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Less is more

-A study of the service lanes at a Danish workshop

Author: Caroline Appel, 20040

Tutors: Malin Holm, Pär Åhlström

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Discussant:

“Lean thinking is about doing more and more with less and less while becoming closer and closer to what the customer wants”

- Womack & Jones, 2003

Abstract:

Today the principles of lean production have proven to be a very successful theory within manufacturing, but not only. More and more researches are showing other areas in which these theories can be applicable. This study focuses on the service lanes at Scania's new workshop in Ishøj with the purpose of making them more efficient and the value flow better with the help of the lean principles and service blueprinting. A current state map is presented and with the help of the theories the non value adding activities are identified and eliminated in the future state map presented in the conclusion. There are also concrete suggestions what can be done in the workshop in Ishøj in order to make it more efficient.

Keywords: lean principles, service, value, value stream mapping, flow, service blueprinting

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1. Introduction

Companies within the production sector have during the recent decades become very good at rationalising and improving their operation. Today, the most prominent philosophy within production companies is Lean Production which is based on the Toyota Production System, (TPS). This has also spurred research about how these principles can be applied within other areas. The Lean-philosophy is about a way of thinking and a tool to help making the company more efficient, but foremost how to relate to your customers and how you see your own organisation. As in all activity development it is all about engagement, but also about developing a new way of thinking and a new culture in the organisation to be able to reach the goals you set up.

In most companies service is the part that can give the greatest margins and that is most difficult to imitate. Therefore this part of the company is becoming more and more important and many companies are putting more and more effort on making also this part within the company more efficient. Within the truck and bus industry continuous service is crucial for the truck and bus drivers to be able to perform their work safely, which indicates a big income for the companies offering the service.

To be able to give the best service possible to the customers without too high costs, it is important how the service workshop is built up – to make sure that the flow is value adding to both the customer and the company. Lean has, as mentioned, a couple of fundamental principles, whether it comes to production or service. One of those is pull instead of push which handles both working method and the physical layout. A workshop should be adjusted to the clients' needs to make the work flow as smooth and efficient as possible. The clients' needs are in this case the kind of repair or service their vehicle needs. It is impossible to adjust a workshop to all the needs that the drivers have, but you have to adjust it to the most common repairs that are requested and build the workshop as smoothly as possible according to this. A smoothly and efficiently built service workshop means amongst other things that the trucks or buses can be moved smoothly from one spot to another or even remove some spots and that they do not need to go back and forth between different buildings. This means that the workshop should be so thoughtfully built that there is a logical flow between the different stations, that the treatment of the spare parts is handled in a smooth way so that the technicians will not have to look for them or go unnecessary far to get them.

The Ishøj workshop is a big project where the ambition has been to create a process and flow oriented layout. Now one year has passed since the workshop was initiated and it is therefore interesting to see how the workshop works and see what can be improved before “old habits” start to root. I have chosen to investigate the process of the service lanes for both trucks and buses. The reason for choosing the service lanes has been that it is the most common “repair”. This makes it easier to conduct a study on this topic since the repetition is high. It is probably also one of the most important things to investigate since the company then can profit the most if the efficiency there can be improved.

This workshop was built before Scania started building their standardised workshops and since Scania is a company well-known for using the lean principles, this makes it even more interesting to look at what the principles actually can achieve in practice within service and to see how the lean principles can improve the efficiency of the workshop.

2. Problem discussion

With this chapter I aim to explain why this specific field of research and case study was chosen and why it is of interest to conduct further investigations within the subject.

Operations management has its origin in manufacturing, but the growth in the service industries the last decades has forced researchers to reconsider some of the well established theories within operations management. Hence, the challenge has now become to apply quantitative tools to the qualitative factors within service such as value and experience. A good example of the handling of this transition is the theory of lean (Bartezzaghi, 1999). Today the principles of lean production is a quite established theory. Although the principles have proved to be very successful within manufacturing (Womack et al., 2007), initial research also show similar results when it comes to the use of lean principles within the service industry (Bowen& Youngdahl, 1998, Ahlstrom, 2004). An example of applying lean principles not only within manufacturing, but also within service, is Scania. They have recently started to build standardised workshops. Since this is something that Scania just has started practicing this gives me an opportunity and challenge to investigate non-standardised workshops and how they can become more lean.

Having decided to focus on operations management and lean in my master thesis, the choice to investigate the case of Scania was simple. Scania is well known for their use of lean principles and moreover it is a large company of great importance. I was fortunate to get a positive response to my request to write my thesis for Scania Denmark, which has given me a perfect opportunity to look beyond the theoretical aspect of lean and focus on what the theories of lean principles can achieve in practice.

3. Methodology

The aim in this chapter is to outline the methodology by which this research project has been conducted. I will first define the purpose of the thesis and then have a look at the general research approach and method. Thirdly, the design of the research will be outlined and finally the quality of the findings in terms of validity and reliability will be discussed.

3.1 Purpose

The purpose of this thesis is to identify the critical points in the service lanes at Scania's workshop in Ishøj with the help of the lean principles and service blueprinting. I will investigate in what sense the lean principles will be able to make the service lanes more efficient by making a value flow analysis. Hence, my research question is:

In what way can the service lanes at Scania Ishøj become more efficient by using the lean principles?

3.2 Research method and approach

3.2.1 Qualitative or quantitative method

Usually, there are two different methods within social studies, qualitative and quantitative. The greatest difference between the two methods lies in the usage of numbers and statistics (Holme & Solvang, 1991). The quantitative studies often answer the question "how many" while the qualitative method answers the question "why" (Svenning, 1999). The crucial thing when choosing the method is to choose the one that suits the research question the best (Holme & Solvang, 1991, Svenning 1999, Alvesson & Sköldberg, 1994).

The quantitative method is more structured and controlled by the researcher where he or she can be more selective in the information and the answers. Statistics is also an important matter in these kinds of studies, where the researcher turns the information into numbers and then makes statistical analysis (Holme & Solvang, 1991).

The main thought with the qualitative method is to exemplify and make conclusions with the help of examples (Svenning, 1999). The qualitative method places the observer in the centre of the world that he or she wished to observe (Alvesson & Sköldberg, 1994). The method has an understanding purpose and the aim of the method is that the researcher can achieve a deeper understanding of the problem studied with help from different sources of information, but also to be able to describe the whole of the situation where the problem occurs (Holme & Solvang, 1991). The method is also characterised by the closeness to the

source of information since it is adapted according to the situation itself and the interviewee's view. Since the qualitative method gives a total perspective and a more complete understanding than the quantitative method in case studies (Holme & Solvang, 1991), this method is found the most appropriate to investigate the process of the service lanes.

3.2.2 Deductive or inductive

Also when it comes to the choice of research approach it is very important to make a choice based on the research question and the knowledge available to the researcher (Eisenhardt, 1989).

Deductive results come from conclusions about specific events drawn from general principles (Andersen, 1998) and are often used in quantitative studies, where the researcher tries to manipulate the variables in order to test the hypotheses and make the theory out of that (Svenning, 1999). The model does not really explain anything but rather tries to establish a fact which makes the approach quite flat (Alvesson & Sköldberg, 1994). The qualitative studies are on the other hand more inductive where the researcher shows from the empirics that a theory is valid (Svenning, 1999). Inductive studies are also common in explorative studies (Andersen, 1998).

From the courses in Operations Management at SSE, I had the basic theories of lean production. After the first weeks of observation at Ishøj, I had to read more about the theories of lean service as I needed more theory to interpret the empirics. The alternation between drive of new theory and new empirics Alvesson & Sköldberg (1994) refer to as an abductive approach and makes the empirics develop by new theoretical understandings. According to the authors this approach is often used in case studies.

3.2.3 Exploratory vs. explanatory research

According to Kerlinger (1986) there are two major types of research. The first, the exploratory research, has the objective of becoming familiar with a topic. There is usually no model in these kinds of researches and the concepts of interest need to be better understood and measured (Malhotra & Grover, 1998). Exploratory researches aim both to investigate situations or phenomena that have not been so explored earlier but also to identify problems within an organisation (Andersen, 1998). The other type of research is

explanatory and is devoted to finding causal relationships among variables from theory-based expectations and how and why variables should be related (Malhotra & Grover, 1998).

I have chosen an explorative method for this study since I, according to the purpose, aim to identify weak points within the service lanes in order to make them more efficient.

3.2.4 Case study

When conducting a research the first step is to identify what type of research you aim to conduct and develop a research model and methodology that fits well with this. Each strategy of doing a research has particular advantages and disadvantages depending on three conditions (Yin, 2003):

- 1) The type of research question
- 2) The control an investigator has over actual behavioural events
- 3) The focus on contemporary as opposed to historical phenomena.

In general, case studies are preferred when posing the question how or why, when the investigator has little control over events and when the focus is on a contemporary phenomenon with some real-life context. "How" and "why" questions are more explanatory and likely to lead to the use of case studies. This is because such questions deal with operational links needing to be traced over time, rather than more frequencies or incidence (Yin, 2003). Since my research question is a "how" question, a case study is perfectly appropriate to fulfil my purpose.

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 2003).

Case research has been one of the most powerful research methods in operations management (Voss et al., 2002), and is preferred when examining contemporary events, but when the relevant behaviours cannot be manipulated. The case study relies on direct observation of the events being studied and interviews of the persons involved in the events (Yin, 2003).

There are many advantages of using a case study approach. According to Yin (2003) and Eisenhardt (1989) the unique strength is its ability to deal with a full variety of evidence – documents, artefacts, interviews and observations but also Meredith (1998) claims that the phenomenon can be studied in its natural setting and meaningful relevant theory generated from the understanding gained through observing actual practice.

3.3 Method and data collection

The research has been performed by studying the technicians at the service lanes, the work process of the technicians and the trucks, buses and technicians way through the process. This has been done by spending 20 whole days on the shop floor and 14 days with a couple of hours on the shop floor, observing what is happening and talking to the technicians and the clients. I have had 7 longer interviews with 5 truck technicians performing service and 7 longer interviews with 4 bus technicians performing service. I have also had the ability to spend a couple of days with 5 different managers. I have spent one day each with the bus and truck foreman, two days with the former head of economy with introduction and longer interviews and discussions, 2 days with the head of clients responsible for the client relations and contracts and had one longer interview with the head of stocks. All persons whom I have had longer conversations with and followed in their work have been positively disposed to my questions and to me observing them in their work. In my opinion, being always around also makes it easier to pay attention to details which is exactly what is needed in this kind of thesis.

I have also been able to talk to some of the clients who come and leave their trucks at the workshop. They have found my thesis interesting and have appreciated to talk to me for a while since it has made the waiting time pass quicker with something new happening and putting themselves in focus.

Since I have used the theories of service blueprinting in conducting this thesis, I have performed the study in this way:

1. Identifying service family
2. Collecting data, phase 1
3. Map the current state
4. Collecting data, phase 2
5. Detail the current state map
6. Analysing the current state map by identifying waste/NVAs
7. Draw a future state map

Identifying the service family:

Each mapping involves a redesign of a specific process or set of processes, called a service family. This represents all the work and transactions the team would like to change, using the value stream mapping tool. The mapping begins with identifying these service families.

The research object was chosen after a meeting at the workshop in Ishøj, in compliance with my tutor, professor and Ishøj's management. Making the service lanes more efficient was identified as most interesting since it is the most common job that customers come to the workshop for.

Data collection phase 1 and current state map:

Once the product/service family has been established, it is time to draw a *current state map*. To be able to do this, I have collected data from both truck service and bus service lanes.

The first part of the study has been to observe the process of the different services for several days and try to establish the steps in the service. This has been done during 2-3 days a week during one month, from when the technicians start their days at 7 or 7.30 a.m. until they finish at 3 or 3.30 p.m. depending whether they work on the truck or bus section in order to find the "standard process". During these days I have also talked a lot with the technicians to find out how they experience their work and I have been able to ask them questions whenever I have been extra curious about something and to make sure that I understand every step in the process. I have followed different technicians also in order to find out a "standard" way of performing the tasks and not only one technicians' way.

After this first data collection I have, according to the blueprinting theory, tried to map both all the steps in the process but also identified the technicians and the trucks and bus way through the process. According to Keyte and Locher (2004), this is the beginning point of the transformation of the enterprise. It represents how the company organises and progresses work today, its baseline condition. The map does not solve any problems itself, but is rather a way of gathering information on a process quickly and visually to point to problems in the company's work streams.

Data collection phase 2 and detailed current state map:

The second phase of the data collection has been to time all the activities to see how long every activity takes to perform. This has also been done several days and on several

technicians to be able to find out the average time and not to just rely on one technician or one day when things might go extremely smoothly or extremely problematic.

With this information I have been able to complete my current state map, with not only identification of the steps, but also how long they take in order to be able to see what takes far too long, what needs to take time and what could become more efficient. The times of all activities have been marked on the current state map.

Value:

Since the working process of this study has taken the form of a value stream analysis, a crucial thing is to try to identify the value for the customer. Hence, I have tried to get to know from the customers what they value. This has been done through half-hour individual semi structured interviews when they have come in with their truck. With help from this and by talking to the technicians, I have been able to identify what is value adding for the customer, what is not value adding and what is not value adding but necessary to perform the value adding activities.

Analysing the current state map by identifying waste:

To be able to make a trustworthy analysis it is essential to identify the root causes of the problems (Keyte & Locher, 2004). Therefore, in order to analyse the current state map and identify different kinds of non value adding activities, I have also had to learn why things are the way they are.

