Management. Sage publications, London.

Sabel, C., Zeitlin, J., 1985. Historical Alternatives to Mass Production: Politics, Markets and Technology in Nineteenth-Century Industrialization. Past & Present, 108, pp. 133-176

Sabel, C.F., 1982. Work and politics: the division of labor in the industry. Cambridge University Press, Cambridge.

Samuel, D., Found, P., Williams, S. J., (2015). How did the publication of the book The Machine That Changed The World change management thinking? Exploring 25 years of lean literature. International Journal of Operations & Production Management, 35(10), pp.1386-1407.

Sandkull, B., Johansson, J., 2000. Från Taylor till Toyota: Betraktelser av den industriella produktionens organisation och ekonomi. Studentlitteratur. Lund.

Saunders, I.W., Preston, A.P., 1994. A model and a research agenda for total quality management. Total Quality Management, 5(4), pp. 185-201.

Schade, J., 2013. A design process perspective on the energy performance of buildings. Doctoral thesis, Luleå University of Technology.

Schonberger, R.J., 2007. Japanese production management: An evolution: With mixed success. Journal of Operations Management, 25(2), pp. 403-419.

Schumacher, E.F., Kirk, G., 1977. In: Kirk, G. (Ed.), Schumacher on Energy: Speeches and Writings of E.F. Schumacher, Cape, London.

Segerstedt, A., Olofsson, T., 2010. Supply chains in the construction industry. Supply Chain Management: An International Journal, 15(5), pp. 347-353.

Sharma, A., 1997. Professional as agent: Knowledge asymmetry in agency exchange. Academy of Management Review, 22(3), pp. 758-798.

Sharman, G., 1984. The Rediscovery of Logistics. Harvard Business Review, September-October.

Sheth, J.N., Newman, B., Gross, B.L., 1991. Why we buy what we buy: a theory of consumption values, Journal of Business Research, 22(2), pp. 159-70.

Sheth, J.N., Uslay, C., 2007. Implications of the revised definition of marketing: from exchange to value creation. Journal of Public Policy & Marketing, 26(2), pp. 302-307.

Shingo, S., 1981. Study of 'Toyota' Production System from Industrial Engineering Viewpoint. Japan Management Association, Tokyo, Japan.

Shingo, S., 1984. Den nya japanska produktionsfilosofin, övers. L.O Södahl. MGruppens Förlag, Stockholm.

Simkin, M.V., Roychowdhury, V.P., 2003. Read before you cite! Complex Systems, 14, pp. 269-274.

Sink, D.S., Tuttle, T.C., 1989. Planning and Measurement in your Organisation of the Future, ch. 5. Industrial Engineering and Management Press, Norcross, GA, pp. 170-84.

Slack, N, et al., 1998. Operations Management 2nd edition. Financial Times, London.

Slack, N., Chambers, S., Johnston, R., 2001. Operations Management, 3rd edition. Pearson Education Limited, Harlow.

Slater S.F., 1997. Developing a customer value-based theory of the firm, Journal of the Academy of Marketing Science, 25(2), pp 162-167.

Smith, A., 1776. An Inquiry into the Nature and Causes of the Wealth of Nations, London: printed for W. Strahan; and T. Cadell, (Source: Edinburgh Research Archive) URI: http://hdl.handle.net/1842/1455

Snee, R.D., 2005. When Worlds Collide: Lean and Six Sigma. Quality Progress, 38(9), pp. 63-65.

Spear, S. Bowen, K.B., 1999. Decoding the DNA of the Toyota production system, Harvard Business Review, September-October, pp. 96-106.

Spear, S.J. 2004. Learning to lead at Toyota. Harvard business review, May, pp. 78-91, Harvard Business Review, September-October, pp. 96-106.

Sprent, P., Smeeton, N.C., 2001. Applied Nonparametric Statistical Methods, Third edition. Chapman & Hall/CRC, Boca Raton, Florida.

Squire, B., Cousins, P. D., Brown, S. 2005. Collaborating for customisation: an extended resource-based view of the firm. International Journal of Productivity and Quality Management, 1(1-2), pp. 8-25.

Srinidhi, B., Tayi G.K., 2004. Just in time or just in case? An explanatory model with informational and incentive effects, Journal of Manufacturing Technology Management, 15(7), pp. 567-574.

Stainer, A., 1997. Capital input and total productivity management. Management Decision, 35(3), pp. 224-232.

Stentoft Arlbjørn, J., Vagn Freytag, P., 2013. Evidence of lean: a review of international peer-reviewed journal articles. European Business Review, 25(2), pp. 174-205.

Stern, P.C., 1986. Blind Spots in Policy Analysis: What economics doesn't say about energy use, Journal of Policy Analysis and Management, Vol. 5, No. 2, pp. 200-227.

