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Lean Transformation in Healthcare
a Case Study at Skaraborgs Sjukhusgrupp

Master of Science Thesis
in the Information Systems in Logistics Programme

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Abstract

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The quality of the Swedish healthcare has a prominent position internationally, but long queues for various treatments, are today often criticized and debated. However, patient queues and delays are often not the result of resource problems - they are the result of flow problems. The trend in recent years has been a knowledge transfer from the manufacturing industry to healthcare on how to create flow. Lean Manufacturing, which originates from the Toyota production system, has received a lot of attention. While Lean Manufacturing is a well described management framework, the proceeding to *become* "Lean", referred to as a "Lean Transformation" is considered more contextual.

This study, conducted in 2010, investigates how to achieve sustainable Lean Transformations in the context of the Swedish healthcare system, with a focus on the patient flow through surgery departments.

The methodology was designed as a qualitative case study, with a triangulation of data sources: a main case (KSS Skövde) and a reference case (SUS Lund), combined with the breadth of view from literature. In the main case, the author participated in a process improvement team as an action researcher. The reference case was investigated with interviews.

The concrete measures identified on how to improve the patient flow, are very similar between the two cases, and are also well in line with basic Lean concepts. This suggests that other Swedish hospitals, who are in the beginning of a Lean transformation, have much to gain from studying the findings from others.

The great challenge is however to create sustainability, which is basically a question of suitable leadership and cultural change. Even if these areas are less tangible, the issues and findings from the two cases have a lot in common, most of which references can be found in Lean literature.

The report also discusses how Lean is not an option in the healthcare system - it is a necessity. Moreover, it is argued why the entrepreneurial drive is something that possibly needs attention in the healthcare Lean work, despite the Lean literature in general advocates the opposite.

Keywords: Surgery, Productivity, Planning, Patient flow

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1. Introduction

1.1 Background

According to both Swedish and international studies we must expect the medical services to carry a greater load in the future. At the same time resources are decreasing. The quality of the Swedish healthcare yet has a prominent position internationally, but long queues for various treatments, are today often criticized and debated. In an attempt to shorten the queues by force, a health care guarantee has been given the Swedish citizens by law. In practice this means there is a maximum number of days you will have to wait for various treatments. If your local hospital cannot live up to this guarantee, you have the right to see a doctor at another hospital - at the expense of your local hospital.

The healthcare system is known to be inefficient, which ironically is most fortunate; there is room for improvements to solve the equation. Often, patient queues and delays are not the result of resource problems, they are the result of flow problems (Haraden & Resar 2004, p.3).

> **Note**
> Before moving on, an early note on terminology has to be made. Flows here refer to the patients and their journeys through the healthcare organization. On this journey, the patients may meet several doctors, nurses and administrative personnel in different departments. However, a flow is more often referred to as a process, which formally can be defined as a chain of recurring activities that create value for a patient or relative (Rentzhog 1998 as cited by Lifvergren 2009).

Unnecessary activities, such as an administrative task performed duplicate times in different departments is one cause of delays. Another, and possibly greater cause, is the way many small flow variations along a process can cascade and multiply with each other, eroding the overall flow. Causes of variation can be individual activities performed in inconsistent ways, with uneven throughput times, or with inconsistent quality. It can also be balancing issues, poor production leveling, fluctuations in human resources etc. Interestingly, the incoming flow of various medical conditions is remarkably constant. Hence, most variation issues are created inside the health care organizations (Haraden & Resar 2004).

Healthcare organizations have a long tradition of being organized and managed by departments, which can be referred to as functional oriented management. It brings little attention to the performance of the flow of patients crossing the departments. Hence, the customer overall experience may suffer, despite the medical care may be flawless in the departments individually.

The last 20 years, several managerial practices has been suggested that directs the attention to what actually *adds value* along a process. These practices all go under the concept of process management. Some promising results have been shown from organizations who have embraced it,

but the co-existence of process management and functional oriented management is a challenging balancing act (Hellström et al. 2010).

The trend in recent years has been a knowledge transfer of process management skills from the industry to healthcare, even if there has been some skepticism to the applicability and good of such knowledge in healthcare. Notably the management programs of Six Sigma and Lean Manufacturing has received a lot of attention.

Without yet going into any details of the concepts, Six Sigma has its origin in Motorola, and Lean Manufacturing is basically a rip-off of the so called Toyota Production System (TPS).

The latter is the subject of this report. The record of success stories with companies implementing Lean Manufacturing is overwhelming. Despite its origin in the automotive industry it has today made its way into most industries including the public sector and healthcare. Lean Manufacturing is recognized for its holistic approach to reach operations excellence. At its essence, it is about creating fast and smooth pull-based[1] production flows, organized around a distillate of activities that adds value for the customer. In this it has a many concrete principles and tools to help decrease variations and increase the share of customer value adding time. A great emphasis is also put on leadership and the importance of growing and involving all employees in continues improvements.

Note
It may be confusing that within Lean Manufacturing literature, the definition of a process differ from the one given in the previous note in this chapter. Within Lean, a process is referred to as a value stream, and an activity in the value stream is referred to as a process. This report does not use this definition. Instead see the previous note for the definition used. The meaning of the term flow is however the same within Lean terminology, as discussed before. Conclusively, the terms process and flow are used interchangeably in this report, referring to the same thing.

1.2 Purpose and Research Question

The purpose of this study is to investigate the proceedings to become Lean, referred to as Lean Transformations, in healthcare organizations. Svante Lifvergren, the Development Director at the Skaraborg Hospital Group (SkaS) in Sweden, and Ph.D. student in Quality Sciences at Chalmers University of Technology, means there is a lack of generalizable experiences on *how* a comprehensive development of a healthcare system shall be carried out. Most reports are case studies with non-generic results (Lifvergren 2009, p.5).

Surgery departments, along with emergency departments, are core functions in an hospital and play a decisive role for the overall flow. This makes them interesting to study specifically. This leads us to the research question of this study:

How can you, based on the concepts of Lean, improve the patient flow through a surgery department while grounding for a long term lean transformation of the whole hospital?

The expected outcome of the study is a set of key success factors on what actions to take, as well as what activities to avoid.

[1] Pull-based flows means flows that are driven by downstream actual needs, i.e. the customer needs.

1.3 Limitations

As Peter Hines (2007) claims, there is no silver bullet for the proceedings of a Lean transformation - the best way to go about is always contextual. Liker (2004, p.111), makes the same claim. Given this, the scope of the studied system must be limited to functions that are contextually comparable between hospitals. Otherwise no general conclusions can ever be made to share between hospitals. This is why a surgery department was chosen, apart from it being a critical section of a patients journey through an healthcare organization. However, contextual conditions will never be identical, meaning no completely generic answer should be expected.

An issue that will be treated as a contextual condition only, is the present accounting principle. Today, all accounting is made with the departments as cost centers. This unfortunately promotes a vertical focus, instead of promoting a process oriented collaboration cross the organization. In short - there are incentives related to accounting that easily discourage process oriented thinking, but this study will not investigate how to address this issue.

This study will focus on productivity and flow. Patient security is not actively investigated, even if it is not ignored.

2. Methodology

The methodology was designed as a qualitative case study to obtain an in-depth contextual analysis, that is combined with the breadth of view from literature. There was a main case and a reference case, where the purpose of the latter was to contrast the findings from the main case. This setup represents a triangulation of data sources.

In section 2.1 of this chapter, the overall research process is described. This includes an introduction of the different types of data sources.

Action research was used for the main case. Hence, it was a core part of the research process. The basics of action research is explained in section 2.2. This will also highlight some notable criticism that has been posed on action research.

How data was captured, for the different types of data sources, is described in the 2.3 Data Collection section.

The chapter is then completed with a discussion on trustworthiness, in section 2.4. The word trustworthiness is used as a replacement term for reliability and validity, which is discussed first. The section then comments the use of triangulation in data sources to demonstrate trustworthiness.

2.1 Research Process and Data Sources

The main case was the Swedish hospital Kärnsjukhuset (KSS) in Skövde, part of the Skaraborg Hospital Group (SkaS). In spring 2010 the author participated as an action researcher in an improvement project at the surgery clinic. Details of the main case are presented in chapter 4.

As a reference case an improvement project, started in 2007, at the orthopedic clinic of the Skåne University hospital (SUS) in Lund, was used. This Swedish hospital began their overall Lean Transformation at about that same time (2007). The author had however no participation in this case, and the data collected relies mainly on interviews. As for the main case, all details of the reference case are presented separately, in chapter 5.

The research process can be described as three iterative phases, as shown in figure 2.1. While the purpose of the figure is mainly to illustrate the research process, it also shows the different data sources. For details on the data sources, refer to the 2.3 Data Collection section.

The main focus of the (1) *introduction* phase of the study was a literature study. Lectures and the Lean Healthcare conference in Lund were also attended. The aim and research question evolved

over time and was not given from start. Introduction meetings for the main case were held, even if the improvement work had not started yet. The reference case was chosen after a presentation of the case at the Lean Healthcare conference in Lund.

The (2) phase of *Empirical data collection and Analysis* was mainly about participating in the improvement project of the main case, in the role of an action researcher. For a description on how the action researcher role was applied in this study, refer to the 2.2 Action Research section. Two days were also spent following the work of the surgery planners. The process details of the improvement work is later explained as part of the case description, in chapter 4. As the work evolved and observations were made, new literature studies were iteratively made. Late in this phase the reference case was investigated with two interviews, of which one on site. The reference case was investigated to contrast the findings in the main case.

The (3) *results* phase was about compiling and validating the findings, from all three data sources. This also included a meeting with the main contact in the main case to validate and discuss the improvement team's findings, as well as the contents in a journal of reflections. The report was written through all phases, even if the analysis and discussion was completely written in the last phase.

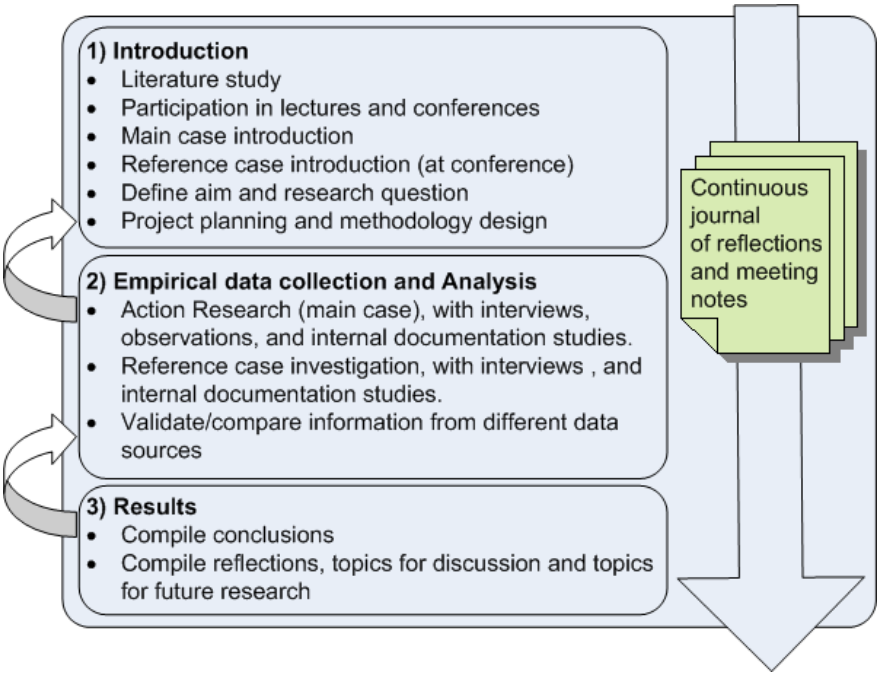


Figure 2.1: *Research Process*

2.2 Action Research

2.2.1 The Process of Action Research

The general role of an action researcher complies well with the work made in this specific study. Brien (1998) describes how the role of an action researcher is more than just being an observer and reporter of an improvement project. The researcher must also act as a facilitator who fosters a reflective analysis among the project participants, ensure the intervention is informed by theoretical considerations, actively give comments and suggestions, participate in planning and designing the

improvement work and so forth.What action research provide, over an approach of just observing, is that you are allowed to analyze the link between actions and consequences, hence you get an insight in the stimulus-response association.

Researchers have described and illustrated the process of action research in slightly different ways. The important common denominator is that action research is always conducted in a cyclical or iterative manner. "...the research proceeds by doing and by making mistakes in a self-reflective spiral of planning, acting, observing, reflecting, planning, etc." (McNiff 1996, p.22) Despite the different flavors, the cyclic nature of a typical action research process closely mirror the fundamental elements of the PDSA cycle (Plan, Do, Study, Act) (Whitehead 2005).