Future state map:

The future state map focuses on a new design for the value stream and the intended performance at a point in a lean transformation. Often, the future and current state mapping influence each other – many ideas for the future value stream begin already during the current state drawing when challenging the structure of the current value stream. The first future state map should show the desirable design in three to six months for implementation since it gives the company the ability to complete a few significant projects in a timely manner (Keyte & Locher, 2004).

The future state map has been drawn after identifying the critical points and non –value adding activities in the current state map and after trying to eliminate as much waste as possible.

3.4 Research quality

According to Yin (2003) there are four kinds of tests to establish the quality of any empirical social research. These are:

- Construct validity: Use multiple resources of evidence, establish chain of evidence, have key informants review draft of case study report
- Internal validity: Do pattern-matching, do explanation-building, address rival explanations, use logic models
- External validity: Use theory in single-case studies, use replication logic in multiple-case studies
- Reliability: Use case study protocol, develop case study databases

3.4.1 Validity

Validity is the ability to measure what we want to measure, the connection between theory and empirics (Svenning, 1999).

The construct validity lies in establishing correct operational measures for the concepts that are being studied, which is often problematic in case study researches. Critics often point to the fact that a case study investigator fails to develop a sufficiently operational set of measures and that subjective judgements are used to collect the data (Yin, 2003). In order to increase the construct validity I have chosen to rely on multiple sources of evidence, for example interviews with persons on different levels, observations and time measuring.

Internal validity refers to the project itself and the direct correlation between theory and empirics, how study is designed while the external validity refers to the theoretical ground that the research is based upon. This is about the project's anchoring in a wider perspective, the ability to generalize out of a specific study. If the empiric is not trustworthy the research is not trustworthy either. It is easier to achieve validity in a qualitative study, especially when it concerns the internal validity since qualitative methods allow us to stay close to the empirical world. By observing people in their everyday life, listening to them talking about what is on their minds and looking at what they produce the researcher in this case obtains first-hand knowledge of social life unfiltered through concepts, operational definitions and rating scales (Svenning, 1999). In this study I have tried to achieve internal validity mainly through explanation-building and bias has been eliminated by following and interviewing

most technicians dealing with the service lanes during not only one day but two months. I have also let my “tutor” at Scania read this thesis in order to make sure that I have not misunderstood anything.

The external validity can be as hard to achieve in both a qualitative and quantitative study – if the data collected is not true in a qualitative or quantitative study, it is not possible to generalise from the results (Svenning, 1999). This has been a major barrier in case studies. Critics often state that single case studies offer a poor basis for generalising. However, they are implicitly contrasting the situation to survey research where a sample readily generalises in line with a larger universe. This analogy to samples and universes is incorrect when dealing with case studies. Survey research relies on statistical generalisation whereas case studies rely on analytical generalisation. In analytical generalisation the investigator tries to generalise a particular set of results to some broader theory (Yin, 2003). Due to the choice of one workshop and only one part of it as the object of study and the explorative nature of my research, it is hard to establish high levels of external validity. However, while writing this thesis I have tried to take every step possible to increase the validity of my findings. I strongly believe that similar conclusions could be drawn if this study was performed on other service lanes if they were built in a similar way. Yet, it is important to state that there is no evidence to support that these findings could be generalized to other workshops concerning their service lanes without further research being conducted.

3.4.2 Reliability

The reliability means that the results should be trustworthy. Many scholars mean that a study is reliable when the same measurement tools can be used several times and give the same result and others that the same concept and questions should give the same result (Svenning, 1999). One prerequisite for allowing another investigator to repeat the study is to document the procedures followed in the study (Yin, 2003). To make this possible I have always walked around with a pen and paper and kept a diary with the daily observations and written down all my interviews. I have also been fortunate to ask questions to the interviewees whenever I needed any more information.

Making observations at a company is positive in the way that you can alter between observing, listen, asking and acting. But there are always risks to observations. The researcher can become attached to the company and the interviewees that he or she loses the perspective and role as an observer. There is also a risk that the results are affected by

the researcher's presence if the interviewees get influenced by it and don't act naturally or feel that they should answer "right" instead of telling the truth. Achieving a kind of control over the qualitative data and avoiding different kinds of bias can be done through something called triangulation meaning that the researcher uses different kinds of methods and measures for the same study which adds validity and reliability to the study (Svenning, 1999). In order to avoid bias I have interviewed people on different levels, observed the services during several days, followed everything that is happening and talked to the technicians during the work. Finally, to verify the observations and interviews, I have timed all the activities a couple of times to get an average time of all steps of the process.

3.5 Delimitations

To be able to perform a case study and be able to understand, describe and explain what is going on inside an organisation, it is necessary to study the organisation in its existing environment and situation. This has to be done by studying many different factors which also implies that the units studied have to be reduced in order to be able to conduct the research with limited resources like time and researchers but also to be able to manage the information obtained by the study (Andersen, 1998). Hence, this is the reason for choosing to study only the service lanes in one workshop. I am well aware of the fact that the choice of making a one case study reduces the possibility of generalization of the findings. Also I did not feel the need to compare these service lanes to others since the purpose is to look at just the service lanes at Ishøj and see how they can become more efficient and the research is therefore not meant for comparison but more for exploring the unique problems of the service lanes at Ishøj. However, a comparison would not have added anything further to the study.

4. Theoretical framework

This chapter aims to introduce the main theories that will be used in this thesis and to make an understanding for the reader of the main theories within lean production and service blueprinting that will constitute the foundation for my theoretical framework and analysis.

4.1 Introduction

How much waste is there in an enterprise? Or, stated differently, what percent of activities undertaken by each of us every day actually contribute toward the creation of value for our customers? These are questions that arise when you get the task to make something in a company more efficient. According to Liker (2004), most business processes are 90% waste and 10% value-added work. Womack and Jones (2003) define waste (called *muda* by the Japanese) as any human activity which absorbs resources but creates no value. This means mistakes that require improvement, production of not wanted items that only makes inventory grow, processing steps that are not really needed because they don't create value, movement of employees and transport of goods from one place to another without any purpose, goods and services that do not meet the needs of the customers etcetera. The answer to the problem *muda* is lean thinking. It provides a way to identify value, make the value creating actions in the best way, conduct the activities without interruption and perform them more effectively. Lean thinking is therefore lean since it provides a way to do more with less - less human effort, less equipment, less time, less space, while still coming closer to providing what the customer really wants.

4.2 Service

Services are unusual in the sense that they have impact, but lack form (Shostack, 1984). Many services occur, are marketed and produced at the point of contact with the customer. And they are dependent upon both the service provider's and the service receiver's perspectives (Svensson, 2003). The customers report time and again that both results and process quality are important to them in their selection of service providers. These are important elements in what is often called the value equation (Heskett et al., 1997). Thus, the description of the customer's value profile becomes strategic as it is the basis of understanding how to create a competitive advantage (Hines et al., 2002).

Unlike physical goods, services are dynamic, unfolding over a period of time through a sequence or constellation of events and steps. They can be viewed as a chain or constellation of activities that allow the service to function effectively (Bitner et al., 2008). Since service encounters are human interactions, the quality of service is thus essentially affected by the perspectives of both the service receiver as well as the service provider (Svensson, 2004).

According to Grönroos (2000), services have many distinctive features which include:

- They are intangible and heterogeneous
- Their production, distribution and consumption are a simultaneous process
- They are essentially activities or processes
- They represent a core value that is created in buyer-seller interactions
- Customers participate in their production
- They cannot be kept in stock
- There is no transfer of ownership

The performance of service quality can be affected by the performance of other service encounters in the sequence. This raises the question of performance thresholds as another parameter of importance in sequential service quality in service-encounter chains. Performance threshold decreases as the sequential service quality improves and increases if the service weakens. Thus, the performance threshold has a significant influence on the outcome of sequential service quality in service encounter chains. The service quality performance in each consecutive service encounter contributes positively to the ultimate sequential service quality. For example, poor reliability, like delays, in one service encounter can affect reliability in other dependent encounters. (Svensson, 2004).

The service performance in a service encounter is dependent upon an interactive process between the service provider and the service receiver. Therefore the interactive process affects the actual performance of the service provider as well as the service receiver's interpretation of the service performance. Hence, the interactive process continuously influences the service provider's and service receiver's expectations and perceptions of the service (Svensson, 2003). Furthermore, from the service provider's point of view, increasing customer participation may lead to more efficiency (Fließ & Kleinaltenkamp, 2004).

The way in which a service is delivered is often as important as results delivered to the recipient. According to Heskett et al. (1997) five universal dimensions of service process quality can be identified. These are:

1. Dependability (If the service provider did what was promised)
2. Responsiveness (If the service provider was in a timely manner)
3. Authority (If the service provider elicited a feeling of confidence in the customer during the service delivery process)
4. Empathy (If the service provider was able to take the customer's point of view)
5. Tangible evidence (If there was evidence left that the service was indeed performed.)

4.3 Lean

In 1980, Toyota first caught the world's attention. Why? Because it was then it became clear that there was something special about Japanese quality and efficiency (Liker, 2004). This is why Womack and Jones (1990) decided to write the book *The Machine that Changed the World* where the Toyota production system was studied with the result labelled lean production. The book presents a wealth of benchmarking data to show that there is a better way to organise and manage customer relations, the supply chain, product development and production operation (Womack & Jones, 2003). To properly understand lean production, it is crucial to look at every step of the process, beginning with product design and engineering, going beyond the factory to the customer who relies on the automobile for daily living. It is also crucial to understand the mechanism of coordination necessary to bring all these steps into harmony and on a global scale, a mechanism called *the lean enterprise* (Womack & Jones, 2007). *The Machine that Changed the World* (Womack & Jones, 2007) presented a couple of operation principles used at Toyota. These are:

- *Elimination of waste*
- *Zero Defects*
- *Pull instead of push*
- *Multifunctional teams*
- *Decentralisation*
- *Vertical information systems*
- *Continuous improvement*

As it turned out, the book was a great success and when the writers went to launch the book around the world, many readers said that they were anxious to give lean production a try. Their question was only how to do it. Womack and Jones interpreted their question as actually being the key principles to guide their actions. This raised the idea for their next book, *Lean Thinking* (2003) actually written in 1996, but later revised in 2003. In this book the authors concluded that lean thinking can be summarized in five principles:

- *Specify value*
- *Identify the value stream*
- *Make value flow*
- *Pull instead of push*
- *Pursue perfection*

In 1970s, services were on the rise, as well as the frustrations with the inefficiencies, poor quality and low productivity characteristics of the sector (Bowen & Youngdahl 1998). Something had to be done. And the solution was to be found... In both their books Womack & Jones (2003, 2007) claim that lean thinking is applicable to practically any activity, whether a good or a service. This has led to numerous studies trying to examine this closer. Some of these studies that will be used in this thesis are described below.

Bowen & Youngdahl (1998) write in their article "*Lean*" Service: in defence of a production-line approach that the management literature in the late 1980s and 1990s has tended to argue against the transfer of manufacturing principles to service, but promoted the transfer of service principles to manufacturing. The authors instead argue that production-line approach should continue to transfer from manufacturing to service since there are clear evidences like Taco Bell and McDonald's, that service firms benefit from borrowing the managerial rationality used in manufacturing.

Ahlström (2004) also argues in his article *Lean service operations: translating lean production principles to service operations* that lean production indeed is applicable to service operations, although there are contingencies to the application which stem from the characteristics of services.

Another study is the one that Pagell and Melnyk (2004) have done in the article *Assessing the impact of alternative manufacturing layouts in service settings* that come to the conclusion

that services face the same competitive pressures as manufacturers and that therefore service providers face similar trade-offs among different layouts as those faced by manufacturers.

I have chosen to focus on the principles of lean production to see how the service lanes can become more efficient by using them. The principles of lean thinking have been combined with service blueprinting as a tool in order to identify value and the value stream.

4.3.1 The principles of lean production

Lean production is lean because it uses less of everything compared with mass production – half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time, etc. It also requires keeping more than less than half of the needed inventory on site, results in fewer defects and produces a greater and growing variety of products (Womack & Jones, 2007).

Since Womack and Jones (2007) asserts that the fundamentals of lean production are applicable anywhere by anyone, lean principles are increasingly being applied to service companies in an effort to improve customer service through the elimination of waste (Bowen & Youngdahl, 1998). In service systems, as contrasted with manufacturing systems, the five fundamental principles mentioned above do not always apply in obvious ways. Many service systems, for example, even those that are operated in a wasteful manner, are by their nature pull systems because all work is initiated by the customer (Ahlström, 2004).

To properly understand lean production, one must look at every step of the process, beginning with product design and engineering, then going far beyond the factory to the customer who relies on the automobile for daily living. It is also crucial to understand the mechanism of coordination necessary to bring all these steps into harmony and on a global scale, a mechanism called *the lean enterprise* (Womack & Jones, 2007).