Stern, P.C., Dietz, T., Abel, T., Guagnano, G.A., Kalof, L., 1999. A Value-Belief-Norm Theory of Support for Social Movements, Human Ecology Review, 6(2), pp. 81-97.

Stone, K.B., 2012. Four decades of lean: a systematic literature review. International Journal of Lean Six Sigma, 3(2), pp. 112-132.

Storper, M., Harrison, B., 1991. Flexibility, hierarchy and regional development: the changing structure of industrial production systems and their forms of governance in the 1990s. Research policy, 20(5), pp. 407-422.

Strang, D., David, R.J., Akhlaghpour, S., 2014. Coevolution in Management Fashion: An Agent-Based Model of Consultant-Driven Innovation1. American Journal of Sociology, 120(1), pp. 226-264.

Sturgeon, T.J., 2002. Modular production networks: a new American model of industrial organization. Industrial and corporate change, 11(3), pp. 451-496.

Ståhlbröst, A., Holst, M., Krogstie, J., Gudmundsdottir, A., Olesen, A., Braskus, L., Jelle, T., 2012. Users and Energy Savings - Their Perspectives and Needs, Information Systems Research Seminar in Scandinavia (35), aug. 17 2012 - aug. 20 2012, Stockholm.

Sugimori, Y., Kusunoki, K., Choa, F., Uchikawa, S., 1977. Toyota production system and Kanban system Materialization of just-in-time and respect-for-human system, International Journal of Production Research, 15(6), pp. 553-564.

Södahl, L.O., 1984. Foreword. In: Shingo, S., Den nya japanska produktionsfilosofin, övers. L.O Södahl. MGruppens Förlag, Stockholm.

Söderholm, K., 2013. Housing, public policy and the environment in a historical perspective: lessons from Swedish post-war society. International Journal of Sustainable Society, 5(1), pp. 24-42.

Sörqvist, L., 1997a. Difficulties in measuring the cost of poor quality. Measuring Business Excellence, 1(1), pp. 38-40.

Sörqvist, L., 1997b. Effective methods for measuring the cost of poor quality. Measuring Business Excellence, 1(2), pp. 50-53.

Taguchi, G., 1986. Introduction to quality engineering: designing quality into products and processes. The Organization, Tokyo.

Tangen, S., 2004. Performance measurement: from philosophy to practice. International Journal of Productivity and Performance Management, 53(8), pp. 726-737.

Tangen, S., 2005. Demystifying productivity and performance. International Journal of Productivity and performance management, 54(1), pp. 34-46.

Teece, D.J., Pisano, G., Shuen, A., 1997. Dynamic capabilities and strategic management. Strategic management journal, pp. 509-533.

Towill, D.R., 2007. Exploiting the DNA of the Toyota Production System. International Journal of Production Research, 45(16), pp. 3619-3637.

Trentmann, F., 2004. Beyond consumerism: new historical perspectives on consumption. Journal of Contemporary History, 39(3), pp. 373-401.

Tushman, M.L., Nelson, R.R., 1990. Introduction: Technology, organizations, and innovation. Administrative Science Quarterly, 35(1), pp. 1-8.

Tzokas, N., Saren, M., 1999. Value transformation in relationship marketing. Australasian Marketing Journal (AMJ), 7(1), pp. 52-62.

Van der Haar, J.W., Kemp, R.G., Omta, O., 2001. Creating value that cannot be copied. Industrial Marketing Management, 30(8), pp. 627-636.

Vargo, S.L., Lusch, R.F., 2004. Evolving to a new dominant logic for marketing. Journal of marketing, 68(1), pp. 1-17.

Vargo, S.L., Lusch, R.F., 2011. It's all B2B… and beyond: Toward a systems perspective of the market. Industrial Marketing Management, 40(2), pp. 181-187.

Vargo, S.L., Maglio, P.P., Akaka, M.A., 2008. On value and value co-creation: A service systems and service logic perspective. European management journal, 26(3), pp. 145-152.

Vargo, S.L., Morgan, F.W. 2005. Services in society and academic thought: an historical analysis. Journal of Macromarketing, 25(1), pp. 42-53.

Voss, C.A., 2005. Alternative paradigms for manufacturing strategy. International Journal of Operations & Production Management, 25(12), pp. 1211-1222.

Vrijhoef, R., Koskela, L., 2000. The four roles of supply chain management in construction. European journal of purchasing & supply management, 6(3), pp. 169-178.

Wan, H. D., Frank Chen, F., 2008. A leanness measure of manufacturing systems for quantifying impacts of lean initiatives. International Journal of Production Research, 46(23), pp. 6567-6584.

Warnecke, H.J., Hüser, M., 1995. Lean production. International Journal of Production Economics, 41(1), pp. 37-43.

Webster Jr, F.E., 1992. The changing role of marketing in the corporation. The Journal of Marketing, 56(4), pp. 1-17.