2.2.2 Criticism on Action Research

Seemingly many researchers are debating the very validity of action research, such as Turnock & Gibson (2001), McInnes et al. (2007) and Newman (1999), to mention only a few.

Typical criticism as compiled by Dr. David Garson (2010) are: unsystematic gathering of data, reliance on subjective measurement, that the observer possibly may distort the observed behavior, and lack of objectivity. Garson continues that action research is however at the same time promoted for its reliance "on first-hand information, high face validity of data, and reliance on relatively simple and inexpensive methods." Moreover, it provides a stimulus-response association as described earlier.

Regarding the risk for lack of objectivity, the author believes this is mitigated in this study from the observer (the author) being an external participant.

There is also criticism on not doing several iterations. Criticism has been posed to many reports that "...rely on simple two-point comparisons, such as 'before' and 'after' scenarios or direct comparison of two consecutive years' financial results. These can mislead management for a whole host of reasons. Most data, especially that derived from healthcare processes, exhibits natural variation. Consequently, two-point comparisons of data might provide completely the wrong interpretation of a situation." (Walley et al. 2006, p.95) This study will stay within one improvement cycle only, of which the reader must be aware.

2.3 Data Collection

2.3.1 Literature Study

The literature study has involved books, scientific reports, commercial reports, articles, and university web sites. For each topic in the theoretical framework, the process of selecting literature was made in three steps, as shown in figure 2.2. Below, the steps are described:

Step 1 First a search of potentially relevant documents was made, on the search engines / databases of Google, Google Scholar and Emerald Science Direct. Typical key search strings were (selection) "Lean Implementation", "Lean Transformation", "Lean Healthcare", "Process management Healthcare", "Process Healthcare Implementation", "Process management public sector", "Six Sigma Healthcare", "Lean Six Sigma", etc. For web information, only university web sites and web sites of credible research institutes were considered.

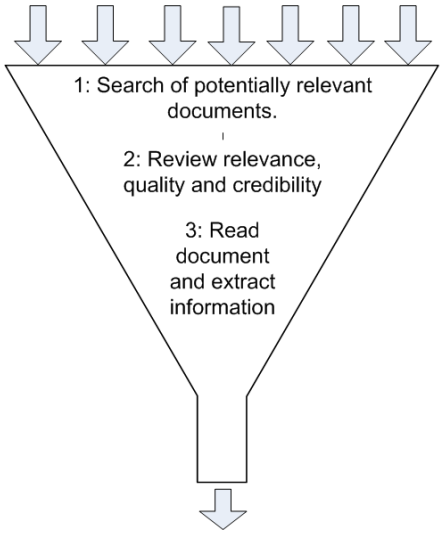


Figure 2.2: *The basic process of the literature study*

Step 2 The relevance and quality was reviewed for each document, by reading the abstract and/or conclusions. The source was also investigated to determine credibility. It is also notable that step 2 had three optional inputs:

a Documents cited in other documents.

b Various literature used in university courses.

c Literature recommended by the supervisor, lecturers etc.

Step 3 As a third step the artifact was read to find useful information. Key information was underlined and for some artifacts a simple recap was written, for a later reference.

2.3.2 Observations

All observations were participatory and unstructured by nature. Nonetheless all observations were documented in the journal, with time and place. Key statements, interesting quotes, and own reflections were noted. No tape recordings were made.

2.3.3 Interviews

Semi-structured interviews was the main source of information for the reference case. They were also used to summarize experiences and reflections from the improvement team in the main case. All semi-structured interviews were prepared with an interview proforma with key topic headings. This also included follow-up topics related to certain keywords.

Many conversations/discussions were also made with different employees and participants in the improvement project. Formally, these were unstructured interviews, which can arguably be seen as a part of the participatory observation.

2.3.4 Internal Documentation

Internal documents (secondary internal data) have been investigated, such as implementation reports, internal management reports, and statistics concerning queue history, waiting times, operation room usage, usage of beds, etc.

For the main case, statistics was extracted from internal databases (operation planning systems, ERP etc). This was made by a certain member in the improvement team, when requested. As a participant in the improvement team, the author had an influence on what data to extract and investigate. For the reference case, the same type of data was requested, for a comparison.

2.3.5 Lectures and Conferences

The author had a strategy of participating in relevant lectures and conferences, when the opportunity was given. Table 2.1 is a compilation of the events attended. Notes were taken and powerpoint presentations were collected when provided. When not provided, photos were taken of selected slides.

Table 2.1: *List of lectures attended*

Date	Lecturer	Role	Lecture Title / Topic	Site	Organizer
2010-01-18	Prof. Peter Hines	Chairman LERC (Lean Enterprice Research Centre), Chairman SA Partner	Going Lean or Staying Lean	Göteborg	Plan Logistics Association
2010-02-26	Torbjörn Jacobsson	Phd candidate	Phd dissertion: Implementation of Process Solutions in Healthcare	Göteborg	Chalmers University of Technology
2010-03-16	Ann Esain	Head of the Health and Service Group at Lean Enterprise Research Centre, Cardiff Business School, Wales, UK	Improving an Healthcare system	Lund	Lean Healthcare Confereance - a Lean Forum and Skåne University Hospital joint venture
2010-03-16	John Toussaint	CEO Thedacare Center for Healthcare Value, UK	Leading a Lean Healthcare Transformation	Lund	
2010-03-16	David Fillingham	Chief Executive, Royal Bolton Hospital, UK	Experiences from a lean transformation – an English hospital	Lund	
2010-03-17	Pelle Gustafson	Manager Ortopedic Clinic, Skåne University Hospital, Lund	History/Experiances from an Ortopedic Clinic Lean Implamentation	Lund	

2.4 Trustworthiness

A good qualitative study is one that can help us "understand a situation that would otherwise be enigmatic or confusing" (Eisner 1991, p.58 as cited by Golafshani 2003). The authors' perception of quality in this context refers to the "usefulness and trustworthiness of the study, from the perspective of the reader".

With this basic understanding of quality as a spring board, this section will outline some important terminology regarding scientific establishment of truth, see 2.4.1.

Trustworthiness in this study is demonstrated through a triangulation of data sources, described in 2.4.2.

2.4.1 Terminology

The concepts of *reliability* and *validity*, especially the former, is argued by many to not be applicable in a qualitative research paradigm. In a quantitative paradigm reliability basically expresses weather a result is replicable, and validity expresses weather a measure is representative given what is intended to be measured. These definitions are hard to translate into the qualitative paradigm, where the concepts tend to blur. Terminologies that encompasses both are then sometimes used, such as credibility, transferability and trustworthiness (Golafshani 2003).

According to Golafshani it is common for researchers to develop their own understanding of validity (or whatever term is chosen), since there is no universal definition for it in a qualitative context. Moreover, it can be argued that if validity can be demonstrated, reliability must follow, since there can be no validity without reliability (Lincoln & Guba 1985 as cited by Golafshani 2003).

Based on the reasoning above, this study will avoid the terms reliability and validity and simply settle for the term *trustworthiness*. In the authors' opinion, using the word trustworthiness best reflects an understanding that there is no absolute truth in a qualitative paradigm. It is the researchers' role to demonstrate the *degree* of trustworthiness and it is then the readers' role to judge it.

2.4.2 Triangulation of Data Sources

How is trustworthiness demonstrated? Golafshani (2003), points to many researchers that advocate triangulation, just like in a quantitative context. Many things can be triangulated, such as several investigators who interpret the same interview data, the use of several methods, or triangulation of data sources. The latter form of triangulation was used in this study, as shown in figure 2.3. One could also argue that these three data sources represent a triangulation of data collection methods.

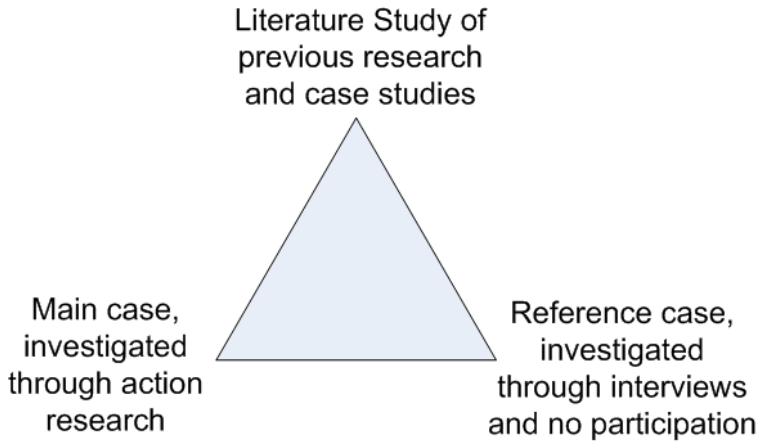


Figure 2.3: *A triangulation of data sources was used to obtain trustworthiness for the study.*

3. Theoretical Framework

Management philosophies tend to come and go in fashion-like cycles, and "new" ones are sometimes just repackaged or relabeled versions of previously popular methods. There is a plethora of managerial buzz-words and it is easy to become cynical. Hence, when implementing new management philosophies they are easily dismissed as fads (Näslund 2008). As early as 1972, Levitt argued that organizations in the service sector would benefit from applying industrial approaches. Today there is a bit of a "hype" in the Swedish healthcare system to implement Lean. But what really is Lean? Some voices are being raised questioning the true purposes of Lean. Is it a way to squeeze more out of employees? Is it not just the flavor of the week?

These types of questions require a solid description of what Lean truly is, which is the main purpose of this chapter. It goes back to the root concepts of the Toyota Production System, the origin of Lean (section 3.1). Pay extra attention to the so called iceberg metaphor in section 3.1.6 (p.19), which illustrates the "hard" and "soft" aspects of a Lean Transformation. The Analysis chapter is structured based on this.

This chapter will also describe another major management philosophy - Six Sigma (section 3.2, p.19). In this, some noteworthy differences between Six Sigma and Lean Manufacturing are highlighted. The reason Six Sigma is presented is that it has been and is used at SkaS, the main case.

3.1 Lean Manufacturing

It is probably fair to say that most peoples' notion of a factory is a dirty place of oily machines, large inventories, and forklifts driving back and forth carrying big pallets of materials. In fact, this is what most factories once looked like, but the characteristics of a mature Lean Manufacturing plant is different. It is clean, inventory levels are low, and products flow smoothly through the plant with only short waiting times. At its essence, Lean is about creating fast and smooth pull-based[1] production flows, organized around a distillate of activities that adds value for the customer. But why is the target set on this, and where does Lean come from? An historical background will give an answer in the 3.1.1 Historical Background section.

After that, an overview of Lean and its main parts is given in section 3.1.2, p.12. This section also serves as a reading guide to the rest of the Lean Manufacturing section.

[1] Pull-based flows means flows that are driven by downstream actual needs, i.e. the customer needs.

3.1.1 Historical Background

The basic concepts of Lean Manufacturing dates back to the end of second world war and Toyota. At the time the business conditions for Toyota were tough in comparison to US manufacturers like Ford and GM. The latter had plenty of cash and a big market that allowed mass production with economy of scale. Cost per piece and machine was low. Big facilities allowed large inventories and several production lines. Handling a variety of vehicles was not an issue. Now, Toyota had very limited resources after the war and they operated on a small market[2] that allowed no economy of scale (Schonberger 1982). Still, there was in fact a greater demand for variety in vehicles. The facilities were small and they had basically only one production line. Given this, the Toyota management realized they were *forced* to have a flexible and mixed production flow, low inventories, and short lead times (to turn around cash fast).

While producing under these seemingly harsh conditions, Toyota made a critical discovery of something not intuitive: short lead times and flexible production flows actually bring higher quality, better customer responsiveness, higher productivity, and better utilization of equipment and space (Liker 2004, p.8,21).

Toyota developed and conceptualized their way of producing into what they labeled the Toyota Production System (TPS). The "Toyota way" of production was discovered by the world manufacturing community decades later with the best selling book The Machine That Changed the World, by Womack et al. (1990). Here the concept Lean Production, or just Lean, was first coined (Liker 2004, p.25). Womack & Jones (2003*a*) later wrote Lean Thinking where Lean was showed to be extendable "beyond automotive production, to any company or organization, in any sector, in any country" (Hines et al. 2008, p.4). Today concepts like Lean Logistics, Lean Software Development, Lean Service, Lean Care etc have emerged.