Elimination of Waste:

The most characteristic principle of lean production is the persistent pursuit of waste - everything that does not add value to the product (Monden, 1983). However, regardless of whether an activity appeared to be wasteful from a shop-floor point of view or be costly, it is the customer that ultimately decides what constitutes waste, and what does not (Hines et al., 2004). Since the customer is not willing to pay for waste it should be eliminated. However, since waste exists for a reason, the causes behind the existence of waste must be removed

first (Ahlström, 2004). The wasteful activities are usually classified into seven different groups: delays, reviews, mistakes, duplication, movement, processing inefficiencies, and resource inefficiencies. The most common problems included a lack of standard procedures, long service times, communication breakdowns, and poor personnel management. Most scholars that write about waste build their theories upon the seven types of waste in business or manufacturing processes that have been identified by Toyota (Liker, 2004):

- 1) *Overproduction* – Producing items for which there are no orders. This generates waste in form of overstaffing and storage and transportation costs because of excess inventory (Liker, 2004).
- 2) *Waiting* – Workers that are only there to watch an automated machine or have to stand around and wait for the next processing step, supply, tool, part etc. or just being without any work due to stockouts, processing delays, equipment downtime or capacity bottlenecks (Liker, 2004). Time can be wasted for example directly in a queue or when waiting for information to be transmitted (Maleyeff, 2006).
- 3) *Unnecessary transport or conveyance* – This includes carrying work in process long distances, moving materials, parts or finished goods into or out of storage or between processes.
- 4) *Overprocessing or incorrect processing* – This includes the ineffective use of resources in performing a specific task (Maleyeff, 2006) by taking unnecessary steps to process the parts, inefficient processing due to poor tool and product design causing unnecessary motion and producing defects. Waste is generated when providing higher-quality products than is necessary (Liker, 2004) or when there is a lack of standardised ways of procedures which can cause personnel to “invent the wheel” every time a specific task is to be performed (Maleyeff, 2006).
- 5) *Excess inventory* – This includes excess raw material, WIP or finished goods causing longer lead times, obsolescence, damaged goods, transportation and storage costs and delay. Extra inventory also hides problems as production imbalances, late deliveries from suppliers, defects, equipment downtime and long setup times (Liker, 2004). The set-up times may need more careful consideration in certain types of services – there may be a need for staff to take some time to get acquainted with the job when switching between tasks. One way of reducing this waste in this instance may

be to avoid the loss of concentration that often follows having to switch between tasks too often. This can be done through trying to assure that larger blocks of time can be devoted to one task (Ahlström, 2004)

6) *Unnecessary movement* – Any wasted motion that employees have to perform during the course of their work, such as looking for, reaching for or stacking parts, tools etc. This also includes walking.

7) *Defects* – Production of defective parts or correction. Repair and rework, scrap, replacement production and inspection mean wasteful handling, time and effort.

However, often an eight type of waste is discussed, *Unused employee creativity*, which would include losing time, ideas, skills, improvements and learning opportunities by not engaging or listening to the employees (Liker, 2004).

Zero defects:

To attain high productivity, all parts need to be fault-free from the beginning (Karlsson & Ahlstrom 1996) and therefore the principle has a proactive approach and focus on the prevention of errors before they occur (Wheelwright & Bowen, 1996). The quality assurance is a responsibility of everyone and the goal is to achieve a higher degree of process capability and control (Ahlström, 2004).

Pull instead of push:

If you are able to design, schedule and make exactly what the customer wants just when he wants it means that you make what the customers actually tell you what they need – you can let the customer *pull* the product from you as needed, rather than pushing products, not always wanted, onto the customer. This also makes the demands from the customers much more stable since they know that they can get what they want right away (Womack & Jones, 2003).

Usually, most services almost by definition can be characterised as a pull system. They can not be stored and therefore they have to be produced as it is needed. However, many workshops operate a mixture between a pull and push system by scheduling some repairs or services and also keeping some customers in a queue by making it able for them to drop in whenever they have time. Being characterised by simultaneous production and consumption does not preclude some services from keeping customers in a queue. This

results in a system operating with a mixture between a push and a pull. (Ahlström, 2004) Within vehicle service though, there exists an ideal situation of pull. This is to be able to schedule as many services as possible so that the parts needed for the service can be precisely predicted. When the customer first schedules service for a given day a preliminary order for the necessary parts is prepared. Womack and Jones (2003) describe a very good example of this procedure. The day before the service the dealer calls the customer to be sure that the repair or service will be conducted the next day and the order is confirmed. On the morning of the service visit, the mechanic examines the car to see if any additional parts are needed and orders them to be supplied within the next hours.

Multifunctional teams:

The workforce makes an important contribution to a lean production system (Monden, 1983). A multifunctional team is a group of employees who perform different tasks where each team is given the responsibility to perform all the tasks within a particular product flow (Karlsson & Ahlström, 1996). This releases the operators' potential (Ahlström, 2004) and the increased flexibility reduces the vulnerability of the production system. However, this requires efforts in staff training (Karlsson & Ahlström, 1996). The teams are also made responsible for some indirect tasks like maintenance, procurement, quality and material handling and control (Wheelwright, 1981).

Decentralisation:

In a lean production system the numbers of hierarchical levels are reduced by pushing the authority down to the lower levels of the organisation (Ahlström, 2004). The fundamental argument is that increased quality, productivity and flexibility can be achieved by transferring responsibility and decision making to employees (Bowen & Youngdahl, 1998). The supervisory tasks are transferred to the teams through team leaders who take on the supervisory roles of advisers, coaches and providers of support, as opposed to the traditional roles of bossed, disciplinarians and givers of specific assignments. Important is also that the team leadership should be rotated among employees especially trained for the task (Ahlström, 2004).

Vertical information systems:

Vertical information systems are information systems that are relying on direct information flows to the relevant decision makers (Cole, 1985). Information is important to make the

multifunctional teams able to perform according to the goals of the company (Karlsson & Ahlström) and the vertical information system also allows for rapid feedback and corrective action (Cole, 1985). What is important is that to make the employees aware of the operating objectives, the system has to be in real-time, problem identifying and problem solving orientated but also a need for systems taking information up through the organisation (Ahlström, 2004).

Continuous improvement:

After elimination of waste, continuous improvement is the most fundamental principle of lean production (Ahlström, 2004). Just as waste, the constant striving/endeavour? for perfection has its own word in Japanese, *kaizen* (Imai, 1986). Continuous improvement is defined as a systematic effort to seek out and apply new ways of doing work. However, although managers realize the importance of continually improving processes, they have found it challenging to manage the continuous improvement. The challenge lies in creating an infrastructure to coordinate continuous improvement projects (Anand et al., 2009).

According to Womack & Jones (2003), in order to maintain perfection, the value stream managers have to follow the lean principles; identify all the activities that bring a product from concept to launch, eliminate all activities that don't add value, and make those activities that do create value proceed in a continuous flow as pulled by the customer. The next step is to analyze the results and then start the evaluation process again. The crucial part is to continue this procedure as a normal part of the product's life, as a core activity of management. The perfection has to be brought up into clear view so the objective of improvement is visible and real to the whole enterprise. As mentioned, the key to success for perfection is transparency - the fact that in a lean system everyone can see everything. As mentioned earlier, this makes it much easier to discover better ways to create value. There is almost instant and highly positive feedback from for employees making improvements, a key feature of lean work and a powerful spur to continuing efforts to improve.

But, as Womack & Jones write (2003), perfection is like infinity - trying to envision it is impossible, but the effort to do so, provides inspiration and direction essential to making progress along the path. What is needed is a vision, to select two or three most important steps to get you there and defer the other steps until later.

4.4 Value stream mapping/Service Blueprinting

To be able to perform my study in the best way, I have chosen to combine the principles of lean thinking with theories of *service blueprinting*. Service mapping is a type of flow-charting technique that has been employed for years in process analysis. This technique was raised to a new level by concepts developed by Shostack that she called “blueprinting” of service processes (Shostack, 1984). The purpose of value stream mapping is not only to assist a management team or service developers in visualizing and communicating not only how the organisation acts today, but also how they should act in the future to influence the cost, service and quality of its products and services (Keyte & Locher, 2004). Blueprinting is used to identify starting points for improving process efficiency (Fließ & Kleinaltenkamp, 2002). In fact, value stream maps are the essential lean tools that enable and facilitate value stream management, as well as the key management tools for continuing to implement and manage new value streams. This is why value stream mapping is the first and most important tool for establishing the direction and focus of a lean transformation (Keyte & Locher, 2004).

A service blueprint allows a company to explore all issues inherent in creating or managing a service. The process of designing a blueprint involves the consideration of several issues. These are identifying processes that constitute the service, isolating fail points, establishing a time standard execution time for the service, and finally analysing the profitability. Unlike flow charting the primary goals of service mapping are to chart activities from the point of view of the customer (Bitner et al., 2008), insure that all aspects of the service add value to the customer’s experience of the service, and identify points at which the service system might break down or otherwise fail to produce the intended value for customers (Keyte & Locher, 2004). With the help of the value stream analysis and by careful observation, it is almost always possible to identify three types of actions (Womack & Jones, 2003):

1. Steps that actually create value
2. Steps that create no value but are unavoidable with current technologies and production assets
3. Steps that create no value as perceived by the customer and have to be eliminated immediately

The activities that are identified as value-adding mean that customers would be willing to pay for these activities, such as when the customer cannot perform a task on their own or without considerable time or cost (Maleyeff, 2006).

A blueprint illustrates that workers are never to blame for flaws in a process – the process design is the management's responsibility. The blueprint encourages creativity and pre-emptive problem solving and it can reduce the potential for failure and enhance management's ability to think effectively about new services. It also helps to cut down the time and inefficiency of random service development (Shostack, 1984). Although organisational negligence of the fact that the success or failure of a service relies on an interactive process and causes the act of service blueprinting to be risky (Svensson, 2003), to leave the services to individual talent and managing the pieces rather than the whole makes a company more vulnerable and creates a service that reacts slowly to market needs and opportunities (Shostack, 1984).

4.4.1 Value

To be able to do a service blueprint the crucial thing is to define value. This is also first question in the Toyota Production System "What does the customer want from this process?" The answer is what defines value (Liker, 2004). The problem with value is that it can only be defined by the customer but created by the producer. It is up to the customer to define value since the product or service has to meet the customers' needs at a specific price at a specific time (Womack & Jones, 2003) which makes this definition relative (Heskett et al, 1997).

Customers today are strongly value-oriented and they seek results and service process quality that far exceeds the price and acquisition costs they incur for a service (Heskett et al., 1997). To define value has therefore become the main challenge for the producer (Womack & Jones, 2003). Is speed the response seen as valuable by the customer? More valuable than for example convenience of appointment or other attributes? There are process- and cost tradeoffs involved in setting the service promise and the organisation has to adapt the process what the customers value (Baum, 1990).

Generally only a small part of the steps that for example a mechanic takes add value to the product as far as the customer is concerned, but some of the non value-adding steps are necessary. The point is therefore to minimise the time spent on non-value adding activities

by positioning for example tools and material as close as possible to the mechanic (Liker, 2004).

According to Hines et al. (2004), value is created if internal waste is reduced, as the wasteful activities and the associated costs are reduced, increasing the overall value proposition for the customer. Value is also increased, if additional features or services are offered, which are valued by the customer. Another thing that has value to many customers is convenience, like place, time and form utility. But as every customer is unique, the value will vary among them, requiring that a service provider remain sensitive to the needs of various customers. Relationships between price and service acquisition costs have important implications for service providers. Providers finding ways to lower acquisition costs for customers, often can charge higher prices for their services, particularly if they can convince customers of the value of such efforts (Heskett et al, 1997).

Once the rethinking of value has been done (the so called *kaikaku* for value) lean enterprises must continuously return the value question with their product teams to ask if they have really got the best answer. This is the value specification analogue of *kaizen* which seeks to continually improve product development, order-taking and production activities. It produces steady results along the path to perfection (Womack & Jones, 2003). To be able to achieve this, Heskett et al (1997) has made a seven-step procedure to follow:

Development of the process usually involves seven steps:

- 1) Reason for improvement (to show the reason for working on a problem)
- 2) Current situation (to describe the problem and set targets for improvement)
- 3) Analysis (to identify and verify the root causes of the problem)
- 4) Countermeasures (to select and implement measures to correct the root causes of the problem)
- 5) Results (to confirm problem alleviation)
- 6) Standardisation (to identify steps to prevent the problem from recurring)
- 7) Future plans (to plan an attack on remaining components of the problem)

4.4.2 Future state map through flow

After eliminating the obviously wasteful steps the next step is to make the remaining value-creating steps flow to be able to draw a future state map. This means shortening the elapsed

time from raw materials to finished goods or services which will lead to the best quality, lowest cost and shortest delivery time (Liker, 2004). According to Womack & Jones (2003) all activities can be made to flow. When you start thinking about ways to line up all of the essential steps needed to get a job done into a steady continuous flow with no wasted motions, no interruptions, no batches and no queue. Flow principles can be applied to any activity and the consequences are usually dramatic – the amount of human effort, time, space, tools and inventories needed to design and provide a given service or good can typically be cut in half very quickly.

Creating flow exposes inefficiencies that demand immediate solutions. Everyone involved in the process is motivated to fix the problems and inefficiencies that arise since the process will shut down otherwise (Liker, 2004). To motivate the workers to solve the problems, a complete display of the working process might be a solution, so that everyone can see where production stands at any moment. This is an excellent example of a critical lean technique – transparency. In the lean enterprise, the workforce on the shop floor needs to talk to each other constantly to solve production problems and implement improvements in the process. They also need to have their professional support staff right by their side and everyone needs to be able to see the status of the entire production system (Womack & Jones 2003).

To be able to make the system flow continuously, every machine and every worker must be fully capable. This means that they always have to be in proper condition to perform exactly when needed and every part must be done exactly right. To be able to achieve this, the production team must be cross-skilled in every task for example in case if someone is absent and that machinery must be made totally available and accurate through a series of techniques called Total Productive Maintenance (TPM). This also implies that the work should be strictly standardised (Womack & Jones 2003). Cross-trained employees are able to step in for absent employees without disrupting flow, quality, and quantity of work (Monden, 1983).