Wernerfelt, B., 1984. A resource-based view of the firm. Strategic management journal, 5(2), pp. 171-180.

Wheelwright, S.C., 1984. Manufacturing strategy: defining the missing link. Strategic management journal, 5(1), pp. 77-91.

White, G.P., 1996. A meta-analysis model of manufacturing capabilities. Journal of Operations Management, 14(4), pp. 315–331.

Wickman, K., Lingle, C., 2004. Rethinking Tax Policies: New Ideas from a Dead Economist, Institute of Economic Affairs, 24(3), pp. 53-57.

Wijnberg, N.M. 1995. Selection processes and appropriability in art, science and technology. Journal of Cultural Economics, 19(3), 221-235.

Wijnberg, N.M., Gemser, G., 2000. Adding value to innovation: Impressionism and the transformation of the selection system in visual arts. Organization Science, 11(3), pp. 323-329.

Wikström, S., 1996. Value creation by company ‐ consumer interaction. Journal of Marketing Management, 12(5), pp.359-374.

Williams, D.J., 2005. The Birmingham gun trade and the American system of manufactures. Transactions of the Newcomen Society, 75(1), pp. 85-106.

Wilson, D.T., Jantrania, S., 1994. Understanding the value of a relationship. Asia-Australia marketing journal, 2(1), pp. 55-66.

Wilson, J.M., 1998. A comparison of the 'American System of Manufactures' circa 1850 with Just in Time methods. Journal of Operations Management, 16(1), pp. 77-90.

Wilson, J.M., 1996. Henry Ford: A just-in-time pioneer. Production and Inventory Management Journal, 37(2), pp. 26-31.

Winch, G.M., 2006. Towards a theory of construction as production by projects. Building Research & Information, 34(2), pp. 154-163.

Wittrock, C., 2015. Reembedding Lean: The Japanese Cultural and Religious Context of a World Changing Management Concept. International Journal of Sociology, 45(2), pp. 95-111.

Womack, J., Jones, D.T., 1996. Lean Thinking: Banish Waste and Create Wealth in Your Corporation. Simon and Schuster, New York.

Womack, J.., Jones, D.T., 2005. Lean solutions: how companies and customers can create value and wealth together. Simon and Schuster, New York.

Womack, J.P., Jones, D.T. and Roos, D. 1990. The Machine that Changed the World: Based on the Massachusetts Institute of Technology 5-million Dollar 5-year Study on the Future of the Automobile, Rawson Associates, New York, NY.

Woodall, T., 2003. Conceptualising 'value for the customer': an attributional, structural and dispositional analysis. Academy of marketing science review, 12(1), pp. 1-42.

Woodruff R.B., 1997. Customer Value: The Next Source of Competitive Advantage, Journal of the Academy of Marketing Science, 25(2), pp. 139–153.

Woollard, F.G., 1925. Some notes on British methods of continuous production. Proceedings of the Institution of Automobile Engineers, 19(2), pp. 419-474.

Woollard, F.G., 1954. Principles of Mass and Flow Production. Iliffe & Sons, London.

Woollard, F.G., Emiliani, B., 2009. Principles of mass and flow production: including some notes on British methods of continuous production 1925 / Frank. G. Woollard; with commentary and analysis by Bob Emiliani. 55th Anniversary special reprint edition. Wethersfield, CT.

Wren, D.A., 1994. The Evolution of Management Thought. Wiley, New York.

Yin, R. (2003), Case study research: Design and methods, 3rd ed. Thousand Oaks, CA: Sage.

Young, T.P., McClean, S.I., 2008. A critical look at lean thinking in healthcare. Quality and Safety in Health Care, 17(5), pp. 382–386.

Yung, W. and Chan, D. (2003), "Application of value delivery system (VDS) and performance benchmarking of flexible business process reengineering", International Journal of Operations & Production Management, Vol. 23 No. 3, pp. 300-15.

Zeithaml, V.A. (1988), Consumer perceptions of price, quality, and value: a means-end model of synthesis of evidence, Journal of Marketing, Vol. 52, July, pp. 2-22.

Zerbe Jr., R.O., McCurdy, H.E., 1999. Failure of Market Failure, Journal of Policy Analysis and Management, 18(4), 558-578.

Zipkin, P.H., 1991. Does Manufacturing need a JIT Revolution? Harvard Business Review. 69(1), pp. 40-50.

Åhlström, P., Karlsson, C., 1996. Change processes towards lean production: the role of the management accounting system. International Journal of Operations & Production Management, 16(11), pp. 42-56.