3.1.2 An Overview of Lean - The TPS House

Toyota illustrates TPS as a house - the TPS house, see figure 3.1. This house is also used to illustrate Lean, but is still called the TPS house. The reason a house is used, is to illustrate that the system is based on a structure, not just a set of tools and techniques. The different parts of TPS (or Lean) are intended to play in concert. It is often emphasized in literature that Lean should not be seen as a mere toolbox (Liker 2004, p.7,10,12,34; Hines et al. 2008, p.34,84)

This section will give an overview of Lean by introducing the main parts of the of the house. Some parts will be described in more detail in subsequent sections.

The Roof

The roof of the house represents the perfection you strive for; best quality, lowest cost, shortest lead time, best safety, and high morale.

The Two Pillars

There are two pillars that hold up the roof. The first pillar is *Just-In-Time (JIT)*. JIT is a set of principles, tools and techniques within Lean to achieve pull driven flows. That is, flows controlled by

[2]This was before the globalization era, when Japan and the US were two separate markets

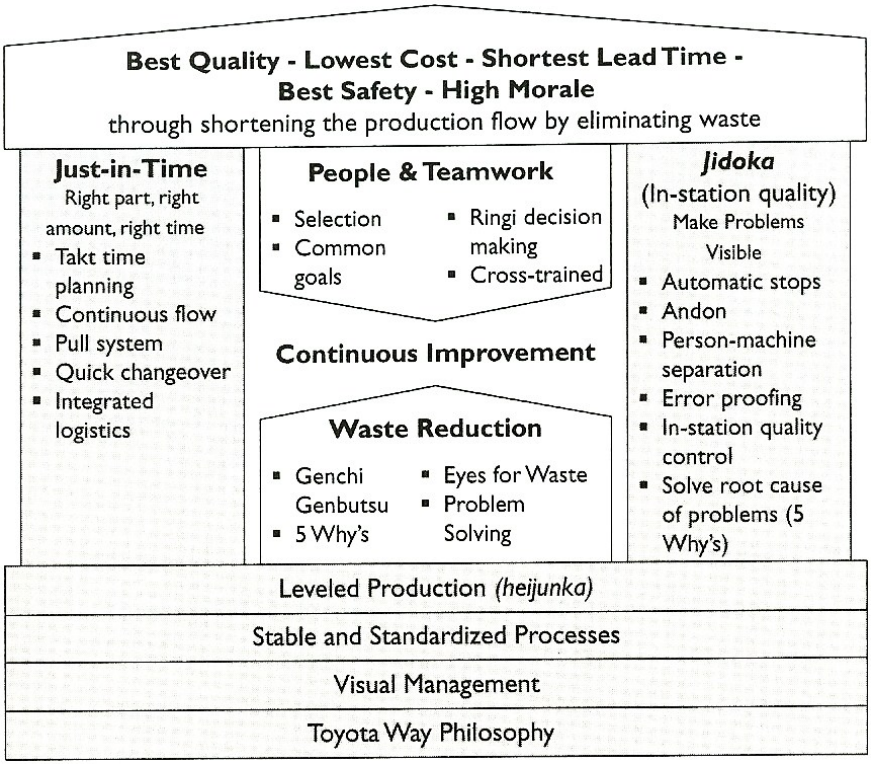


Figure 3.1: *The TPS house - a system based on a structure. Graphics source: Liker (2004)*

demand. A pull driven flow prevents over production and allows the delivery of the right products at the right time in the right amounts. Pull driven flows implies short lead times, something only possible with low inventories, which requires an evenness in flow. This, in turn, requires a stable production in small batches, even quality, and a leveled workload over time. Another effect is that cash turnover rates gets high and quality problems are automatically surfaced. The JIT properties complies well with the needs Toyota had after world war II (see the 3.1.1 Historical Background section) (Liker 2004, p.23). JIT is outlined in the 3.1.3 JIT-section.

The second pillar to hold up the roof is *Jidoka* - In Station Quality. This is a set of concepts based on the principle that all quality issues must be surfaced and addressed immediately. No defect pieces must be passed on to the next station in a flow (Baudin 2007). This can be related to the JIT pillar; with very low or no security buffers there is no room for defects. Jidoka is not outlined further.

The Foundation

The pillars rest on a solid foundation. The *Toyota Way Philosophy* largely represents a profound concern about the society, the well being of employees, and the growing of employees competence. The importance of the TPS philosophy and the company's culture, for a successful Lean transformation, is described in section 3.1.6, p.19.

The *Visual management* part of the foundation is a concept to create a clean and structured working environment, with high accessibility of information, tools, materials, documents etc that are needed in the daily operations. It promotes staff involvement and the ability to see any abnormalities at a glance. It is well aligned with the rest of Lean - it helps to surface problems, reduce waste and build morale (Liker 2004, p.150). Visual management is described in section 6.1.6, p.54.

Other parts of the foundation, on which the pillars rest, are *leveled production* and *processes that are stable and standardized*. The need for this will be discussed in the 3.1.3 JIT section.

The Heart

The heart (center) of the house is about waste reduction and continuous improvement through team work.

Waste reduction is the systematic elimination of unnecessary activities that do not add value for the customer. This must be seen in a context where the evenness of the flow and the burden on employees and equipment are equally important. Waste reduction is described in section 3.1.4, p.15.

Team work is advocated with the principle that management must move away from the traditional "command and control" behavior, and instead involve in the work on the shop floor while recognizing the value of the employee knowledge (Hines et al. 2008, p.30). This unleash creativity and enables *continuous improvement* (Liker 2004, p.112). Note how this very much relates to the *TPS philosophy*, in the foundation of the house.

3.1.3 Inventories and Just In Time - JIT

As said in the overview description of Lean (section 3.1.2), JIT is a set of principles, tools and techniques within Lean to achieve pull driven flows, i.e. flows controlled by demand. Keeping inventories low is a key measure within JIT.

Inventories can be translated to patient queues in an healthcare environment (Jacobsson 2010). By "storing" patients in a waiting room a doctor is protected against unpredicted events such as a delayed patient, which is a type of interruption in "supply". An inventory that compensate an unreliable production, unreliable supply (in time or quantity), or an unpredictable demand within the frame of the lead time, is a *security inventory*. The more variations you have, the larger this inventory must be. To reduce the security inventory, you must stabilize your production (quality included). Among other things, this requires a systematic focus on maintenance, standardized operation procedures (SOP's), and a need to continuously capture the knowledge from the ones knowing the equipment - the operators. You also need to do what you can to stabilize demand and increase the reliability of supply. Again, this typically involves a closer cooperation with both customers and suppliers.

There are also *cycle inventories* and *leveling inventories* (Lumsden 2006, p.284). A cycle inventory is what you must have to compensate production made in large batches, or uneven incoming/outgoing deliveries. See figure 3.2. Patients are not treated in batches, but the "supply" of referrals can indeed be uneven (this is shown later). For an even capacity utilization, production must be leveled over time. This is the purpose of a leveling inventory.

Large inventories have an impact on lead times, which affects the responsiveness to customers, cash turnover rates etc. Large inventories also enable a habit of not having to confront problems (Liker 2004, p.99). Moreover, with a large inventory the discovery of quality issues are easily delayed when defect units are perhaps not used in a next station for several weeks (Liker 2004, p.29,93). Gently lowering inventories surface problems that can be addressed successively. This approach is illustrated with the metaphor of the Japanese Lake (figure 3.3), where the water in the lake is the inventory and the rocky bottom represents the many problems an inventory covers. A boat crossing the lake will discover the rocks one by one if the water is lowered.

With the understanding of what inventories are, one realize however that they may never be removed completely. "Inventory buffers in the right place can actually allow for better overall flow across the enterprise." (Liker 2004, p.90)

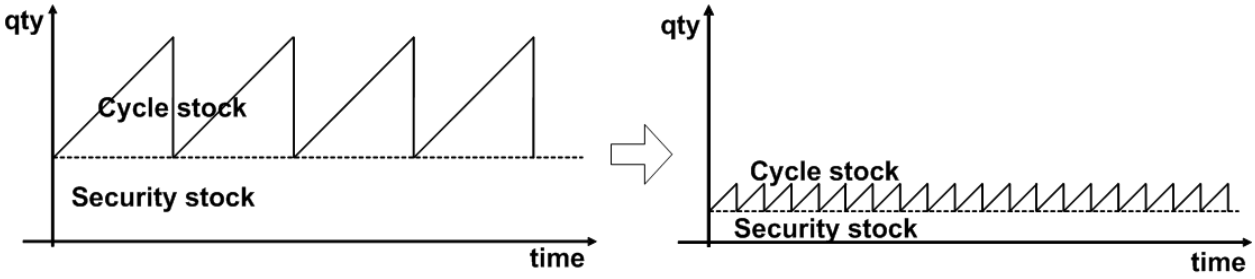


Figure 3.2: *An inventory can be divided in a cycle stock and a security stock. To minimize an inventory, the sizes of batches and deliveries must decrease. Predictability on demand and reliability of supply and production must increase.*

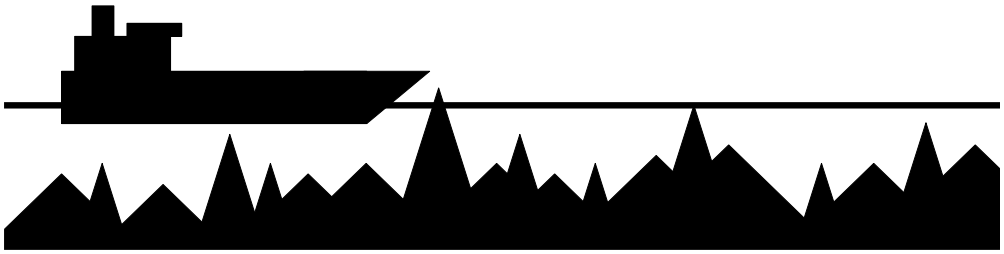


Figure 3.3: *The Japanese Lake, a metaphor of an inventory and the problems it covers.*

3.1.4 Waste Reduction and The Three M's

Lean manufacturing is mostly described as a management philosophy concerned with the systematic elimination of waste (Ahlstrom 2007), i.e. the elimination of unnecessary activities that do not add value for the customer (Monden 1983). The principle of reducing waste can be directly translated to the healthcare system (Fillingham 2007). Waste must however be understood from a systems perspective, where the evenness of the flow and a leveled burden on employees and equipment are equally important as focusing on what are value adding activities. If not, the principle of reducing waste is easily reduced to a cost reduction concept. Cost reduction was a mantra in the industry until the early 80's. Big machines and mass production through economy of scale was used to drive costs down. However, while the cost per piece in each machine was low, the overall costs were not. Quality gurus like Deming and Juran then came about and promoted how quality work can reduce cost more than cost itself (Liker 2004, p.24,25).

Within in Lean there are the so called three M's: Muda (waste), Mura (uneveness) and Muri (burden). Below these are described.

Muda (Waste)

Waste is defined as everything that do not add value to your customer (Monden 1983, Womack & Jones 2003*b*). It should be noted that the customer in this context refers not only to the paying end customer, but also the next operation downstream the flow. This is also Demings' definition of a customer (Liker 2004, p.23). Knowing what the customer wants is in fact considered the first

step to create flow (Hines et al. 2008, p.72). In this it is important to distinguish the *perceived* customer need and the *real* customer need. Hence, one must capture the "voice of the customer", VOC.

Toyota have defined seven main categories of waste. Liker (2004) who have studied Toyota for over 20 years have added an eights waste, which has been widely accepted. In Liker's own words the wastes are:

1. Overproduction
   - Producing items for which there are no orders, which generates such wastes as overstaffing, and storage and transportation costs because of excess inventory.
2. Waiting (time on hand)
   - Workers merely serving only to watch an automated machine or having to stand around waiting for the next process step, tool, supply, part, etc., or just plain having no work because of stockouts, lot processing delays, equipment downtime, and capacity bottlenecks.
3. Unnecessary transports or conveyance
   - Carrying work in process (WIP) long distances, creating inefficient transport, or moving materials, parts, or finished goods into or out of storage or between processes.
4. Overprocessing or incorrect processing
   - Taking uneeded steps to process the parts. Inefficiently processing due to poor tool and product design, causing unnecessary motion and producing defects. Waste is generated when producing higher quality products than needed.
5. Excess inventory
   - Excess raw material, WIP or finished goods causing longer lead times, obsolescence, damaged goods, transportation and storage costs, and delay. Also, extra inventory hides problems such as production imbalances, late deliveries from suppliers, defects, equipment downtime, and long setup times.
6. Unnecessary movement
   - Any wasted motion employees have to perform during the course of their work, such as looking for, reaching for, or stacking parts, tools, etc. Also, walking is waste.
7. Defects
   - Production of defective parts or correction. Repair or rework, scrap, replacement production, and inspection mean wasteful handling, time, and effort.
8. Unused employee creativity
   - Losing time, skills, improvements, and learning opportunities by not engaging or listening to your employees.