Often, the work of developing and displaying the process flow map itself, makes individuals appreciate how overall success is affected by their individual contribution. A common solution in manufacturing is using mechanisms referred to as the visual factory, where highly visible displays are used to show the current status of work so that everyone involved in the system gets a sense of the relative priorities of the tasks that they need to accomplish.

In cross-functional service systems, where all workers may not be located in a concentrated area, Maleyeff (2006) suggests a computerized version of these displays to be considered.

The end objective of flow thinking is to totally eliminate all stoppages in an entire production process and not to rest in the area of tool design until this has been achieved. To facilitate continuous flow, products are grouped according to product families, and equipment is laid out accordingly (Shah, 2007). The right location, both when it comes to design and physical production is also an important part of flow technique to be able to serve the customers as well as possible (Womack & Jones, 2003). After achieving flow through eliminating all kinds of waste (see 4.3.1), it is possible to draw a future state map.

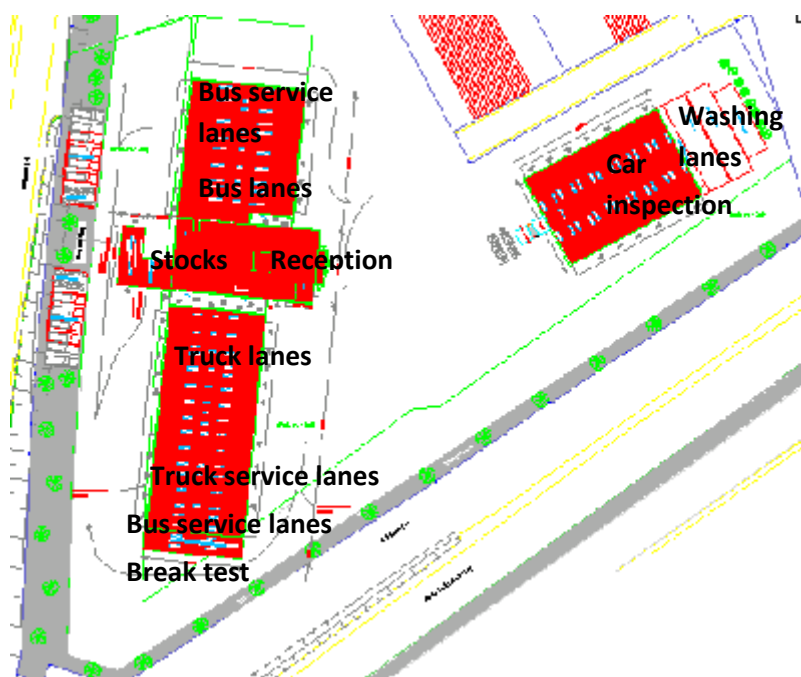
5. Empirical findings

5.1 Background

The Ishøj workshop was built in 2008 with the goal to create the best workshop for clients, workers and activity with the thought of creating one big new workshop for both trucks and buses instead of a few smaller ones. The project idea that started already in 2004, aimed to create a Scania workshop that was functional, efficient and automated, built by modules and durable with optimal flow and logistics including clients, workers, work and traffic. The workshop was also supposed to be built with high priority for environment, security and well-being and involving the workers. The thought was also that the workshop should become a one-stop-shopping workshop where all possible process improvements were elevated and where IT and computers should be used in a maximum way by everyone.

5.2 The workshop

A new workshop also means new activities for the customers. These include a 24-hour service, a washing facility open 24-hours, wheel centre, axel adjustment, glass fibre repair and more. The special features of the workshop are the prefabricated pits or graves, central tool placements which create closeness to machines and special tools, the automatic stock, special cranes and ventilation systems from the roof that create mobility and safety with less risk for accident, a break test facility, personal computers for all workers, special facilities for the drivers and much more.



Fig, 1 Blueprint of the workshop

Today the Ishøj workshop consists of a main entrance, with a reception divided into trucks and buses, one truck workshop and one bus workshop with a total amount of 28 working lanes and 55 repair places. The truck workshop consists of two lanes for the engine and five lanes for repair, three service lanes with a grave-

gate, and one ADR-lane - a lane for trucks with dangerous goods, with grave. Besides that we can find a lane for testing the breaks. On the right hand side of the main entrance we find the bus workshop. This workshop is divided into two engine and service lanes and three repair lanes.

In connection to the workshop there is also a special workshop for accident repairs, two washing lanes and a car inspection facility that is rented out to a governmental company.

New activities and processes for the workers means that every technician has his own desk equipped with the most common tools, his own laptop and energy box. With the laptop the technician can see his daily schedule, find spare parts and information about the truck or bus and order spare parts from the stock.

5.3 Description of the shop floor

As mentioned earlier, the workshop is divided into two parts, one service part for trucks and one for buses. There are 17 technicians working at the truck section, 11 during the day, 3 in the evening 3 in the night. During the day there are also 4 students working. The bus section has 11 technicians working during the day and 3 students. The technicians don't have their own defined places but move around in the workshop with their own "rolling desk". There they have their personal computer, tools and a mobile phone which makes the technicians very flexible. The computer software that is used by the technicians in their work is called

"Carsoft". The technicians always have to log in at the job in Carsoft when they start a job and log out when they are finished with it. There they can also find a schedule on what every technician is working with, they can see how long time is estimated on their own work, what else they have to do that day or if there is anything planned for them

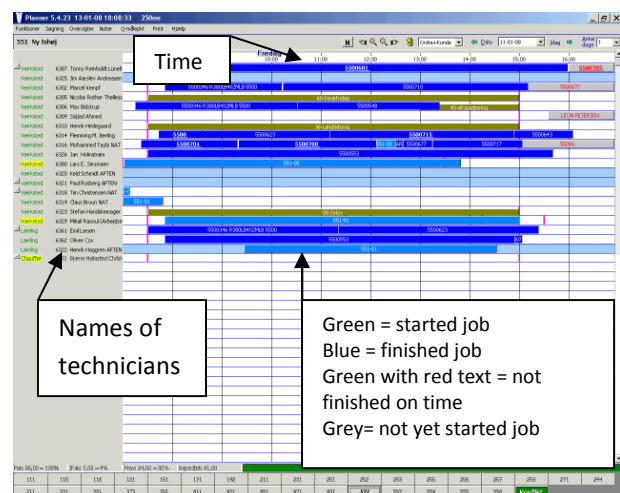


Fig. 2 Extract from Carsoft

other days. They can also see everything that has to be done to the car. In another program, "Multi" they can see what spare parts that should be used and they also use the program to order spare parts from the automatic stocks.

Within the truck section, the first shift starts working at 7.30am and finishes at 3.30pm. The next shift arrives at 3pm to be able to get updated on what they have to do during the night, and works until 11pm. Then the night shift comes in and works until morning. The bus section has two shifts. The first starts at 7 am and finishes at 3 pm and the second shift starts at 2.30pm and works until 10.30pm. Since there are three shifts in the truck workshop; day, afternoon and night, the workshop is able to be open 24-hours from 10pm on Sundays until 3pm Fridays. If anything happens during the weekend drivers can always call the service duty that is open 24 hours a day and can drive out to help if necessary.

5.4 The work on the shop floor

5.4.1 Trucks

The most common task that clients come in with their trucks for is a service. The services are divided in to Small, Medium or Large service (and X which means that they control the oil). The time for the service depends on the size of the service, how many axels the truck has and what extra things the technicians have to do on the truck. The service is divided into different parts, starting from the bottom of the car and up. There are standard times and prices for all repairs, services and spare parts that are equal for all Scania workshops that are decided by the head quarters in Södertälje. If the technician discovers something extra that needs to be done on the car, they write it down by hand or in the computer.

A service starts with a client either calling in to book a time for the service or they just arrive at the reception without having booked a time in advance. As the client arrives, a working card is prepared by the foreman, where the client is registered. The foreman writes down the faults with the vehicle and writes what needs to be done. The computer automatically fills in how much time each procedure should take and how much it costs. This is written on the computer in a program and a working card is printed for the technician.

5.4.2 The customers' thoughts about value?

According to the customers what is most appreciated when they leave their truck at the workshop for service is the communication with the technicians and foreman and the service they receive. When the customer comes in with his truck he talks to the foreman about the problems with the truck. Then the foreman writes a working card and gives the job to one of the technicians. If it will take time before a technician is available to look at the truck, the customer

is welcome to sit down and have a cup of coffee, watch the news on TV, read a paper, have a look at all the things that Scania is selling in the "Show room" or even have a meal with the rest of the workers if he comes in at lunch time. There is also a special facility at the workshop where the truck drivers can sleep, connect to internet, play table football and more. It is also possible for the customer to rent a car if he has to leave the truck for service. This is positive for the customer since they do not have to send two persons in when leaving a truck. All this is what the clients call good service and this is what they appreciate when they come there. Then the waiting time before the technician can start with his truck, even if it is half an hour, doesn't really matter for them. The clients appreciate this, to be able to drop-in whenever they want, better than having to make an appointment in advance. What more is special with this workshop compared to others is that it is open 24-hours. Then the driver can come in to get the truck fixed at times when he is not working and using the truck. Whenever he wants, the client can come out to the shop floor to see how the technician is doing with the truck and talk to the technician. But what really creates value for the customer is to get the problem fixed or service to be well performed.

5.4.3 A day on the service lanes with a truck technician

The technician starts with turning his computer on and then he goes to the truck foreman to get his working card and a list so that he will know what to do with the truck. When he gets back in on the shop floor, the computer is on and he writes the chassis number in the software program and all the information about the truck is shown. The technical information about the vehicle is especially useful when the technicians have to find the right spare parts for the truck.

As the truck driver arrives with his truck, he leaves it on the parking lot. Usually they just drop by without making an appointment in advance. When the service of the truck starts, the technician drives the truck in to the service lane which is built in a way that there is a pit under the truck where you can find necessary tools to change oil etc. When the truck is in place, the technician checks on the computer what service kit is needed for that truck in particular, writes it down, goes to the scanner, writes his work number, the number of the job (order number), the location and the order number and scans the service kit number. When the time comes to change the oil, the technician tabs in the hose number, the working code, order number and the volume needed and the filling is done automatically. The oil filling for the engine is done on the floor level and the rest, like filling gear oil is done in the pits. Here though, the technician has to hold the hose until they can see that it is filled up. To

change the oil takes about 30 minutes, but the times are being counted on Scania's standard times as well as the costs for the procedures.

The technicians often prepare the truck for car inspection. Therefore, during the service, the technicians go through the whole truck. They often find things that have to be fixed before the car inspection since they know exactly what requirements the trucks have to fulfil. If they find something that has to be dealt with and that doesn't take too long to fix (like for example cool the engine for the trucks that are transporting meat) or that is urgent, they do it right away. If they are not sure if the fault should be fixed right away they call the foreman who calls the client to see if they have time to wait for the problem to be solved right away. If not, the truck driver has to make an appointment and come back at another time. When it is time to go to the car inspection, which is in the same area as the workshop, the technician drives the truck there. Sometimes it happens they have to wait for 10 minutes or even more until the vehicle in front of them is ready. The reason for this is that the company that is renting the facility for the car test is a governmental company and hence open for other cars as well.

When the technician has completed the work on a truck, he writes in the computer which extra repairs have been done in the computer (if he hasn't done that during the work) so that they automatically come up on the working card when the foreman has to print the invoice. Then he drives the truck out to the parking lot, gives back the working card to the reception and grabs the next working card. With some customers they have the deal that they pick up and leave the truck at the client's company. Hence, this part might sometimes take some more time.

Although all the technicians can carry out a regular service, there is some kind of specialisation on the workshop. During most services there occurs a stop in the flow of the truck because not all the technicians have the license to control the speedograph, which makes them unable to control the drivers driving- and resting times. This leads to the situation where the technicians drive the truck out when they are ready with the part that belongs to them, but the truck is not finished but has to be driven in again to the workshop to control the last part.

5.4.4 Ordering spare parts

The technicians order their spare parts through their personal computer by checking the order number of the spare part and write it in the computer. It might take some time to first

find the right part and then before the spare part comes out to the stock. Sometimes a box can even get stuck on the way, so the technicians stand there and wait without seeing that the box is half way there.

If they know the order number of the spare part by heart, they prefer to go to the stocks directly and order it from the computer there because it takes less time.

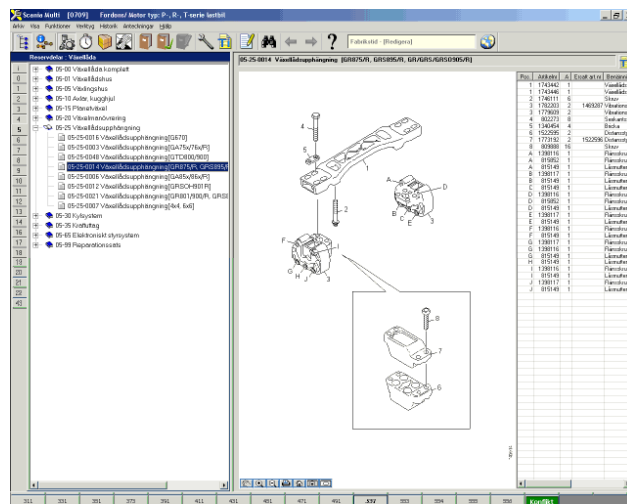


Fig. 3 Ordering spare parts from Multi

Sometimes it happens that a technician

has to wait longer for a spare part. Then he goes to help on another truck meanwhile. This could also happen even though he doesn't have to wait for spare parts, but if the foreman decides that he should help someone else. Very often, about three times a day, there is a small spare part missing that has to be picked up from another Scania workshop, for example Valby, which is a workshop 14 km away from Ishøj. The reason for this is that in order to avoid having big stocks Scania has chosen to have some spare parts in Valby and some in Insøj. The stock balance is also not always correct, which has the effect that if a truck comes in for an urgent matter, it cannot be fixed during the day but has to wait for the night shift to be fixed. The problem also is that the technician is often looking for the spare part everywhere for about 15 minutes before he realises that they don't have it in the workshop.