References on the web

Taylor, F.W., 1911a. Shop Management (http://www.gutenberg.org/cache/epub/6464/pg6464.html, Accessed on February 5, 2015)

Taylor, F.W., 1911b. The Principles of Scientific Management (http://www.gutenberg.org/cache/epub/6435/pg6435.html, Accessed on February 5, 2015)

Etymological Online Dictionary. http://www.etymonline.com/index.php. Accessed on December 14, 2014.

References on the web, background

http://blog.svd.se/frobergsbilar/2014/03/19/toyota-gate-varre-an-gm-skandalen/ (Accessed on March 20, 2014 and August 14, 2016)

http://www.reuters.com/article/us-toyota-settlement-idUSBREA2I0VB20140319 (Accessed on August 14, 2016)

http://www.theguardian.com/business/2014/mar/19/toyota-1bn-settlement-car-safety-probe, (Accessed on March 25, 2014 and August 14, 2016)

US Department of Justice (all Accessed on March 20, 2014 and August 14, 2016)

http://www.justice.gov/opa/documents/toyota-def-pros-agr.pdf

http://www.justice.gov/opa/documents/toyota-info.pdf

http://www.justice.gov/opa/documents/toyota-stmt-facts.pdf

http://www.justice.gov/opa/pr/2014/March/14-ag-286.html

References on the web, Statistics Sweden (SCB)

(All accessed on December 9, 2015)

http://www.scb.se/sv_/Hitta-statistik/Statistik-efter-amne/Hushallens-ekonomi/Inkomster-och-inkomstfordelning/Inkomster-och-skatter/Aktuell-pong/302201/Behallare-for-Press/369661/

http://www.scb.se/sv_/Hitta-statistik/Statistik-efter-amne/Priser-och-konsumtion/Byggnadsprisindex-samt-faktorprisindex-for-byggnader/Byggnadsprisindex-BPI/12486/12493/26943/

Other references

The Swedish History Museum, Meet the Vikings, 20 June - 28 August 2016, (information based on "What price a life")

PUBLICATION LIST

Appended papers

The following journal articles are appended to this thesis:

Paper I:

Wallström, P., Segerstedt, A., 2010. Evaluation of forecasting error measurements and techniques for intermittent demand. International Journal of Production Economics, 128(2), pp. 625-636.

Paper II:

Schade, J., Wallström, P., Olofsson, T., Lagerqvist, O., 2013. A comparative study of the design and construction process of energy efficient buildings in Germany and Sweden. Energy Policy, 58, pp. 28–37.

Paper III:

Chronéer, D., Wallström, P., Exploring waste and value in a lean context: A critical view, Submitted to International Journal of Business Management.

Paper IV:

Wallström, P., Vennström, A., Chronéer, D., The difficulties to operationalize value and waste: A case study of Value Stream Mapping, to be submitted.

Reports, book chapters and articles

CILECCTA (FP7 project). 2013. Sustainability within the Construction Sector: CILECCTA – Life Cycle Costing and Assessment. ISBN 978-82-536-1343-7. (www.cileccta.eu)

Wallström, P., 2010. Mätning och uppföljning i byggindustrin från projekt till process: med fokus på produktivitet, resurs- och materialflöden. Luleå tekniska universitet.

Norberg, H., Wallström, P., Olofsson, T., Segerstedt, A., Tarandi, V., Isaksson, L., Outters, N., 2009. Byggsynkronisering. Luleå: Luleå tekniska universitet.

Segerstedt, A., Wallström, P., 2008. Prognosering med exponentiell utjämning. Bättre produktivitet: tidning för PLAN och regionala produktivitetsföreningar: med plan-nytt.

Conference papers

Ellingham, I., Fawcett, W., Wallström, P., 2013. Time preference and risk aversion among development and construction professionals and managers. IAPS International Network Symposium June 25-28, 2013, A Coruña, Spain.

Wallström, P., Lu, W. & Olofsson, T., 2013. The Interaction of Contractor's Cost Flow with Operational Practice: A Simulation Study. CIB W78 International Conference - October 9-12, Beijing, China.

Wallström, P., Vennström, A., Olofsson, T., 2011. Mätning och uppföljning av byggprojekt med fokus på produktivitet, resurs- och materialflöden. PLANs Forsknings- och tillämpningskonferens 2011 – Logistik i praktisk tillämpning. Persson, F., Rudberg, M., (red.). Stockholm: Logistikföreningen Plan, pp. 81-93.

Wallström, P., Segerstedt, A., Norberg, H. Olofsson, T., 2008. Inventory and production management in construction industry: an introduction. International Symposium on Inventories 15, August 22-26, 2008, Budapest, Hungary.

Wallström, P., Segerstedt, A., 2008. Evaluation of forecasting techniques for intermittent demand, 15th International Working Seminar on Production Economics, March 3-7, Innsbruck, Austria.

Licentiate thesis

Wallström, P., 2009. Evaluation of forecasting techniques and forecast errors: with focus on intermittent demand. Luleå tekniska universitet.