Waste must always be considered in the light of flow. For example, if waste is instead considered in the light of utilization of people and machinery, the result is typically overproduction (which is waste #1 in the bullet list above) (Liker 2004, p.8). The technique of Value Stream Mapping (VSM) helps to map flows and what actually adds value for the customer (Rother & Shook 1999). Figure 3.4 is an example of a value stream map. Note the bottom right corner, where the quota of value adding time over lead time is shown as an important KPI (key performance indicator). Also note that the total non value adding time is usually a lot larger than the total value adding time. Hence, removing non value adding activities (waste) will usually have a much greater impact on the total lead time, than if you spend your efforts improving the performance of the value adding

activities. When it comes to the value adding activities, reduction of variation is instead more important for the overall flow. But that is for the next paragraph - Mura.

Mura (Uneveness)

In the 3.1.3-section, it was discussed and shown how evenness in flow is a prerequisite for reducing inventories and shortening lead times. The smoothest flow is the most productive flow (Schmenner & Swink 1998). Sometimes the fable of the turtle and the hare is used as a comparison. The hare is fast in its spurts (like batch production), but is beaten by the turtle with its continuous move (lean) (Liker 2004, p.115).

Interestingly, unevenness (mura) is the root cause behind most waste (muda). With an evenness that allows one piece flow, almost all muda is eliminated (Liker 2004, p.31). Again it must be stressed however, that creating one piece flow by simply removing all inventories will create a very bad flow. Any unevennesses that one is not able to address, such as demand over time, must still be leveled out with inventory (Liker 2004, p.115). Conclusively: inventories must be as low as possible, but not lower.

Muri (Burden)

One could ask why inventories must always be used to level out peaks in a flow. Why cannot everyone just work a little harder on the peaks? The reason is waste. Overburden on people results in safety and quality problems. Obviously it may also have a negative impact on employees loyalty and morale. Overburden on machines results in breakdowns and defects. Just as mura (unevenness) causes muda (waste), mura (unevenness) also causes muri (overburden), which again causes muda (waste).

Reducing muri is an important part of lean management and lean culture. However, it is fair to say that as easy it is to explain and understand the concept of muri, as easy it seems to forget about it. Out of the three M's, muri is the one least mentioned and addressed. Sadly, this affects the sustainability of a Lean Transformation. For example, if people in an organization believe Lean is about reducing jobs, it is the attention to muri that has been too low (Hines et al. 2008, p.6,7).

Moreover, Toyota do not encourage to run any production at 100%, even if you could. Time must be spent on improvement work and quality work. Immediately solving problems at its source will always save time in the long run. (Liker 2004, p.130) What is encouraged is to slow down and reflect (Liker 2004, p.137,139).

3.1.5 Visual Management

Visual Management, part of the the foundation of the TPS house, is a simple but powerful concept. In the introduction of this Lean Manufacturing section (p.11), it was mentioned that a mature Lean plant is always very clean. A clean and structured working environment has a purpose beyond just being nice. It increases the accessibility of information, tools, materials, documents etc that are needed in the daily operations. If you have to spend time searching for information and various items, you get frustrated, stressed, less focused and obviously less efficient. When it comes to information, it should be highlighted that charts and graphs with KPI's are advocated to be mounted on the walls. This helps to see at a glance the status and what is going on. Moreover, Visual Management brings the ability to see any abnormalities at a glance. Thus, Visual

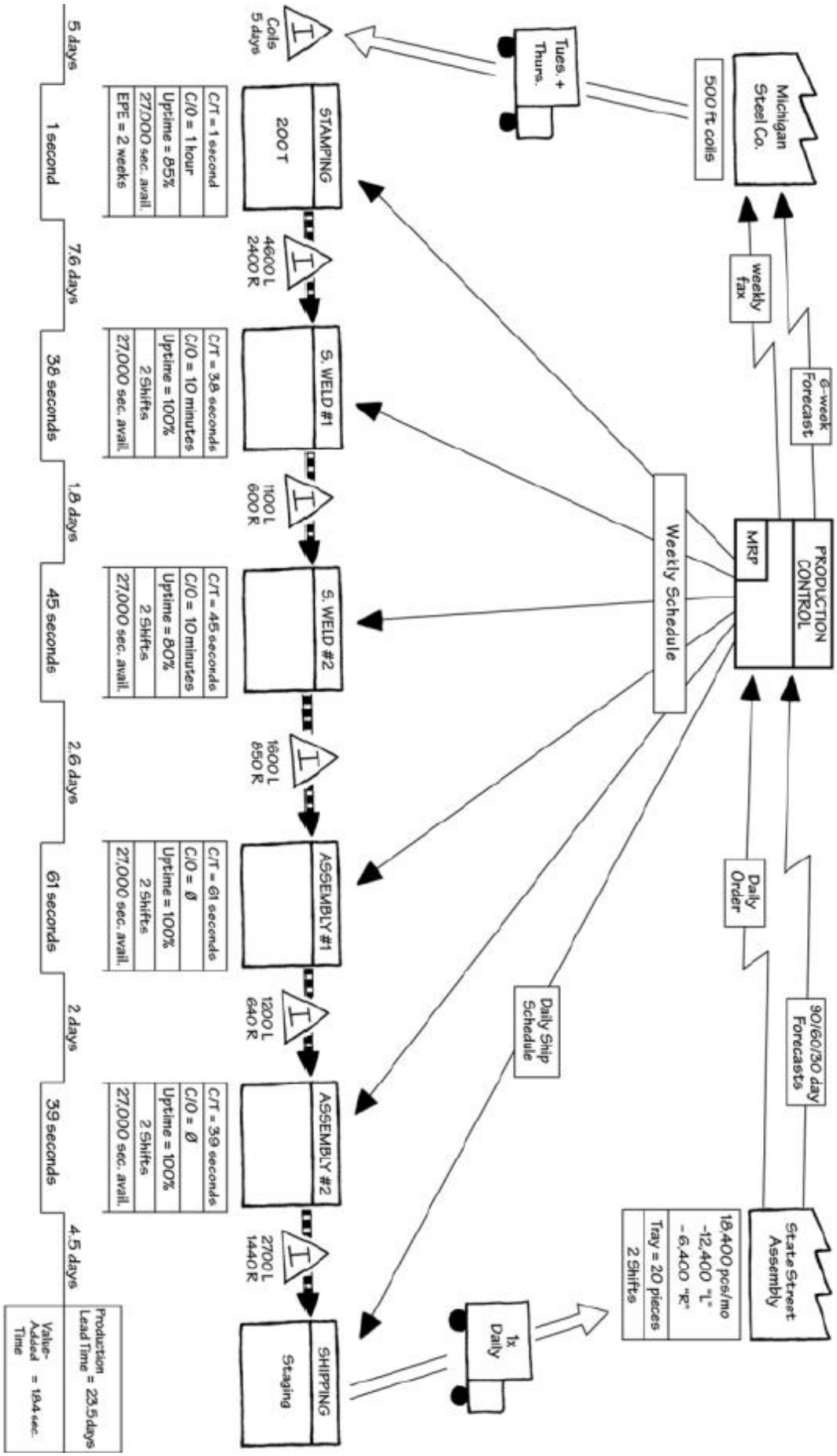


Figure 3.4: Value Stream Mapping (VSM) helps to map flows and what actually adds value for the customer. Graphics from Rother & Shook (1999)

Management is a concept well aligned with the rest of Lean - it helps to surface problems, reduce waste and build morale (Liker 2004, p.150).

Within Visual Management there is a 5 step program to support a strive for perfection - the 5S tool. The five S's (seiri, seiton, seiso, seiketsu, and shitsuke) are: (Hirano 1996)

1. Sort
   Separate commonly used items from rarely used items. Dispose what is not used.
2. Set in order
   Give everything a distinct place and put it there.
3. Shine
   Continuously clean. The very process of cleaning itself acts as a form of inspection, that may help to identify pre-failure conditions.
4. Standardize
   Create rules and standards to to maintain and monitor the first three S's.
5. Sustain
   A stabilized workplace must be set as a target for continuous improvement, in order not to gradually decline back to old ways.

3.1.6 The Lean Philosophy and the Iceberg Metaphor

Voices are sometimes raised saying "Lean is mean", or "Lean is all about working harder and producing more with fewer people". This notion of Lean may be the result of bad experiences from "Lean" projects or "Lean" consultants that have obviously failed to understand the Lean Philosophy. This sub-section will hopefully give an other picture of Lean.

A great part of lean is about leadership; growing employees, team work, self-reflection, respect for people, organizational learning, communicating strategies, long term and consistent visions, what culture is fostered in the company etc. This may sound as managerial mumbo-jumbo, but at Toyota, management really do walk the talk. Unfortunately, this is often not the case in companies who actually label themselves "Lean" organizations. Liker (2004, p.10) claims "Lean thinking based on the Toyota Way involves a far deeper and more pervasive cultural transformation than most companies can begin to imagine." Liker, who have studied Toyota for over 20 years and visited several US and Japanese Toyota plants, meeting all types of employees, also claims one theme stands out at Toyota. He states (p.71): "Every person I have talked with has a sense of purpose greater than earning a paycheck."

An iceberg model is often used to illustrate the challenges of a Lean transformation, see figure 3.5 (Liker 2004, Hines et al. 2008). The top of the iceberg, above the waterline, is what we can see. This is where all concrete tools and techniques goes. Below the waterline, which we cannot see and often underestimate, goes all company culture aspects. These are people-related areas that are crucial to address to enable true results and a long term sustainability.

As said earlier, it is very common for companies to focus only on the tools, which are above the waterline, and forget about the rest. It is also common to have an over-focus on waste (muda) reduction, forgetting about the burden (muri) on employees. If placed on the iceberg, muda and mura would arguably go above the waterline, whereas muri would go under the waterline. Muri was discussed on page 17.

Even if all concrete tools are above the waterline, one can see that many of them are in fact designed to promote a cultural change. Visual management (see p.54) is an excellent example of this. Team work and the introduction of continues improvements (see p.14) is an other example.

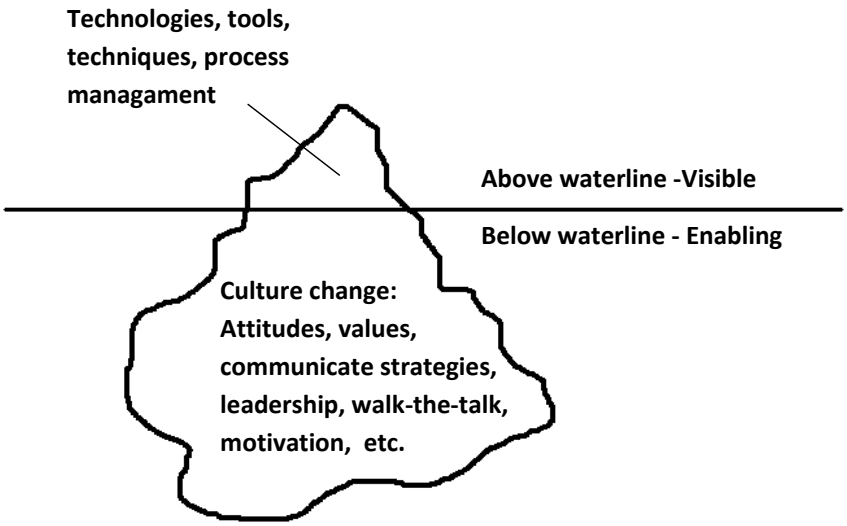


Figure 3.5: *The iceberg model, which illustrates the challenges in a Lean transformation. Most work is related to achieving a cultural transformation. (Own graphics conceptually based on Liker 2004)*

So how can the "people related areas" under the waterline be described? What actually has to be addressed for a sustainable Lean transformation? Hines et al. (2008) has identified three enabling features: (1) Strategy and Alignment, (2) Leadership, (3) Behavior and Engagement. Below, these are described. Where else is not cited, the source is Hines et al. (2008).

Strategy and Alignment

Strategy is about setting the direction for an organization, with a clear purpose and giving all employees an element of ownership. Alignment is about making everyone really understand the strategy, and communicating that everything everyone does can contribute to the success of achieving set goals. The Lean way is to create strategies that can be described and easily communicated on one A3 paper. Conceptually, this is referred to as "A3 thinking", a concept part of Visual Management (Hines et al. 2008).