5.4. 5 Stocks

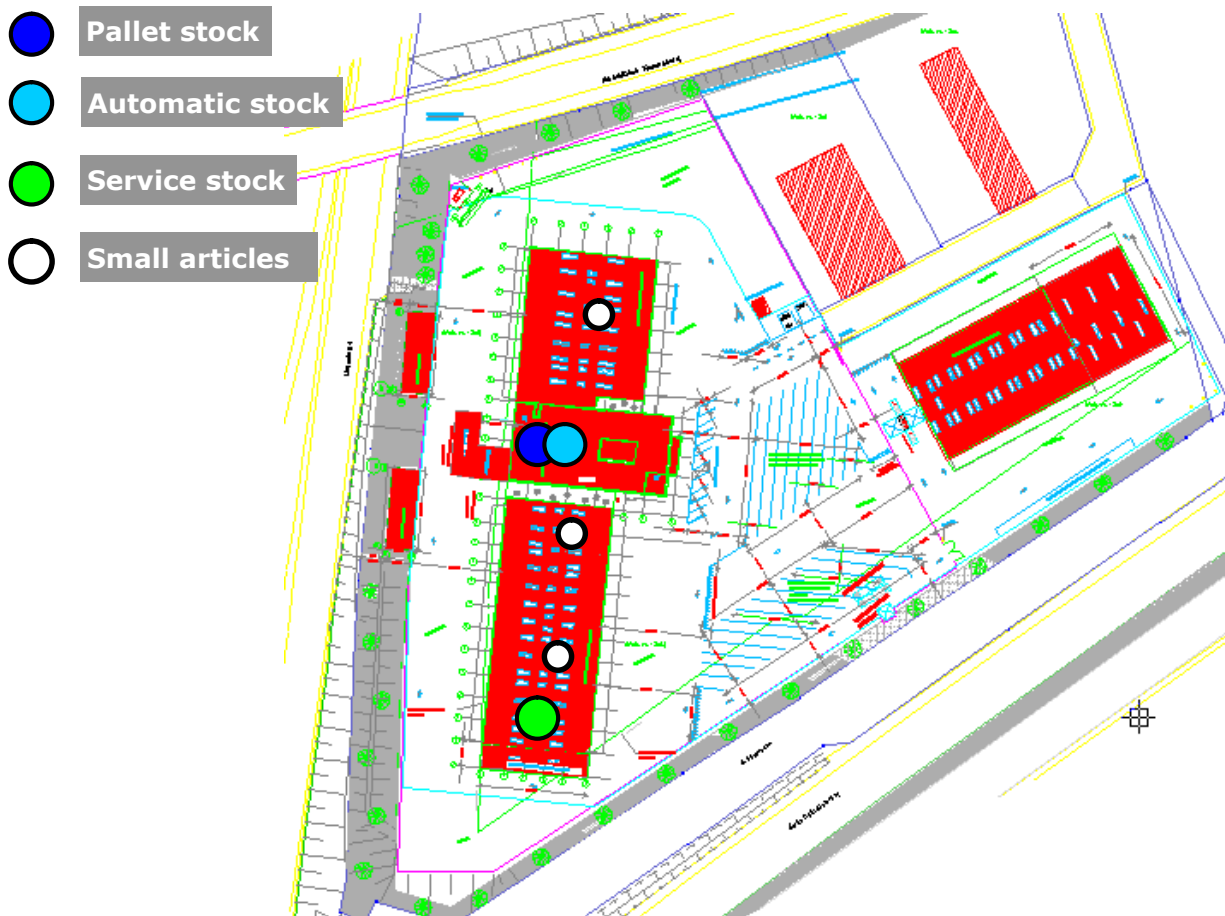


Fig. 4 Stock stations

The main stock is automatic, 16 metres in height with several floors, from the cellar to the ceiling of the building and contains 2800 boxes. What makes the stock automatic is that as parts are ordered from a computer, they automatically come out from the stocks in boxes that are easily available for the technicians. This makes the stock efficient since the technicians don't have to look for the parts they order, only scan them when they come to pick them up. The small parts that are used more frequently are decentralised and spread out in several places over the whole workshop (white circles).

The service lanes where the technicians change the oil are also equipped with a stock (green circle), but only with parts needed for that purpose. There the technicians can find a set with what is needed exactly for their vehicle (truck or bus) and they don't have to spend time on going to the main stock to get what they need. The technician scans everything – the work code, the location number and service kit and it automatically transfers to the work paper.

The pallet stock is used for larger spare parts like cylinders and filters that are taken down with the help from the stock personnel by special carts.

There are three persons working at the goods reception. One person is responsible for driving spare parts to different clients. Around 50 percent of the spare parts are being delivered to clients that have their own workshops but that use Scania's spare parts. One person is responsible for filling up the stock before the technicians arrive in the morning and the third is together with the others working during the day with ordering parts that are missing, filling up the stock with arriving parts and helping the technicians to pick up bigger parts that do not fit in the automatic part of the stock. Many parts are actually ordered automatically; when the computer registers that parts are used, it automatically orders them from the suppliers in Belgium so that they arrive at Scania Ishøj by Sunday night.

Special spare parts that are not usually found in stock can also be ordered manually, through so called Daus-orders. This ordering is done online and the parts usually come from Sweden and arrive the next day.

The parts that are "sold" in advance, which means that they are ordered because they are needed for a repair for a special customer, are put separately in boxes. In this case the truck or bus is already in the workshop waiting for the spare part and a technician has already started working on the repair earlier and then he¹ has realised that another part is needed.

Pre-pick parts are parts that are believed to be needed in a certain repair after talking to the customer when he books a time for the repair. Therefore these parts are prepared in advance, before the client arrives. These repairs are marked with blue stripes in the program Carsoft so that the technician can see that a set of parts are ready for him. Only 11.6% orders in January, 9.8% in February and 8.6% in March were pre-picked because of this. The goal is though to be able to pre-pick at least 30% of the spare parts in advance. The only way to solve this problem is to get the clients used to call in advance and book a time.

5.4.6 Buses

In the bus service section the biggest customer is Arriva, who has 84 buses on a contract that come for service approximately every sixth week. There are also tourist buses on

¹ There are only male technicians at the work shop except for one girl who is a student there.

contract including many smaller customers. The foreman for the buses has a list in the computer of all the buses that are on contract including a special file with information about all the performed services. Sometimes the foreman receives emails from the client about problems with the buses. He then prints the emails and puts even them into the right bus file, so if there is something extra that needs to be done on the bus when it comes to the service he finds it right away. The buses are divided into different geographical regions and bus numbers to make it easier for the foreman to keep a track of what bus to call in. The foreman prints a list for each month and for each geographical region on the buses that should come in for a service and what type of service that alters between the sizes of the services. Then he starts calling in the buses that it is time for. This makes about one to two buses a day from each geographical region, but of course it also depends on what size of service the buses are in for. The service at the bus section is also divided into different sizes, A, B, C and D but are designed by Arriva and it is shifting between the sizes of the services. The size of the service is also dependent on the amount of kilometres that the bus has driven. An A-service, for example, takes three hours. But if two persons are working on it, the foreman divides it on the schedule to 1,5 hours per technician.

The buses can drive up to 23 hours a day with for example six different drivers. Therefore they are usually more worn out than the trucks since the drivers don't take so much care of the buses as do the truck drivers.

Although there are standardised times for services, it is hard to plan in advance the time for repairs that have to be done, since the faults are discovered during the service. This makes it hard to make the schedule for the bus technicians and to know exactly when a bus will be finished. But to avoid idleness, the foreman registers the bus service and repair in the Carsoft system on rather too short time than too long since then the bus technician would stand there without having anything to do until the next bus comes. The time scheduled for the repairs of new buses (up to two years old) are usually shorter than the time scheduled for the old ones (over two years old).

5.4.7 A day on the service lanes with a bus technician

The procedure at the bus section is a bit different from the one at the truck section. The technician also starts the service by going to the foreman, is assigned a bus and gets the working card with instructions what to do. Then they go out to the bus on the parking lot where the Arriva personnel have left it, just outside the service lane. There the inspection

starts with testing that the horn works, that the engine works, the air condition etc. The bus drivers have a special note book where they write what is wrong with the bus. The technicians always check the book in the beginning of the inspection but fix the problems *after* the service and report what they have done in the book as well. The inside inspection of the bus is usually done while the bus goes for a test drive. If the bus technician finds more things that have to be fixed, they write it down on a special paper and repair it after the service is finished.

In attachment to the test drive the technician drives the bus to the washing lane to wash the engine. After the test drive the technician drives the bus in to the truck's service lane since that is where the oil should be changed because of the special pits with the tools so that you can stand under the bus without any problem. The changing of the oil takes about one hour to perform and when that is done, the bus is driven to the bus service lanes. Sometimes it happens that the bus has to wait outside until the finished bus in front drives out.

The technician starts to inspect the bus according to Arriva's instructions. Often defects are discovered meanwhile, but are as mentioned earlier not repaired immediately but are written down on a special list and usually repaired after the service. This is due to the standard times for performance of services, but since the types of repairs differ a lot, it is hard to set a time for repairs. Usually the technicians repair the defects as soon as they are done with the service, but if they are sceptical if the repair is included in the contract they ask the foreman whether they should do it or not.

In every bus service a break test has to be done. To be able to carry out the break test the technician has to log on to a special program on his computer. The program only allows one user at a time. The same system is also used by the car inspection company in the other building, who also is the only one who has the special console that is needed to be able to register the test. The test itself only takes about 10 minutes. When the test is done, the technician drives back to the service tracks with the bus, prints the results and looks so that all data from the break test seem to be correct, logs out from the program and puts the papers in the folder.

When the technician comes back to the service lanes after filling up the bus with oil, he usually only move away when he has to pick up the spare parts. The buses also remain on the same place – on the service lanes - until they are completely finished, even though the service is done and the repair has started. The technician continues with his bus until the

bus is completely finished in order not to lose focus and time to get acquainted with the work, which would take about 15 minutes each time.

Most tools the technicians have at hand, but the larger tools they have to get from another lane and they are always returning them after use. When spare parts are needed, they are not ordered by the computer, but the technicians go to the stock where they tab the order- and work number in and scan the box number and the spare part. The reason that the technician can not order the spare parts "online" from their own computer is due to a lack of internet connection on the bus side of the building. It sometimes happens that the spare parts are not available. Therefore the technicians usually go to the stocks in advance to see so that all spare parts needed for the repair are on place before they start to pick apart the vehicle. There is a lack of digital documentation of the buses, which makes it sometimes hard to find the right spare part in the computer software. Therefore, some technicians write their own book with notes about the article number of the spare parts they need so that they can just directly write in the article number when they need a part without having to spend so much time looking for it. The ideal procedure is also to write down all the parts that are needed for a particular repair and get everything at the same time to save some time on going back and forth.

The buses that the technicians realise that they can not do anything with at the moment, for example if they have to wait for a bigger spare part like an engine, are moved to a special lane that at the moment only is used for that purpose, so that the bus won't take up room in the work shop. If the engine is produced by Scania, it takes about two days to get it to the stocks. But if the engine is produced by another company, as is the case with most of the older buses, it can take up to three weeks to get the engine.

When the bus service should be almost finished, the foreman comes in and asks what faults are found with the bus and tries to appreciate how long the repair will take. He then calls the client and tells him a preliminary time when the bus will be ready to pick up. When the Arriva-employee comes to pick up the bus that is ready, he also leaves a bus for service at the workshop.

6. Analysis

To be able to draw a future state map, I have to, as mentioned earlier, analyse the process out of what adds value and not and how I can make the process flow. In the first part of the analysis I will therefore identify the non value adding activities in order to be able to eliminate them. This part will take form of a value stream analysis of the service lanes. In the second part an analysis of the root causes of the non value adding activities will be identified. This will be done with the help of the lean principles.

6.1 Value identification

What the Ishøj workshop has succeeded in when it comes to meeting the customers' requests is foremost the convenience for the customer like drop-in times, 24 hours availability, that they make both repairs and services, can take the car to the car inspection and the concept of "one-stop-shopping". Hence they are open for most of the customers' needs. All these activities are value adding to the customers.

To be able to identify the non-value adding activities I have identified all the steps in the process and timed them. These are the steps I have identified in the truck section:

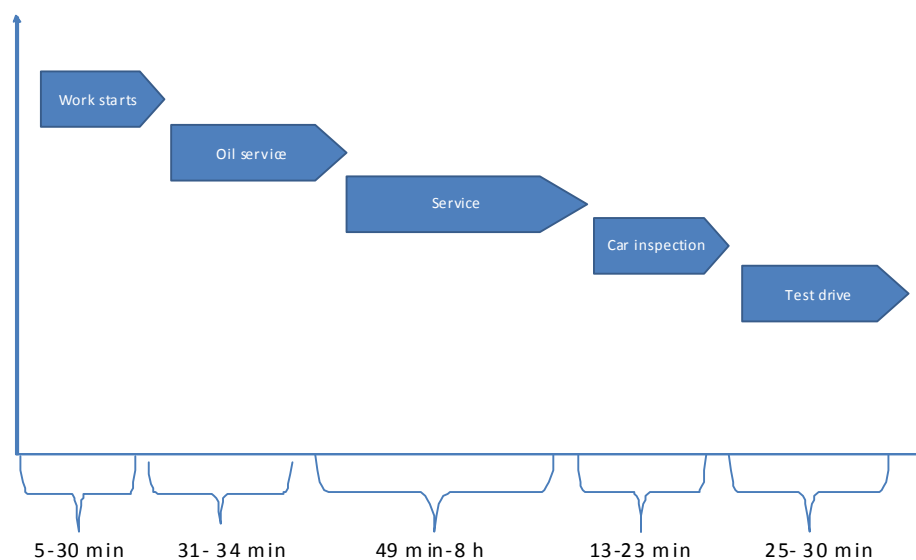


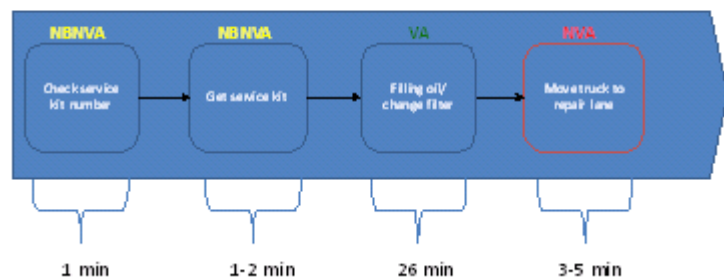
Fig. 5 Timed activities, truck section

After identifying the main steps in the process I had to analyse what activities were Value Adding, Non Value Adding and Necessary But Non Value Adding. The following are the steps in detail marked with what is value adding and not.

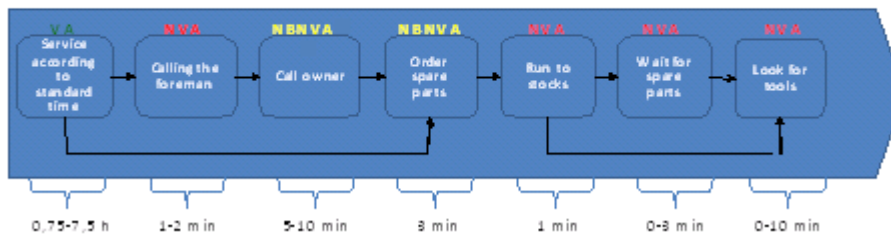
Work starts



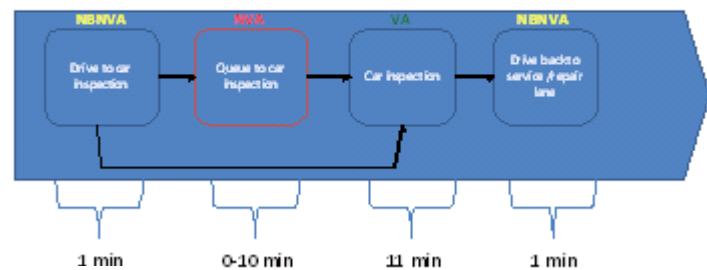
Oil service



Service



Car inspection



Test drive

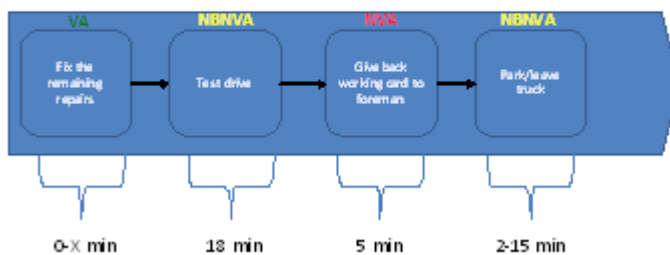


Fig. 6 Timed activities in detail, truck section

As you can see there actually only one Value adding activity on each step. This is when the technician actually performs something with the car that represents what the customer wants to have done – to get the truck fixed according to the service size needed.

To turn on the computer is a crucial thing to be able to know what to do with the truck and to get the information about the truck and what parts are needed and more. Hence this is a necessary but non value adding activity since it does not affect the truck directly. To pick up the working card is something that takes time and the information on the card can also be found on the computer. Hence this is a non value adding activity, described more thoroughly later on. The third activity, to get the truck, is crucial in order to be able to perform the service and even though it doesn't directly help fixing the truck it is a first step to be able to do it and is therefore a necessary but non value adding activity.

The second step in the process is the oil service. To check the service kit number on the computer needed for the truck and to get it takes some time but even though it does not directly fix the truck those are necessary activities to be able to fill the right oil and change filters which are directly value adding activities. As mentioned earlier sometimes the trucks are moved to the repair lanes. This is fortunately not so common now since there is enough room to perform the services on the service lanes. Although, when performed, the activity does not add value in any sense to the fixing of the truck but rather only takes time.

The service part is also divided into a couple of smaller steps. The service itself is performed according to standard times for the different sizes of the services. But as soon as a question occurs whether to fix a repair or not time is spent on phone calls which are non value adding activities. These will also be described more thoroughly later on. To order spare parts and go to the stocks to get them is something that is time consuming but a necessary activity in order to get the right spare parts. What is not value adding in any way is running around and looking for the right tools and also to wait for spare parts. These activities will also be described more in detail later on.

The fourth step is the car inspection. The inspection itself is value adding since it is an activity that the customer wants to have done to the truck and hence the drive to and from the car inspection becomes a necessary activity even though it does not directly add value. Something that does not add value at all is the queuing to the car inspection. This activity will also be described later.

The last step in the process is fixing the remaining repairs and taking a test drive. Fixing the repairs is directly value adding to the customer however the test drive is necessary but not really value adding but can be seen more as a form of quality control. Giving back the working card is as mentioned earlier not value adding for the customer since it doesn't really have to do with what the customer wants to be done to the truck. The last part is to return the truck or leave it on the parking lot. To return the truck obviously gives more value to the customer, but even if driving it out to the parking lot does not directly add value to the customer it is a necessary activity.

When it comes to the buses the problem is the same. The steps identified are as follows:

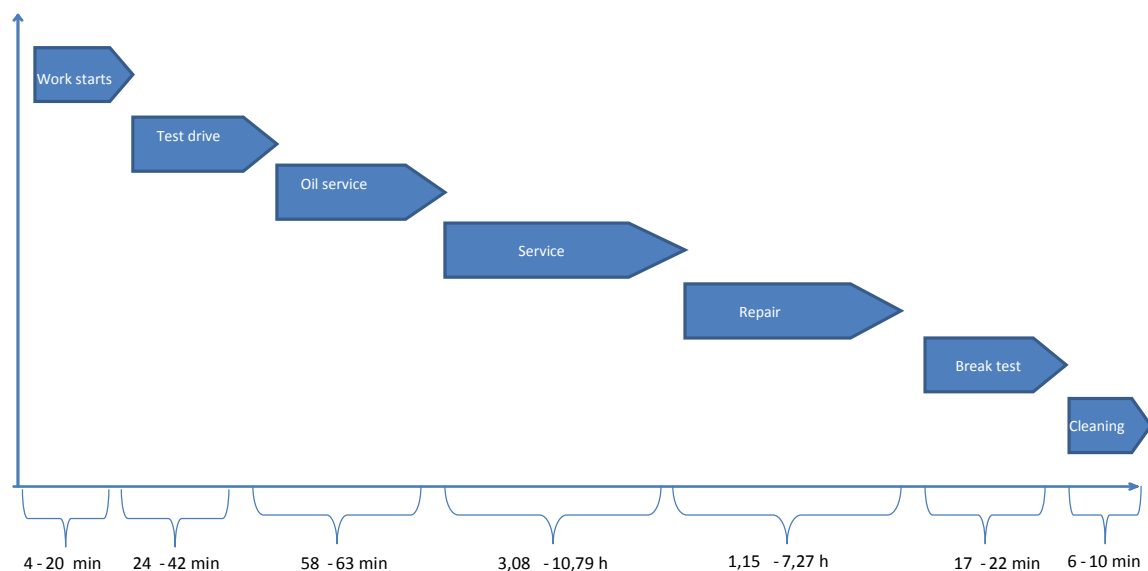


Fig. 7 Timed activities, bus section

Here, the Value adding activities are also when the technicians actually do something with the bus that directly represents what the customer wants to be done – fixing the bus. The Non value adding activities are mostly just a waste of time and don't give any kind of value to the customer. The necessary but non value adding activities are activities where the technicians have to perform something that does not add value directly but an activity that has to be performed in order to be able to perform the value adding activities.

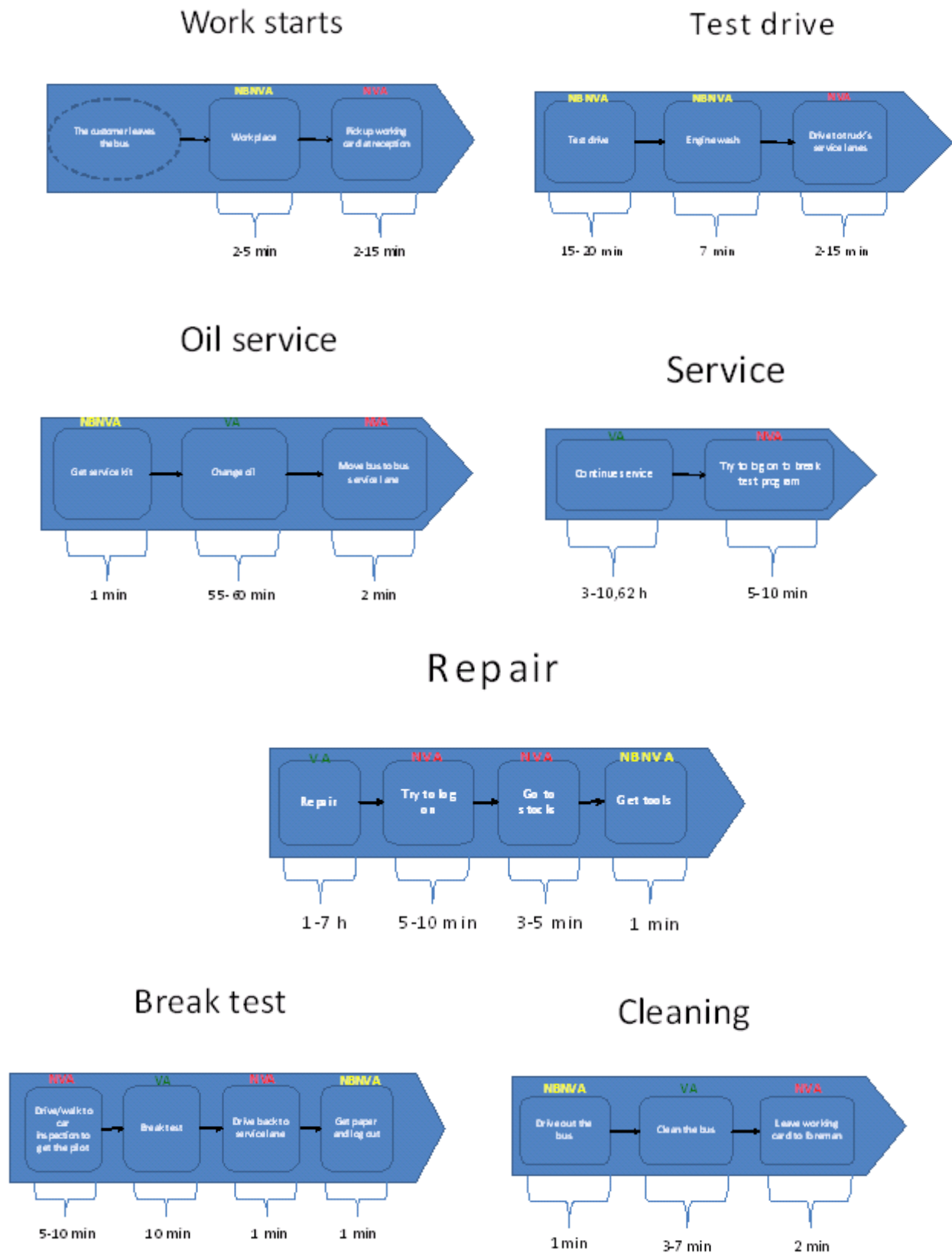


Fig. 8 Timed activities in detail, bus section

To start the work the technicians first should start their computer in order to be able to see necessary information and perform certain activities. Hence, this is a necessary activity even though it does not in itself add value to the customer. Again the problem with the working card occurs which does not add value to the customer and therefore will be more thoroughly described later on.

The test drive and engine wash are not directly value adding activities to the customer but they are still necessary in order to make it possible for the technicians to identify more (de)faults with the bus and to have a clean engine when working with it. What is not value adding though is that the technicians drive the bus to the trucks service lanes to perform the oil service as they then have to drive back to the bus service lanes.

Again, the oil service activities are divided as in the truck section and hence to get the service kit is a necessary but non value adding activity and filling the oil is a highly value adding activity. But after this is done the bus has to be moved to the bus service lanes as mentioned and this becomes a non value adding activity since it is only time consuming and does not add any real value to the customer.