Liker (2004) has identified the number one principle of the Toyota (i.e. Lean) way as "Base your management decisions [including strategies] on a long-term philosophy, even at the expense of short-term financial goals." As part of Toyotas long-term philosophy, the well being of employees and a contribution to society is prioritized. It is simply expected to pay off in the long run. Table 3.1 makes a comparison of the company mission for Toyota Motor Manufacturing in North America and the Ford Motor Company. Toyota mention the contribution to society first. The well being of team members is then mentioned before Toyota's overall growth. Compare this to Ford - the table speaks for itself.

Leadership

Poor leadership is indeed what prevents sustainability. A review of a number of UK manufacturing and distribution organizations, shows the major issues for Lean sustainability failures are:

Table 3.1: *Toyota's mission vs. Ford's (Liker 2004, p80).*

Toyota Motor Manufacturing North America	**Ford Motor Company**
1. As an American company, contribute to the economic growth of the *community* and the United States. 2. As an independent company contribute to the *stability and well being of team members*. 3. As a Toyota Group company, contribute to the *overall growth* of Toyota by adding value to our customers.	1. Ford is a world wide leader in automotive and automotive-related products and services as well as in newer industries such as aerospace, communications, and financial services. 2. Our mission is to improve continually our products and services to meet our customer's needs, allowing us to provide a reasonable return to our stockholders, the owners of our business.

1. Lack of a clear executive vision
2. Lack of an effective communication strategy
3. Failure to create and communicate a real sense of urgency
4. Poor consultation with stakeholders
5. Lack of structure methodology and project management
6. Failure to monitor and evaluate the outcome
7. Failure to mobilize change champions
8. Failure to engage employees
9. Absence of a dedicated and fully resourced implementation team
10. Lack of sympathetic and supportive Human Resources policies

If boiled down, poor management for a Lean transformation is a command-and-control style, where directives are delivered top-down and people are expected to simply "follow the rules". If instead, a mental model of bottom-up empowerment is used, which encourages staff driven improvement, engagement, team work etc, that will pave the way for sustainability. To build a learning organization the leader must also have an in-depth understanding of the work and walk the talk. In that way he/she can guide and coach the work instead of just being a facilitator empowering the employees.

Behavior and Engagement

This part is about how people can be engaged in a Lean transformation and motivated to adopt Lean behaviors. With engagement on all levels, for continues improvements and waste reduction, an organization becomes "self-propelling" - able to sustain it self.

Resistance to change, arguably the opposite of engagement, can be described in four categories:

- Organizational resistance
  The organization fears loosing control and ownership when something is "not invented here".

- Political resistance
  Change is seen as a threat to status quo. Arguably an expression of conservatism.
- Individualized resistance
  Resistance questioning "what's in it for me".
- Technical resistance
  This is the most common form of resistance; what is not understood is resisted.

Regarding behaviors, this involves a change of the culture in an organization. Examples of non Lean behaviors include blame, ego, cynicism, distrust, sarcasm, subjectivity, ambiguity, insincerity, and negativity. Lean behaviors are: trust, honesty, respect, openness, consistency, observation, reflection, listening and objectivity.

3.2 Six Sigma and its Relation to Lean

The purpose of this section is to give a brief description of Six Sigma, and put it on the map in relation to Lean Manufacturing.

The driving force behind the development of Six Sigma was a need for quality improvement at Motorola, where products in the mid 80's were getting an increasingly larger number of components, eroding the share of non-defective final products. Consider the following: With a product of 1000 components, they represent 1000 opportunities for defects (OFD's). If the quality rate of each component is 99.9%, the overall probability for a non-defect product is $99.99^{1000} = 37\%$. For an acceptable share of non-defect products, it was established that for a typical product, the quality conformance of each component would have to be six standard deviations (6σ) within specification limits, which corresponds to 3.4 non-conforming parts per million (NCPPM) (Arnheiter & Maleyeff 2005, p.7). See figure 3.6.

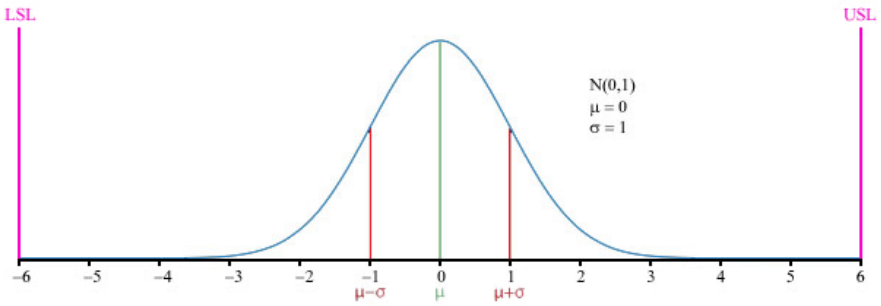


Figure 3.6: *Normal ditribution curve where 6σ is within the specification limits. USL=upper specification limit, LSL=lower specification limit. Graphics: Wikimedia Commons, public copyright.*

To reach this goal, Motorola created and labeled the concept Six Sigma. Arguably, it is to a great extent a bundling of the existing quality programs of TQM (total quality management) and SPC (statistical process control). Nor TQM or SPC will be described here, they are just mentioned as an historical reference.

Six Sigma is a very data driven and evidence based management program. It sees the result and stability of a process (Y), as a function of a set of Key Process Output Variables (X), KPOV's (Wedgewood 2007, p.257). See equation 3.1.

$$Y = f(X_1, X_2, ..., X_n) \tag{3.1}$$

Hence, the KPOV's are the sources of variation that must be investigated and adjusted to obtain a stable process. To support this, Six Sigma makes use of a host of statistical and managerial quality tools like control charts, cause-and-effect diagrams, Pareto charts, affinity diagrams, prioritization matrices, process decision program charts and more (Arnheiter & Maleyeff 2005, p.7).

Six Sigma advocates a methodology for process improvement that is very structured and disciplined. It shall be carried out in improvement teams with certain clearly defined roles and follow a five step cycle referred to as DMAIC. In the words of Dahlgaard & Dahlgaard-Park (2006, p.271) the steps are:

1. Define
   Identification of the process or product that needs improvement.
2. Measure
   Identify those characteristics of the product or process that are critical to the customer's requirements for quality performance and which contribute to customer satisfaction.
3. Analyze
   Evaluate the current operation of the process to determine the potential sources of variation for critical performance parameters.
4. Improve
   Select those product or process characteristics which must be improved to achieve the goal. Implement improvements.
5. Control
   Ensure that the new process conditions are documented and monitored via statistical process control methods (SPC). Depending on the outcome it may become necessary to revisit one or more of the preceding phases.

Successful applications of Six Sigma, made in a variety of industries, are well documented in literature. (Pepper & Spedding 2010, p.144) Proponents of Six Sigma claim Six Sigma is today more than just a quality system - it is a comprehensive business management philosophy/strategy (Näslund 2008, p.272).

At the same time Six Sigma is sometimes criticized for not having a system view. Some arguments are that it has (1) too much of a top-down approach and fails to create conditions where everyone in an organization is involved, (2) that improvements are often made department-wise without the consideration of overall flow, and (3) that Six Sigma projects are only started if expected earnings can be shown, which can lead to sub-optimizations (Andersson et al. 2006, p.293). Moreover, or perhaps consequently, Six Sigma has been criticized for not being a sustainable improvement technique (p.145 Pepper & Spedding 2010, Arnheiter & Maleyeff 2005, p.6).

Lean separates from Six Sigma in a number of ways, see examples below. Whether the differences are contradicting or complementing is left for the reader to judge.

- Arguably, Six Sigma does not have the same system view, as discussed above. In fact, the scope is completely different.

- With Lean, no detailed cost-benefit analysis is expected when implementing something to improve flow (Liker 2004, p.90,112).
- Lean has no disciplined methodology to follow. Instead it relies on a number of principles and is more analytical to its nature (Andersson et al. 2006, p.291, 292).
- Toyota makes use of very few statistical tools. Instead the power of simplicity is advocated. Quality specialists have four simple tools: (1) Go and see, (2) Analyze the situation, (3) Use one-piece flow and Andon (a Jidoka tool) to surface problems, and (4) ask "why" five times (Liker 2004, p.135).
- As discussed earlier (see 3.1.2 and 3.1.6), Lean has a strategy of involving everyone in improvement work, as a core part of the management philosophy. This is reflected in tools and techniques.
- Lean advocates in-station quality (Jidoka), meaning continues inspections. Six Sigma is about acceptance sampling of final products. In the case of poor quality, this results in high internal failure and low external failure for Lean, whereas the opposite is true for Six Sigma (Arnheiter & Maleyeff 2005, p.11).

A fairly new concept is Lean Six Sigma (Andersson et al. 2006), based on the idea of combining the best of two worlds (Liker & Hoseus 2008, p.4). This idea is not new, General Electrics early believed that Six Sigma and Lean complement each other since Lean manufacturing primarily address process flow and waste, whereas six sigma primarily address variation and process design (Magnusson et al. 2003 as cited by Andersson et al. 2006, p.293-294). Arnheiter & Maleyeff (2005, p.5) means that both concepts alone are likely to fail. For example, they argue (p.13) that Lean has a lot to gain from using more data in decision processes. In contrast, Liker & Hoseus (2008, p.4) makes a clear statement when discussing the topic: "The [Six Sigma] charts and graphs look great in the conference-room presentations, but the reality of the shop floor [in a Lean Six Sigma plant] is far from the TPS ideal." There are several books written on the subject of Lean Six Sigma, but there is no uniform definition of the concept. Andersson et al. (2006) concludes that more research is needed regarding when and how the different concepts are feasible, along with a description on how they are practically supposed to work together.

4. Main case: The Department of Surgery at KSS Skövde

Note
This case, as well as the reference case, is part of the empirical data framework to answer the generic research question. Hence, the purpose of this case is not to provide a customer specific recommendation, nor to make a customer specific analysis.

This is the case of an improvement project for a better patient flow at the dept. surgery at the Kärnsjukhuset hospital (KSS) in Skövde, part of the Skaraborg Hospital Group (SkaS), in western Sweden. The SkaS and KSS organizations are introduced in the 4.1 Organization section. Here, the dept. surgery is also described.

KSS and the rest of SkaS are struggling with long patient queues and have issues with health care guarantees not fulfilled. SkaS also need to reduce their budget by 200 MSEK to maintain a financial balance, for the next three years. Moreover, for the next decades a greater load is expected, while resources are expected to decrease. Great efforts have been made within SkaS (KSS included) since 2004, to implement various process oriented quality improvement programs. The history of this, and where SkaS is heading today, is described in section 4.2.

Case details are given in the 4.3 Case Description section. This includes a definition of the project purpose and goal, how the project was performed, and who were involved. Background statistics on queues and more are also given.

The project represents an investigation of the patient flow from referral to surgery. The current process is described in the 4.4 Process section.

Section 4.5 present the findings from the improvement project, where most sub-sections correspond to process steps.

Finally, the 4.6 Action Point section presents a list of actions the improvement team have decided to be taken as of the end of May 2010.

Note that from the perspective of the iceberg metaphor (section 3.1.6 p19), this chapter mainly addresses above waterline issues. Aspects below the waterline are discussed in the 6 Analysis chapter.

4.1 Organization

4.1.1 The Skaraborg Hospital Group (SkaS)

The Skaraborg Hospital Group (SkaS) is part of the Swedish Västra Götaland County. It consists of four hospitals in four cities: Mariestad (SiM), Skövde (KSS), Lidköping (SiL) and Falköping (SiF). The hospitals together provide emergency care and planned care for 260,000 habitants within most specialties. The county, together with SkaS and the county primary health care, are responsible for the complete chain of health care, where the patients are dependent on all stakeholders in the process (Lifvergren 2008*b*, p.11).

The SkaS Hospital Group has a turnover of three billion SEK and handle 19,300 surgical procedures annually. There are 4700 employees and 700 beds. Vertically, there are four divisions in the group, headed by division managers: (1) Medicine and Psychiatry, (2) Surgery, (3) Women and Child Care, and (4) the Lidköping Hospital. Each division has a number of departments, led by a clinical manager. The executive officer of the four hospitals and the four divisions is the hospital director (Hellström et al. 2010, p.4,5).

4.1.2 The Kärnsjukhuset Hospital in Skövde (KSS)

The KSS hospital is the largest hospital in the SkaS group, with 500 beds, 3200 employees and 16 surgery theaters.

It should pointed out that SiF (Falköping) have no surgeons of their own. Surgeons at SiF are staffed with surgeons from KSS. All other staff at SiF, including surgery planners, are their own. There are 4 surgery theaters at SiF, for outpatient surgery only. It sometimes makes sense to study KSS and SiF as one unit.