To perform the rest of the service and necessary repairs is value adding for the customer but there are still small steps within that which does not add value at all. These are to try to log on to the break test program and go back and forth to the stocks. These activities will be analysed in detail later on. To get the necessary tools I have identified as a necessary but non value adding activity since they are needed in order to perform the service but are not directly adding value to the customer.

The next step is the break test which is a highly value adding activity since it is an activity that has to be performed at each bus service according to the law. However, to drive or walk to the car inspection in order to get the pilot needed for the break test is not value adding at all and neither the part to get the papers. This will also be analysed more thoroughly later in the analysis. To drive back in to the service lanes is not value adding either especially if the bus is ready to be cleaned or picked up. The cleaning of the bus could also sometimes be avoided if the technicians used cover paper as they walk inside the bus and therefore can be seen as a value adding activity but also an activity that can be avoided. To return the working card to the foreman is also a non value adding activity and could be removed if everything was done electronically.

Non value adding activities:			
Trucks		Buses	
Pick up working card	WC*	Pick up working card	WC
Move truck to repair lane	Layout	Drive to trucks service lanes	Layout
Calling foreman	Calling	Move to bus service lanes	Layout
Go to the stocks	Stocks	Try to log on to break test program	BT***
Wait for spare parts	Stocks	Go to the stocks	Stocks
Look for spare parts and tools	Stocks	Drive/walk to the car inspection	BT
Queue to the car inspection	CI**	Drive back to service lanes	BT
Give back working card	WC	Leave working card	WC

* WC=Working Card

**CI=Car inspection

***BT=Break Test

Table 1 Non value adding activities found in the service lanes

6.2 Analysing the current state map

Red=Bus, Green= Bus technician, Blue= Truck, Violet= Truck technician

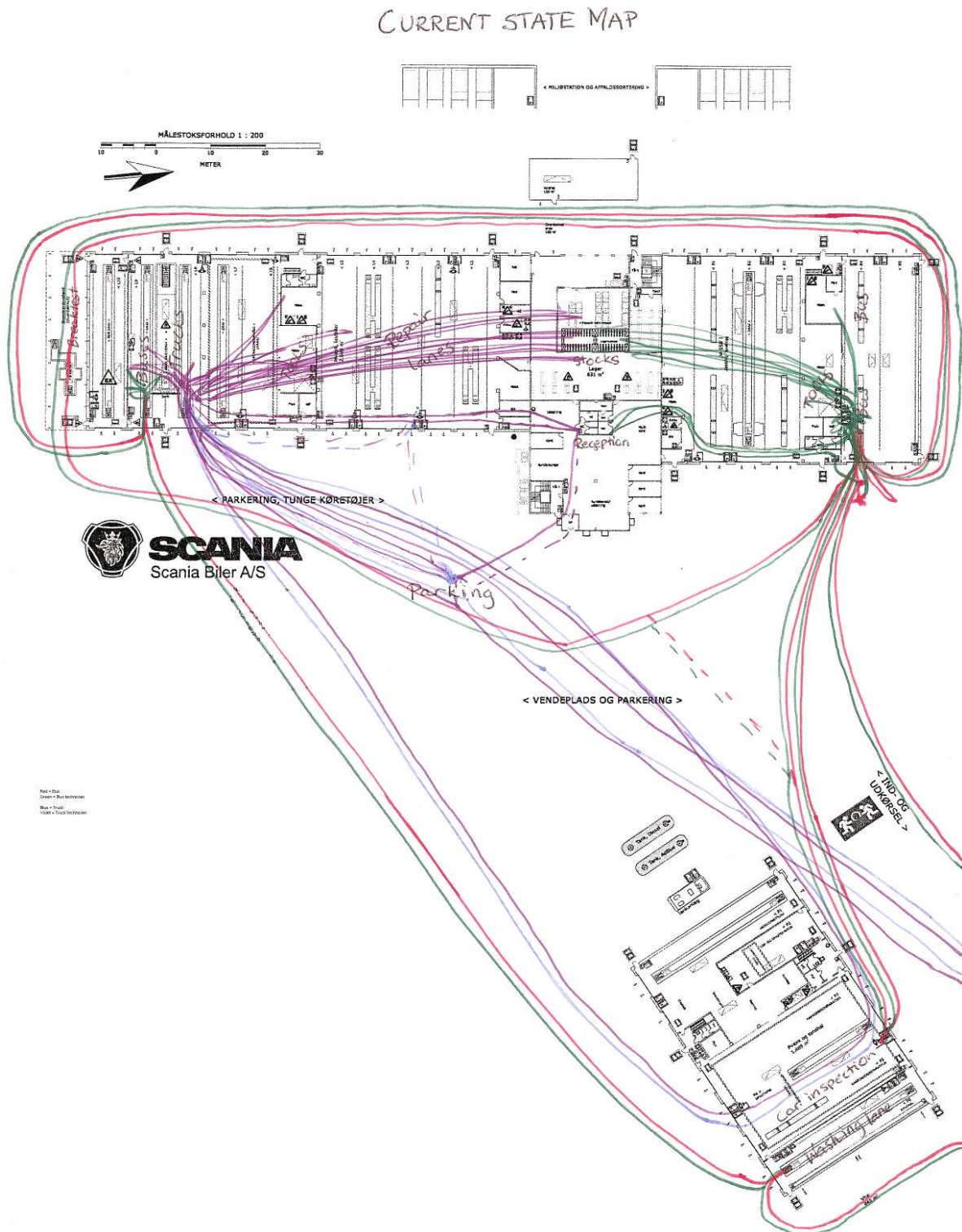


Fig. 9 Current state map

Working card

The first non value adding activity in both the truck and bus section is the working card. Picking up the working card at the reception and leaving it after the job is done and then picking up a new one are **unnecessary movements** for the technicians. This might be good for an update to the foreman of what has been done with the truck, but he might as well see it on the work card in the computer if the technician fills everything in. To pick up the working cards also causes a lot of **waiting** time. Fortunately, the technician can actually start the work without the working card, but he still has to go and get it later on when he has to move anyway, or send someone else, like the student, to get it.

But do the technicians really need to do this? Since they can start without the working cards anyway maybe he could actually fix the whole vehicle without the working card on paper? What if everything would be computerised and they would only use digital working cards? Then the foreman and manager for the truck section would only need to write everything in to the computer and the technician could read it from there and fill in everything extra he does on the computer as well. The same information is already in the system, so why do they have to print it at all? The problem with this solution is the scanning, that they are scanning the job number as they are filling oil. But to just tab in the job number by hand would actually not take so much longer and the technician could just write down the job number when needed. Isn't that faster than going out to the reception and wait for the work card? If the foreman just updates everything on the computer maybe it could be all digitalised. This would remove the waiting and the movement in order to go to the foreman to get the paper and give it back as the job is finished. Then the foreman wouldn't have to print all the work cards either which would save valuable time and be more environmental friendly.

Unfortunately, as it turns out, there is a problem in the connection to the internet in the bus section which complicates the "electronic communication" between the technician and foreman in this matter. But as soon as the problem with the connection is solved, probably with the help from the IT department it would probably be a good idea to try to make everything as digital as possible to minimise the movement of the workers.

Calling foreman

Another non value adding step in the truck section occurs during the service and is calling the foreman. If the technician identifies a fault with the truck he calls the foreman to see whether he should fix it or not. This often causes **waiting** time since he has to wait for a

reply from the foreman after he has checked with the client. Hopefully he can get hold of the client immediately, otherwise this step might take a very long time. How can this waste of time be helped? Firstly, the client should be asked to be able to be by the phone as the truck is in for service. Secondly maybe the foreman can ask if everything should be done on the truck, even when they find unexpected faults and they can agree on what should be done and not and how long the customer is willing to let the truck be at the workshop. If the customer can let the truck be there for a long time, the technician doesn't have to wait for the foreman to call the customer but it is sufficient to only call the foreman. This would shorten one step in the process. Maybe even the foreman can write on the work card or in another way let the technician know what he can do and not and for how long the customer is able to leave his truck there since the technician should be able to estimate how long the repair should take. To apply this kind of **decentralisation of management** gives the technician more responsibility and makes him feel more important and could be a push for him to do a better job.

Car inspection

Another non value adding activity that includes **waiting** could be identified in the truck section - the queuing to the car inspection. This does not happen every time, but quite often and it can take up to 10 or 15 minutes and creates a bottleneck in the flow. This happens because there isn't any system or coordination between the car inspection and Scania and the car inspection is also open for other cars. Maybe this waste could be helped by getting some kind of booking system that coordinates the car inspection with Scania or maybe just a board that shows when the car inspection is ready for customers since it doesn't take more than 2 minutes for the trucks to get there.

To drive the truck to the car inspection and back doesn't directly add value to the customer, but it is a **necessary movement** to be able to go through with the task which is value adding. This is due to how the workshop is built but the car inspection also has to be a governmental company in order to be trustworthy. Therefore the car inspection can not be included in Scania but has to be in a separate part of the buildings, also open for other cars and trucks. This could hence not even be helped if the layout of the workshop would be changed.

Truck service lanes

Within the trucks service lanes, the non value adding activity contains **unnecessary transportation** and occurs when the trucks are moved from the service lane to the repair lanes. This is a waste of time, at least if the truck does not take too long to fix because usually there is enough room for all trucks in the service lanes, even for smaller repairs.

Another unnecessary transportation of the truck is that it has to drive out from the lanes to the parking lot in order to wait to be driven in again when a specialised technician is able to finish with the remaining parts of the service. This is due to the lack of special education of all the technicians. The company could solve this problem by having **multifunctional teams** and letting all the technicians learn everything that is included in a service and give them licence to perform all the tasks included. This would probably also encourage their performance/motivation.

Bus service lanes

In the bus section there were several other non value adding activities identified mostly including **waiting**. One of the activities occurs when the technician drives back with the bus from the engine wash. Sometimes the bus has to wait outside the truck service lane because of another bus that is standing there. This does not happen each time, but enough that I would notice it, and when it happens it might take up to 15 minutes before the truck drives out and the bus can get in on the lane. This is not due to lack of space for the trucks on the service lanes, but rather not thinking from the truck technicians because if they stay at the buses lanes they get even closer to the service- and oil kits. To avoid this problem a simple solution is to let the buses have one lane with two places on the truck's service lanes for a certain time and then the trucks can use the other two service lanes and make sure that all technicians know about this division.

When moving the bus back to the bus service lanes, the same problem may occur, that the finished bus hasn't been driven out of the service lanes yet. Now the technician has to tell someone to drive out the bus or do it himself. But first he has to move the bus that should get in so that the ready bus has place to back out, which also causes **unnecessary transportation**. This might take up to 25 minutes and could be avoided if the technicians drive out the bus as soon as it is ready.

Another non value adding activity identified here that also includes **unnecessary transportation** occurs when the bus moves from the trucks' service lanes to the bus service lanes. This is due to the layout of the workshop but also because of the placement of the oil-filling tools which are in the truck section. The reason that the technicians cannot go through with the whole service at the truck service lanes is because they don't have the right tools to do everything and they also need to change glass- fibres filter in a special room since this is very dangerous. This room is located in connection to the bus service lanes.

Break test

The break test in the bus section also includes non value adding activities. When the bus technicians try to log on to the break test program both **waiting** and **unnecessary movement** occurs since the technician tries to log on the break test program several times during the service. The whole procedure including all the time spent on trying to log in to the program might take up to an hour but the break test itself only takes about ten minutes. This leads to that the service often exceeds the expected time of the service. Apart from being time consuming, it also takes focus away from the service for a while each time the technician tries to log on. It is also an unnecessary movement in the way that the technician has to move away from the bus and go to the computer each time. This problem is due both to bad connection, but also because the program only allows one user at a time and the car inspection is also using it all day and they are using the same program with the same username the whole day. So in some way the technician at least has to tell the car inspection that they need to log in to the program. Instead of going there to do that, as is the case now, they could actually just call the car inspection from their mobile phones and let them know that they need to use the program so that the car inspection logs out for a couple of minutes. In the long run though, it would probably be more efficient to invest in a program that the buses can use without having to take the car inspection into consideration and also to make the internet connection in the bus section work better.

Another non value adding activity within the break test is **unnecessary transportation** when the technicians drive the bus to the car inspection to get the pilot to be able to perform the break test. The problem is that the pilot is needed because in the service contract with the bus customer, a certified break test has to be performed. The only way to have the break test certified is by using the pilot. What could change this problem is to invest in a pilot for Scania's bus section.

Also after the test the technician has to print the certification and go to the printer and get it. A solution to this **unnecessary movement** could be that the data is saved on a special server and connected to the working card so it gets printed together with the invoice.

Ordering spare parts

In the process of ordering spare parts, **waiting** can also be identified. There seems to be a problem in the system that connects the ordering of the spare part with the automatic stock, and creates a delay so it takes a couple of minutes before the computer ordered box with the spare part comes out. Sometimes the box even gets stuck on the way and doesn't get the whole way out. This doesn't happen when the spare part is ordered from the computer in the stocks. Instead of waiting the technician can hopefully use the time to fix something else for a couple of minutes. Otherwise this might be something for the IT-department to work on.

Stocks, spare parts and tools

Going back and forth to the stocks is also something that doesn't really add value to the customer and therefore becomes an **unnecessary movement** for the technician. Although, to actually get the tools needed is a necessary activity in order to be able to fulfil the task. The reason that the technician has to go so far to get the spare parts is the layout. The placement of the stock is quite far from the service lanes because most spare parts are needed for the repairs. Therefore the repair lanes are closer to the stocks than the service lanes.

Another **unnecessary movement** for the technician is when he is looking for tools or for spare parts. When it comes to the spare parts he should be able to look for all the spare parts in the computer system to see if they are available and where. When it comes to looking for tools all the tools should be put back in the same place after use so that the technician knows exactly where to find all the necessary tools. The problem is that some technicians don't put them back in the right place because they feel that they don't have the time or they are too lazy or they found it somewhere where it shouldn't be anyway and they therefore think that it does not matter where the tool is if it was not in the right place anyway.

As mentioned the technicians also often have to **wait** for spare parts to be transported from other workshops. This both takes time and is a waste of money since the company has to

pay a cab for driving it to Ishøj. This could be prevented by pre-picking and making the customers call in a time in advance.

Pre-pick

The usage of pre-pick parts is good and important since it saves time for the technicians. It can lead to better and quicker service since the technicians can pre-pick the spare parts needed for the repair or order the parts that are missing in the stock so that it is there when the repair starts. Therefore they are aiming for as many pre-booking visits as possible but unfortunately it happens very seldom that the foreman can identify the problem in advance since most clients are just dropping by when they need without booking a time. The only way to solve this problem is to make the clients used to calling in advance and book a time. To pre-book is to try to make it even more **pull instead of push**.

The employees

The climate at the work shop is usually calm, without any stress. This might have to do with today's financial crisis, since the work load nowadays only is one third of what the technicians are used to. Now the technicians therefore afford to work two persons on one truck (often a senior and a pupil).

What is positive at the workshop is that the employees are very flexible when it comes to moving around since they have movable desks, laptops and cellular phones. This is positive in the sense that it is easier and less time consuming for the technicians to move than moving the truck or bus. The negative thing with this flexibility is shown when the technician starts helping on another vehicle. This is, as mentioned, quite common but is disturbing the technicians' work since it always takes time to reset and get acquainted with the new job. This might happen not only if the technician is waiting for spare parts and therefore is inactive, but also if the foreman just comes in and demands it. The technicians don't really appreciate this, especially since it is seldom needed. And since the technicians perform different activities on the trucks and buses they don't really need to variation between vehicles.

During my study I found a kind of unused employee creativity when I spent my time in the workshop talking to the technicians. Many of them seem to see problems with different steps in the process and it bothers them that things aren't always working the way they should. They have a lot to say about how things are being handled and tasks are being

performed on the shop floor. Since they are the ones working with this daily, they are also the ones most acquainted with the work and they therefore are the ones experiencing eventual problems. They know what is working well and what would need to be improved. The problems affect their motivation for work and are constantly discussed among them. They have the feeling in advance that the management won't listen to them, which makes them keep everything to themselves. This is a problem since the management can't really know what is going on on the shop floor if they don't communicate with the technicians. As with the truck section I would suggest to have improvement meetings with the technicians, foremen and management continuously. This would make the technicians feel more important and would push them to **constantly work on improvements** in the processes and this would lead to continuous elimination of waste and higher motivation and therefore also probably more efficient work.

Something else that "pushes" the technicians down and that may also affect the productivity of their work is that not everyone has the license to perform all the tasks needed in a service. This could be avoided through introducing **multifunctional teams**. I would therefore suggest that the management puts effort into educating all the technicians equally so that everyone knows how to do all the basics and have all the licences needed to fulfil a whole service.

The bus technicians would also very much like to keep a diary for each bus of what they have done with it so they can follow it up the next time the bus comes in. The problem is that they don't have access to the system. This could otherwise be good both as a kind of quality insurance to see so that not the same problems have to be repaired every time and seeing how good the repairs are proven to be. The bus technicians sometimes also have to read about a bus in advance and check the blueprints in order to get acquainted with the job. Since this is very time consuming due to poor documentation, to keep a diary might also be a good start for documentation of the buses and check how much time each repair moment takes so they keep a track of it. Because once you start documenting each step it will be easier for the future to estimate the time for the bus repairs.

Summary of the lean principles found in the service processes:										
	Working card	Calling foreman	Ordering spare parts	Truck service lanes	Car inspection	Bus service lanes	Break test	Stock & tools	Pre-pick	Employees
Waste	X	X	X	X	X	X	X	X		
O/U Production										
Waiting	X	X	X		X	X	X			
Transport				X		X	X			
O/U Processing										
E/I Inventory										
Movement	X						X	X		
Defects										
Zero defects										
Pull instead of push									X	
Multifunctional teams										X
Decentralisation		X								
Vertical integration systems										
Continuous improvement										X

Table 2 Lean principles used in the process of the service lanes

7. Conclusion

This section will consist of three parts. The first part will answer the research question and the second part will be a discussion containing the principles that I didn't use and why. Finally, in the last section I will give some proposals for future research.

7.1 Answering the research question

So, in what way can the service lanes at Scania Ishøj become more efficient by adapting the lean principles?

By **eliminating wasteful** steps in the process like waiting, unnecessary movement and transportation the process will get a better flow. Frustrations will be avoided and time which is now spent on waiting or other non value adding activities can for example be spent on services on other vehicles. To get the process to flow will make the work more efficient and the through-put-time shorter which will thus enable the workshop to take care of more customers in the future.

Even though most services are **rather pull than push** since the demand has to come from the customer, it can always become more pull. This can be done by getting the customers to make an appointment in advance, which would also solve several problems. This would both solve the problem that the spare parts are often missing and hence be more time efficient in the sense that technicians would not have to wait for spare parts but also cost effective since spare parts would not have to be transported by taxi. This would of course also affect the clients in the sense that they would get better and faster service. Another suggestion would be to have a digital booking program where the truck drivers would be able to log on and book a time together with filling in a form so that the foreman easier could identify the problems and ordering the right spare parts on time. In order to encourage the customers to book a time online it could be rewarded by a price reduction.

Starting to implement **multifunctional teams** is also something that can affect the workshop in a positive way, especially the employees. This would affect their self esteem in a positive way, they would be able to be more productive and complete a whole service themselves without asking others for help. In case of the specialised technicians' sickness, the service would still be able to flow. Even though it might be costly to give the appropriate training to all technicians, it is a long-term investment for the company and gives opportunities for the technicians to rotate more.

They could also start to **decentralise** the decision making for example when it comes to calling the foreman to see what can be done with the truck. This would increase the technicians responsibility and by that also the quality of their performance. Also the productivity and flexibility could be increased by transferring responsibility and decision making to the technicians.

To be able to keep up the work and constantly work on improvements the workshop should implement **continuous improvement** meetings at a regular basis. These kinds of meeting would motivate employees to increase their creativity to find both points for improvement and also new solutions to problems that occur. This would also help to build a kind of trust between the technicians and the management where the technicians would feel more important and that their opinion actually does matter. A suggestion could also be to reward the persons that come up with better solutions to encourage the employees even more. It is here also crucial that the management realises that the workshop can and has to constantly be improved in order to survive competition and that the technicians are the ones mostly acquainted with how the service lanes work in reality and hence the management should realise how important the technicians opinions and suggestions actually are.

7.1.2 Future state map

In order to create the future state map I have taken into account the non value adding activities and tried to eliminate them from the process. This is then how the future state map will look like. As seen the flow looks much more clear and simple even though all the steps are still included.

Red= bus; Green= bus technician; Blue=truck; Violet= truck technician

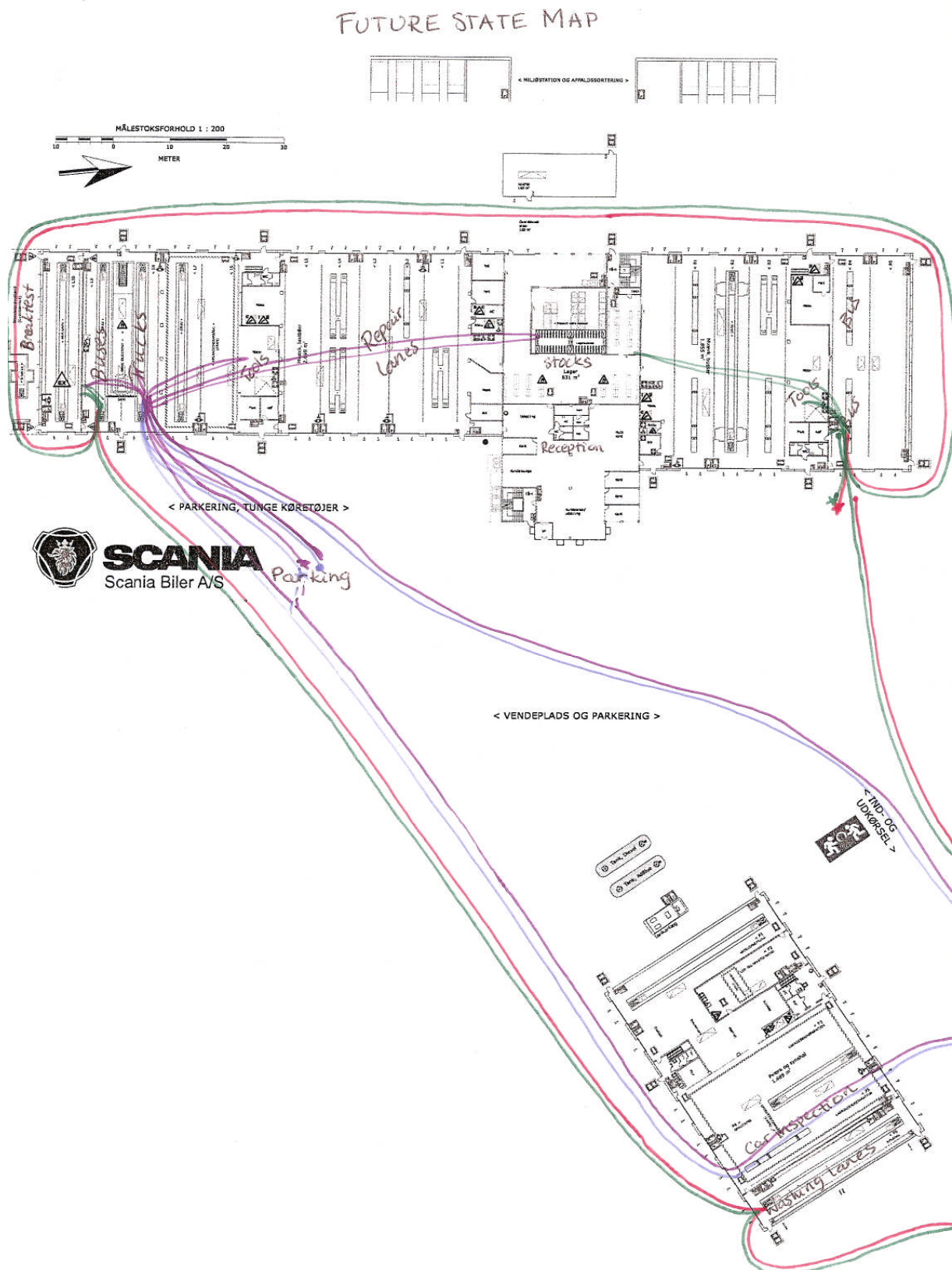


Fig. 10 Future state map

7.2 Discussion

What lean principles were not used in the analysis and why? The two principles I haven't used in the analysis are wastes within production, processing, inventory and defects, **zero defects** and **vertical information systems**.

The first type of waste, overproduction, is hard to find in a service company, since to be able to produce this kind of service, the "order" has to come from the customer. The only thing that possibly could count to the overproduction is the working cards mentioned above. Over processing does not occur either in the process in the sense of making the service "too good" compared to the customers' expectations, needs and what they are willing to pay for. Excess inventory is also not a common waste in the company since the trucks and buses are finished and picked up or delivered to the customer before the technicians start to work on the next vehicle.

To be able to attain high productivity, it is essential that all parts and products are fault free from the very beginning. The goal is to work with products that are fault free through the continuous improvement of the manufacturing process. In this type of services, the aim is to repair the defects which have occurred earlier and regularly bring the vehicle for service in order to prevent defects. Hence, it makes it hard to analyse it from the principle of zero defects. Of course the technicians are trying to fix everything the best they can so that they will not have to redo the work. Although maybe you could say that zero defects could be applicable in the sense that identifying the defects should be done as early as possible in the process. This is also mentioned above with making the customers book an appointment in advance and already then trying to identify the problem.

Information is important in order for the multifunctional teams to be able to perform according to the goals of the company. The first issue here is the mode in which the information is provided to the employees. The objective is to provide timely information continuously, directly in the process flow. This is already done through the Carsoft and Multi-system and that every technician has his own laptop and everyone can follow everyone's work. The performance of the divisions can also be seen in the weekly paper/report that the workshop gets and on a screen in the dining room where also the whole company's performance is shown and compared to the competitors' performances.

As mentioned this could be slightly improved by the internet connection in the bus section and a communication system with the car inspection.

7.3 Future research

Since the lean principles have been proven to apply well on the service lanes and that the flow would be improved by applying the lean principles, probably other parts of the workshop may also be improved by the principles. Hence, to make the workshop even more efficient I suggest future research about lean within different areas but also research on how the clients could get used to book a time in advance since this has proven to be a crucial step in the process. I also encourage the study to be performed on other workshops in order to make them more efficient.

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