4.1.3 The KSS Department of Surgery

The dept. surgery at KSS is divided in four teams[1], covering four medical areas: (1) Section for gastro intestinal surgery, (2) Collerectal section, (3) Section for breast and endocrine surgery, and (4) Section for vascular surgery. Refer to appendix A for a listing (in Swedish) of the different teams and the type-operations they are responsible for. Note that some type-operations are not team specific.

Each team is basically a set of surgeons. Every team also has its own surgery planner. However, nurses do not belong to a specific team. The same goes for anesthesia personnel who provided through a separate department.

In total, there are 30 surgeons at the dept. surgery. Regarding surgery planning there is also one common detail surgery planner, responsible for the coordination of all resources and all operations. This will be discussed later.

[1] In Swedish the teams are (1) Övre Gastro, (2) Nedre Gastro, (3) PEBB, and (4) Kärl

4.2 History of Process Improvement Efforts

Source Information:
This section is based on information from Lifvergren (2008*b*), Lifvergren (2008*a*) and Lifvergren (2009), where else is not cited.

There is a long tradition of quality improvement work at SkaS. The concept of processes made its entrance in the late 90's. Hence, it was at this time the patient's journey was first considered. Comprehensive education efforts were taken within the field of process improvement work. As a result, many successful improvement projects were made, but there was a sustainability problem. A lot of time was spent on process mapping, but the projects rarely reached the goal of a "sustainable solution". According to SkaS, research have shown this to be a common experience in Swedish hospitals.

Balanced Scorecards (BSC) were introduced in 2003. In essence, the BSC is a performance measurement system that "...aims to clarify an organization's vision and strategy and translate them into tangible objectives and measures." (Radnor & Lovell 2003, p179) This gave SkaS an insight of the importance of a long term strategy.

An all-embracing strategy labeled Offensiv Verksamhetsutveckling[2] was set in 2004. See figure 4.1 for its basic principles. At SkaS, the strategy is considered equal to Lean Manufacturing, with reference to Bergman & Klefsjö (2007, p622-629), and the terms are even used interchangeably. For the sake of simplicity this report will stay with the term Lean.

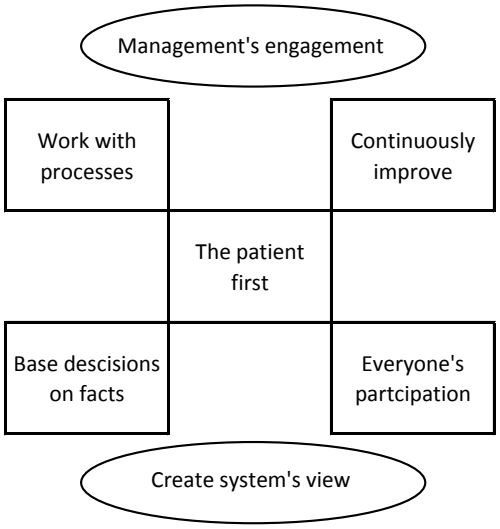


Figure 4.1: *The basic principles of Offensiv Verksamhetsutveckling, which is considered equal to Lean at SkaS.*

Late 2004, Six Sigma was also introduced, which was not considered to contradict Lean. The scientific and data driven approach of Six Sigma appealed to doctors and nurses. A massive education program in Six Sigma have produced >4000 employees with Six Sigma skills on different levels. Although Six Sigma has proven very powerful in many implemented projects, the experience according to SkaS is that it lacks some instruments to work with the complex flows of an healthcare organization. Lean is seen as a way to reduce complexity with its concept of focusing on what is value adding in a flow (process). Moreover, it has been found that the role of Six Sigma project

[2]Offensiv Verksamhetsutveckling literally translates into "Offensive Activity Development"

leaders (often a so called Six Sigma Black Belt) must be reduced since it brings too much of a top-down approach. The role of the team members must be increased and the fundamental values and principles of Lean must be applied to a greater extent. The overall strategies (Lean) must be communicated in the organization. However, a data-driven approach to process improvement and evidence based decisions are still strongly advocated.

4.3 Case Description

4.3.1 Purpose and Goal

The case studied is a an improvement project initiated in spring 2010 for the department of surgery at the Skövde hospital, Kärnsjukhuset (KSS). The purpose of the project is to improve the flow through the department to reduce long patient queues and help reduce stress and frustration that personnel experience with todays way of working. The concrete goal of the project is that "**The patients' journey from referral to treatment shall be no longer than 90 days**". Note that the health care guarantee is 90 days from referral to doctor's visit, and another 90 days from doctor's visit to treatment.

The project covers all medical conditions, but it pays extra attention to a specific condition - Inguinal Hernia[3]. This condition is one that is notorious for not living up to the healthcare guarantee. Next sub section presents some basic statistics on Inguinal Hernia.

4.3.2 Statistics on Inguinal Hernia

Inguinal Hernia repair is the most common surgical procedure, as seen in figure 4.2. The share of operations that need a next visit is very low. Even in absolute numbers, despite the frequency of the condition, it counts for very few next visits. See figure 4.3.

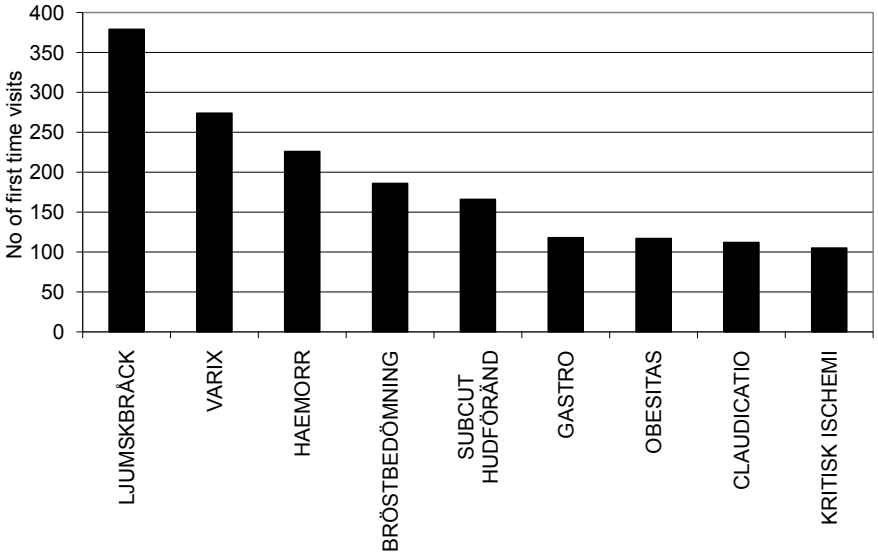


Figure 4.2: *Top 50% reasons of all first visits 2009 at SkaS. "Ljumskbråck" is Inguinal Hernia. There are 88 reaming reasons, that represent another 1600 first visits.*

[3]Inguinal Hernia, for the Swedish reader: Ljumskbråck

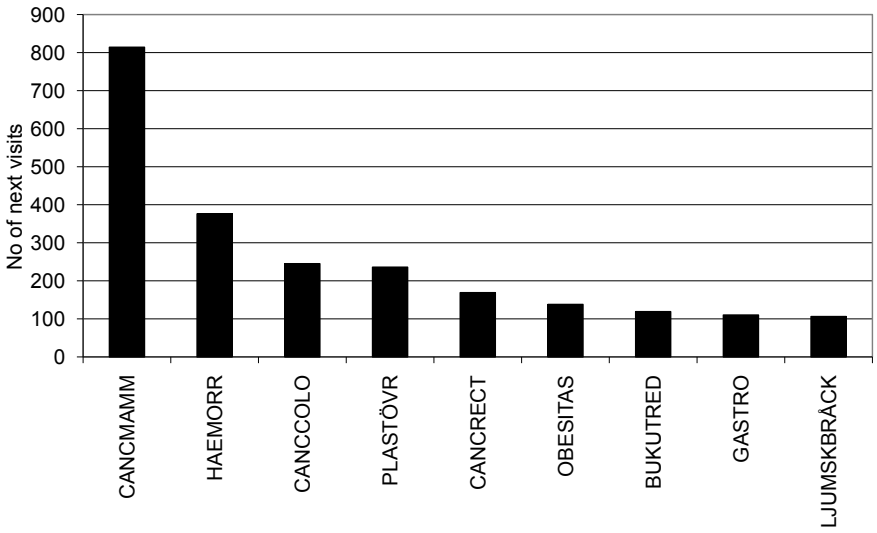


Figure 4.3: *Top 50% reasons of all next visits 2009 at SkaS. "Ljumskbråck" is Inguinal Hernia. There are 89 reaming reasons, that represent another 2600 next visits.*

From a medical perspective, the county principle is that Inguinal Hernia is (almost) always operated. It is however among the very lowest prioritized conditions. Simply put, emergency cases and cancers represent the big volumes prioritized higher. It should be noted that there are also emergency cases of Inguinal Hernia, but these are fairly rare.

The combination of high frequency and low prioritization of Inguinal Hernia, explain why queue problems in the system first tend to arise for this condition. The current queues for Inguinal Hernia early spring 2010 are shown in table 4.1.

Table 4.1: *Production of Inguinal Hernia repairs for January and February 2010 at SiF and KSS, including current queues. The row "queue >90 days" refers to the queue violating the national healthcare guarantee.*

	Jan.	Feb.
SiF Planned	21	42
SiF Result	10	26
KSS Planned	12	24
KSS Result	4	11
Queue > 90 days	34	44
Total queue	139	141

The results were poor for these two months, given the planned production. 66 operations were planned but only 37 were performed. However, there is no trend of the queues growing on a yearly basis. Nor did the total queue grow much during these two months. Hence, the planned production was not very accurate. The queue is basically steady state high, with a balance in the incoming flow and the output. Roughly, 340 Inguinal Hernia operations are made every year.

4.3.3 The 10 Step Model and the Improvement Team Setup

The improvement cycle was and is performed following a 10 step model, below. These steps are designed/identified as the required steps for any sustainable improvement effort (Magnusson et al. 2003 as cited by Lifvergren 2008*a*) At SkaS this is the "standard procedure" of all improvement projects (Lifvergren 2008*a*). This study covers step 1-5 of the project.

The ten step model (own translation):

1. Appoint process owner(s), steering committee, process leader and process team for the process.
2. Define the process; who the process creates value for, where it starts and where it ends.
3. Prove and define the a need of improvement by mapping the process current state and development areas.
4. Measure, verify and understand the need of improvement.
5. Analyze and find possible solutions.
6. Test and evaluate possible solutions and implement the best solution.
7. Secure, spread, and document the improvement.
8. Establish a development plan for the process.
9. Implement a system for management follow-up and conform the process to the organizations balanced scorecards.
10. Implement continuous improvements of the process from given targets and measures.

Regarding step 1, "Process owner", "Steering committee", "Process team" etc, are all Six Sigma pre-defined roles for the improvement team. The process improvement team was formed to be cross functional and cross professional. The complete team setup is shown in table 4.2

4.4 The Process

When defining and mapping the process, it was made for the treatment of Inguinal Hernia. However, the processes of treating other conditions are basically the same.

4.4.1 SIPOC

The process boundaries are defined in a SIPOC[4] diagram, see figure 4.4. All stakeholders in terms of customers and suppliers, along with corresponding process input and output, are identified. This is the outcome of step 2 of the 10 step model (see 4.3.3, p.30).

Note that in the remainder of this report the concept of *suppliers* is frequently used. Then recall that the definition of a supplier was made in the SIPOC diagram.

[4]SIPOC is a Six Sigma tool. It is an abbreviation for Suppliers, Inputs, Process, Outputs, and Customers.

Table 4.2: *The improvement team setup. The roles follow Six Sigma standards.*

Role	Position
Assigner	- Surgery division manager (anaesthesiologist)
Process owner	- Surgery department manager (cheif physician)
Steering commitee	- The assigner (see above) - The process owner (se above) - Chalmers Logistics Professor (external) - Department manager of the anaesthesia clinic
Process leader	- Activity developer (nurse) - Cheif physician in vascular surgery and phd student in Quality Driven Improvements
Process team	- Operations coordinator and detail planner for all departments (nurse) - Dept. manager at SiF. - Collerectal section team planner - Cheif physician in vascular surgery - Economist and Six Sigma black belt - Resident doctor - Cheif physician in team for gastro intestinal surgery (former surgery dept. manager) - Team manager collerectal section (cheif physician) - Dept. manager for dept. 71-72 (nurse) - Dept. Manager for the surgery reception (nurse) - Chalmers Logistics Msc student (the author of this report)

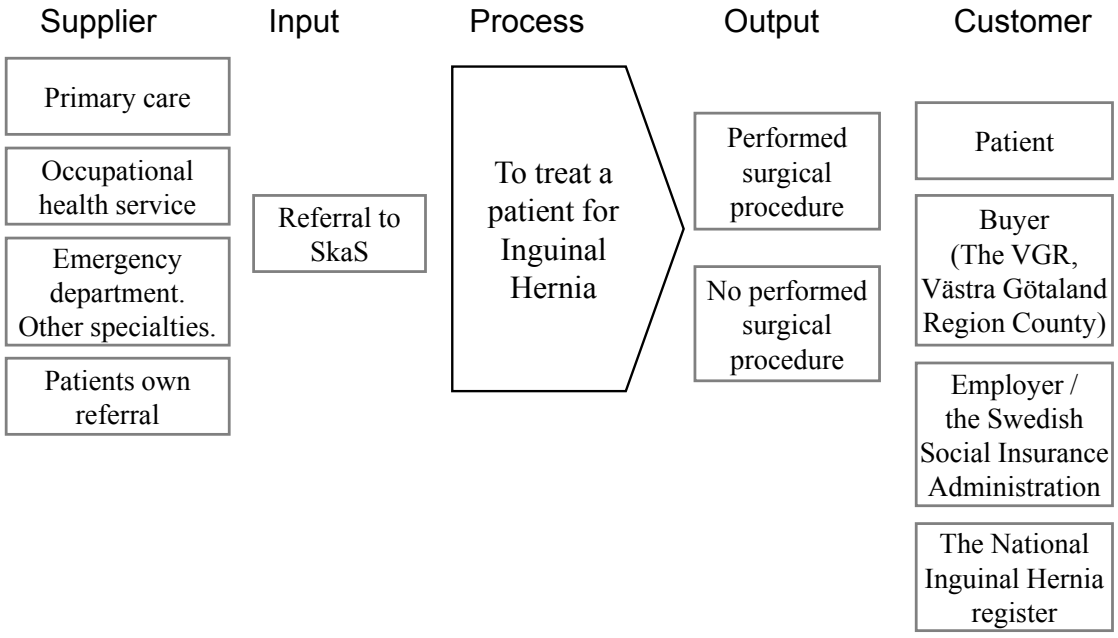


Figure 4.4: *SIPOC diagram defining the boundaries for the process of Inguinal Hernia treatment.*

4.4.2 Process Map

The process itself has been mapped as one main process with two sub-processes. See the process map, figure 4.5. Below, the process is described. The process map is part of the outcome of step 3 of the 10 step model (see 4.3.3, p.30).

Main process:

Step 1 The patient visits a primary care unit or other "supplier" as defined in the SIPOC (figure 4.4). Here the doctor makes a medical evaluation, which may lead to a referral to the KSS hospital.

Step 2 When the referral is received at KSS it is reviewed by a doctor. An estimate is that for Inguinal Hernia less than 4% are rejected.

Step 3 A notice for a doctor's visit is sent to the patient. If the time does not suit the patient, then he/she will have to contact KSS for another time.

Step 4 At the doctor's visit, the patient is examined. Most often, there is a decision for surgery. An estimate is that for Inguinal Hernia, the diagnose is only incorrect in less than 4% of the cases. An additional investigation with for example x-ray may be needed.

Step 5 The patient is put on a waiting list and is then scheduled and noticed for surgery according to the surgery planning sub-process.

Step 6,7 The patient is operated, mostly with outpatient surgery, but depending on the patient's physical condition, inpatient surgery may be needed. For Inguinal Hernia the outpatient surgery represent about 90% of the volume, and the inpatient surgery represent about 10%.

Inpatient surgery sub-process:

Step 6.1 The registration visit takes place about 1-2 weeks before the planned surgery. The purpose is to assure the patient's physical condition is strong enough for surgery.

Step 6.2 At least one day ahead the patient stays at the care unit for supervision.

Step 6.3 Operation

Step 6.4 One day or more the patient stays at the care unit for supervision and aftercare.

Surgery planning sub-process:

Step 5.1 All patients are put on a waiting list in an IT planning system, Orbit. (manually entered)

Step 5.2 Based on waiting lists and the doctors' schedules, a team-specific planner makes a draft surgery plan (a suggestion), for approx. 1.5-2 weeks ahead of time. Note that Inguinal Hernia repair is not a team specific operation - it is a shared responsibility among all teams. However, the planning is made by the Nedre Gastro team planner.

Step 5.3 Every Wednesday each team has a planning meeting with the team planner. The draft plan discussed is adjusted. Beside this meeting, the team planner of Nedre Gastro also contacts other teams to see what Inguinal Hernia surgical procedures they can do. Note that at this stage, it is not yet known which patients will be operated for Inguinal Hernia. For other operations like different types of cancers, the patient is obviously known.

Step 5.4 The planner makes the agreed adjustments in Orbit.

Step 5.5 The patients are sent a notice. If the time for notice is too short, the patient is phoned. Note that the planner has a separate list of patients that have declared they can come in for surgery of Inguinal Hernia with short notice.

Step 5.6 A surgery planner common to all teams, takes the plan from each team planner and makes a detailed surgery plan. This plan include a complete coordination of resources and it defines the expected start and finish times for certain sub-tasks within each operation.

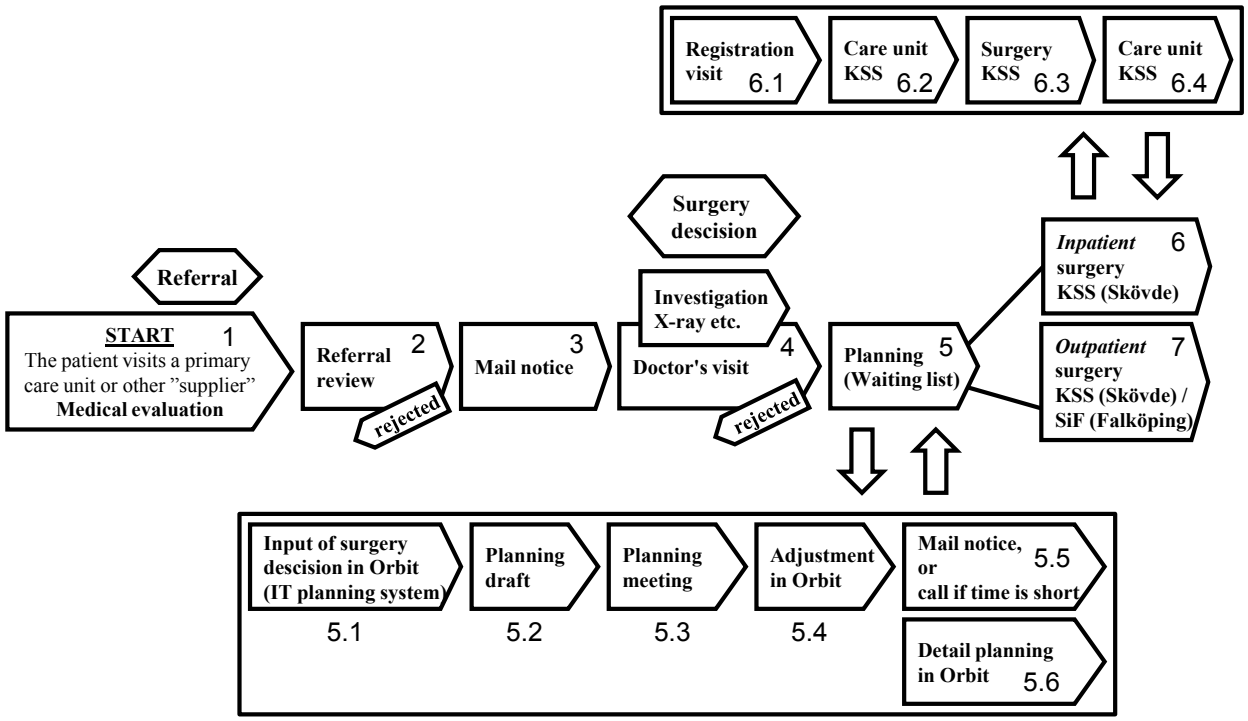


Figure 4.5: *The process steps (numbered) of treating Inguinal Hernia. The processes of treating other conditions are basically the same.*

4.5 Outcome of the Improvement Team's Work

Early on, several hypothesis were put forward to explain the long queues for Inguinal Hernia. These were categorized in a fishbone diagram, which can be seen in Appendix B, p.71. This diagram can be seen as part of the outcome of step 4 of the 10 step model (see 4.3.3, p.30).

Categorized in sub-sections corresponding to different process steps, this section will go through a selected set of key topics that have been investigated or discussed. Some of the topics need further investigation. **This is the current outcome at the time of writing**, of step 4 and 5 of the 10 step model (see 4.3.3, p.30). It should be noted that the last sub-section (4.5.5) discusses a topic that does not correspond to any certain process step - the doctor's schedules.

4.5.1 Referrals Review (Process step 2)

Uneven Flow and Unknown Demand

The number incoming referrals vary greatly from week to week. Figure 4.6 shows the number of referrals, for all conditions, that came to KSS during 2009.

The weekly variations are believed not to be natural. It is simply not possible that the population would be 100% more ill week 22 compared to the week before. Hence, this does not reflect the actual demand. It is a variation somehow caused by the suppliers.

The actual weekly demand is in fact very stable, a chief physician claims, and refers to a very even load at the emergency department, as a comparison. 65% of all beds, and 20% of the operating theaters, are constantly occupied with emergency patients. These numbers never tend to vary.

However, the demand do vary from year to year. The yearly demand is very much unknown which is a problem when budgeting resources. Politicians order operations based on last year's statistics and the current queue. This is known to never add up correctly. Reasons that has been put forward, for the yearly variations in demand, or the variation in incoming referrals, are:

- The year cohorts vary. When a large year cohort reach a certain critical age for a specific condition, there is a "boom" for that condition.
- Political decisions tend to affect the flow of referrals. For example the privatization of primary healthcare providers as well as the right to choose healthcare provider.
- Changes in the medical guidelines (criteria) on when to treat or even diagnose a condition.

As mentioned in section 4.3.2, the demand for Inguinal Hernia operations is believed to be approx. 340 (yearly). It can also be shown that the queues are not growing on a yearly basis. Hence, there is currently a balance in production and demand.

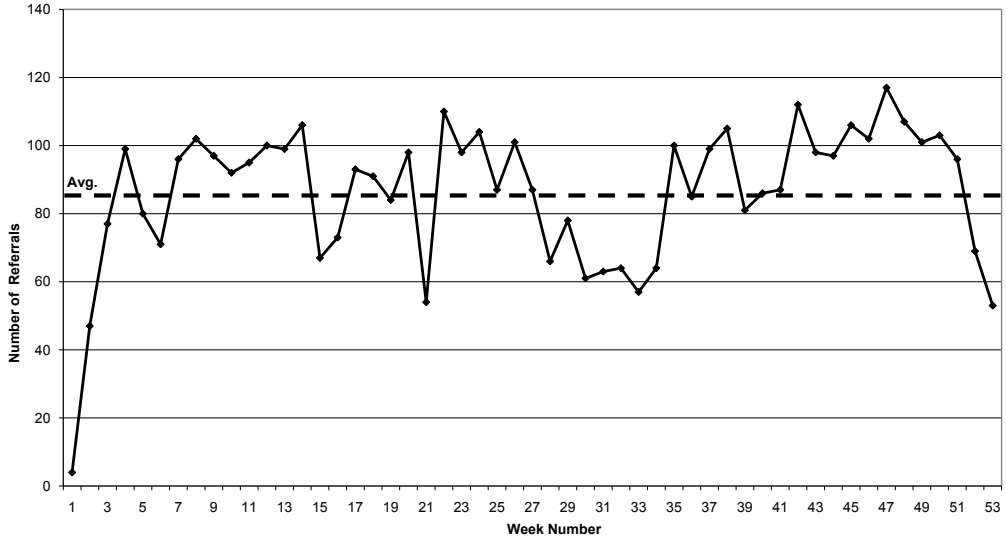


Figure 4.6: *Incoming referrals to KSS per week, 2009.*

Skip the Referrals Review Process Step

Discussions were held whether the referrals review process step can in fact be omitted for certain conditions like Inguinal Hernia. For Inguinal Hernia the share of referrals that lead to a doctor's visit is estimated >96%. If cooperating with the primary care units, this number could arguably be even higher, which would then justify to skip this process step. This action is however left as a future potential measure to shorten the overall lead time for the patient.

Quality of Referrals

The total number of referrals (all conditions) 2009 were 4569 and out of these 3243 led to a doctor's visit. Hence, approx. 30% of all referrals were returned. This issue remains to be further investigated / addressed.

However, as described in the 4.4 Process section, only <4% of the Inguinal Hernia referrals are estimated to be returned.

4.5.2 Doctor's Visit (Process step 4)

Uneveness in Doctors' Visits

As for the incoming referrals, there is also a great variation in doctor's visits per week. See figure 4.7. This is believed to be caused by an uneven staffing of doctors. See section 4.5.5 for more information.

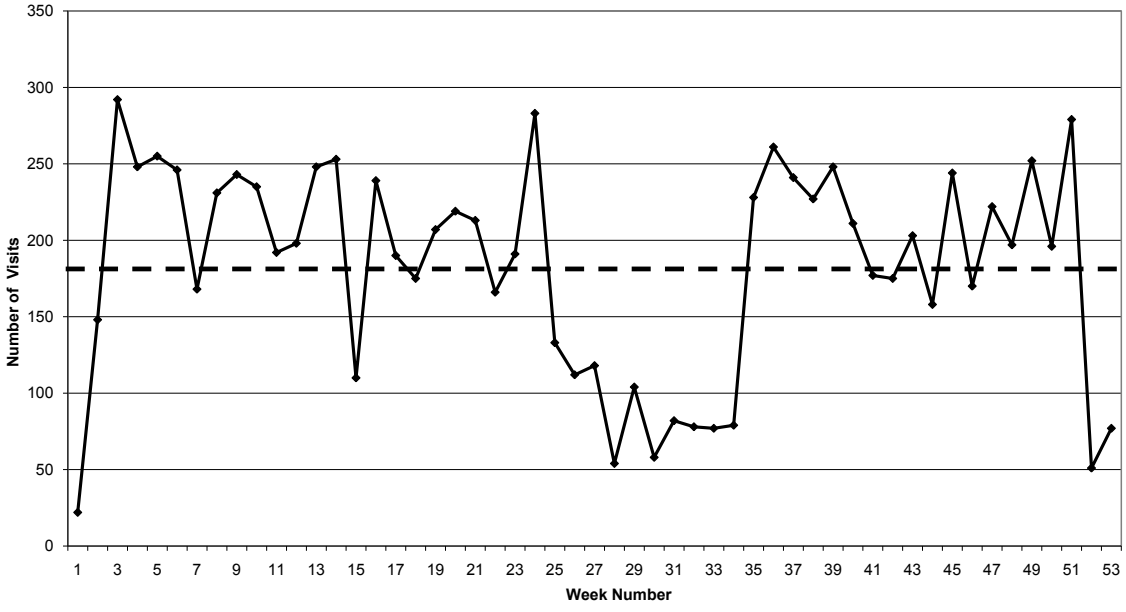


Figure 4.7: *Doctor's visits per week 2009, both first visits and next visits.*

Skip the Doctor's Visit Process Step

As for the referrals review process step, it has been discussed whether the doctor's visit process step can in fact be omitted for certain conditions like Inguinal Hernia. For Inguinal Hernia the share

of surgery decisions is estimated >96%. If cooperating with the primary care units, this number could arguably be even higher, which would then justify to skip this process step.

This action is however left as a future potential measure to shorten the overall lead time for the patient.

4.5.3 Surgery Planning (Process step 5)

Uneveness in Surgery

As for both the incoming flow of referrals and the doctor's visits, there is a great variation in surgery over time. Figure 4.8 shows the number of Inguinal Hernia operations per week during 2008-2009.

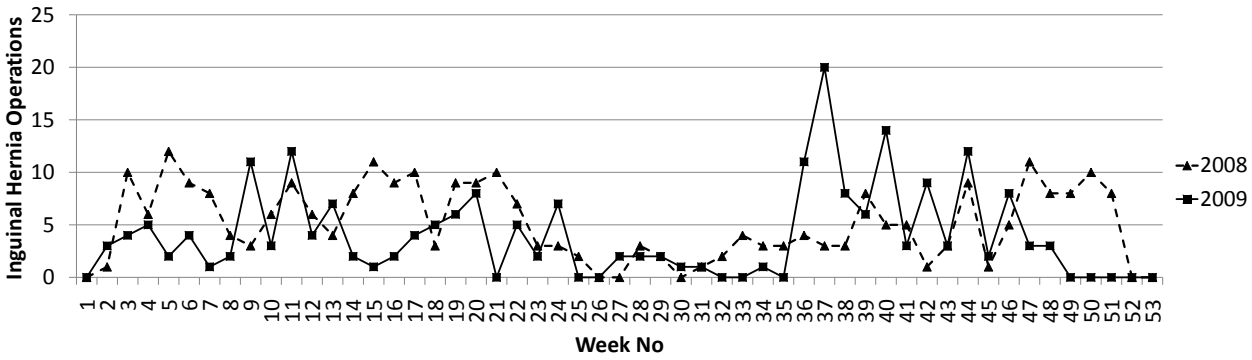
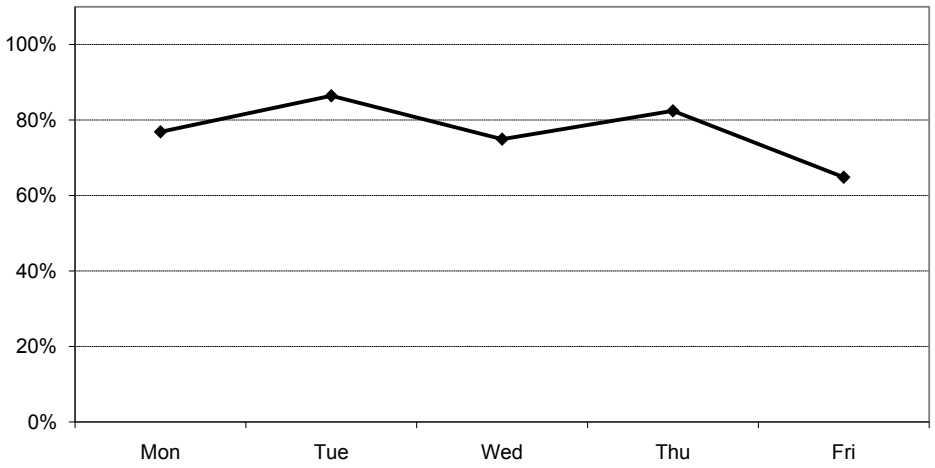


Figure 4.8: *Inguinal Hernia surgery at KSS, for 2008 and 2009.*

Operating Theaters Resource

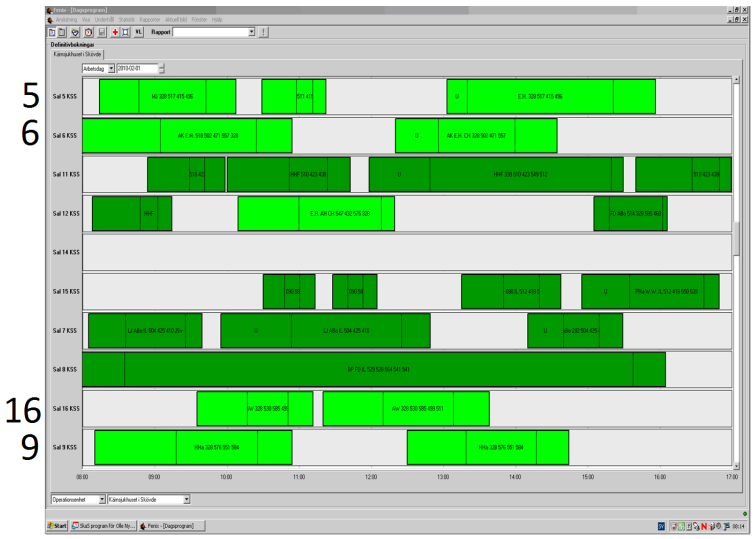
A seemingly common view within the dept. surgery is that there is a lack of operating theaters. This has been investigated. Figure 4.9 shows the average weekly usage of the operating theaters, for the dept. surgery, during 2009. As the figure shows, there was an average usage of 78%. For 2008 the rate was 75%. Usage is defined as the share of scheduled time a theater is used for treating a patient. Simply put, this is from the moment the patient is rolled into the operating theater until the patient is rolled out.

Obviously, the usage can never be 100%. There will always be long operations that are hard to schedule effectively, patient cancellations made with short notice, emergency cancellations for medical reasons, temporary lack of required resources etc. However, when investigating the detailed operation schedule for a selected month (February 2010), there were notable gaps in the schedule. Note that the schedule here refers to the actual outcome. The dept. surgery detail planner made conservative estimates on how many additional Inguinal Hernia operations could have been done for each scheduled day of the month. The total number for the month added up to 46 opportunities of Inguinal Hernia operations, at KSS and SiF. This was a most conservative estimate, but still with 46 additional operations, the part of the Inguinal Hernia patient queue currently violating the healthcare guarantee could have been wiped out in one month. Refer to table 4.1 p.29. A common problem when planning for surgery, according to the dept. surgery detail planner, is that too few or no surgeons are scheduled for surgery. Four selected examlpes of "bad" days are presented in the figures 4.10-4.13, where comments of the planner are also given. Note that the figures shows the actual outcome, but when the planner says surgeons were missing, that means they were not scheduled for surgery and hence "missing" already at the stage of surgery planning.



Day	Avail. hours	Used hours	Total
Mon	1392	1070	77%
Tue	1252	1082	86%
Wed	1436	1076	75%
Thu	1252	1032	82%
Fri	745	483	65%
Total	6077	4743	78%

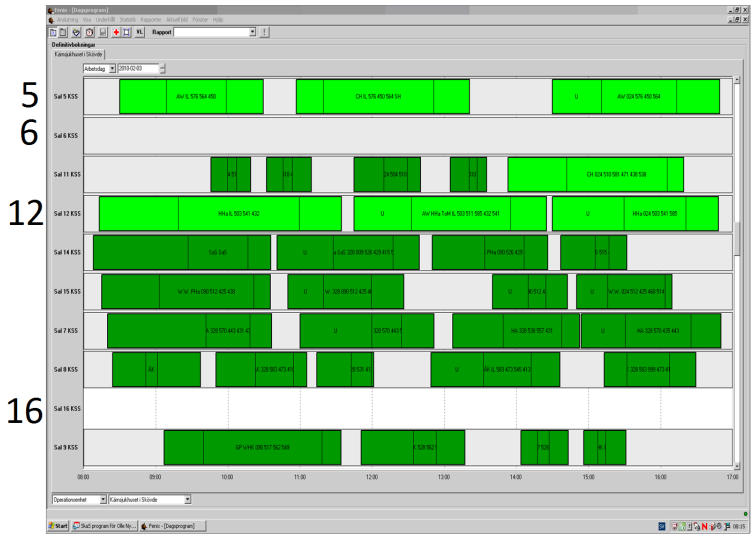
Figure 4.9: *Average weekly usage of the operating theaters, during 2009.*



Surgery planner's comments:
Regarding room 16, the surgeon had to round the children care unit in the morning. Don't know why the afternoon is empty.

Estimated extra operations: 1

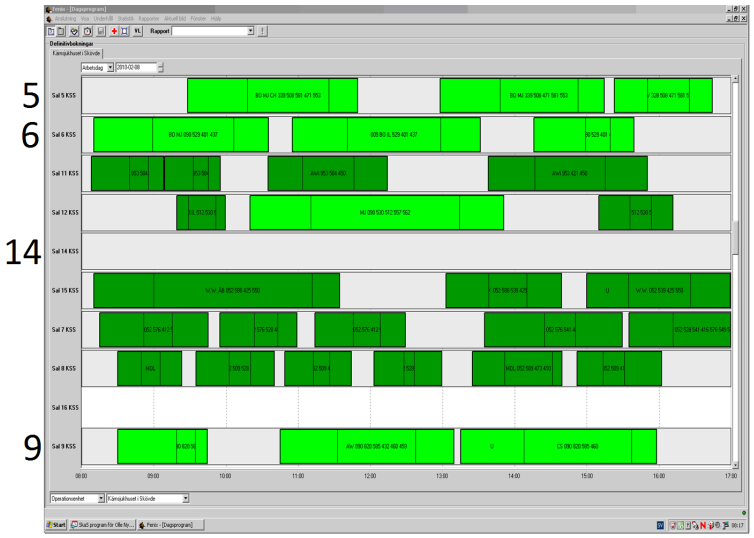
Figure 4.10: *Surgery detailed plan 2010-02-01. Available room numbers are shown to the left.*



Surgery planner's comments:
Regarding room 6 and 16 there was no surgeon in duty. Only one team out of two were operating.

Estimated extra operations: 6

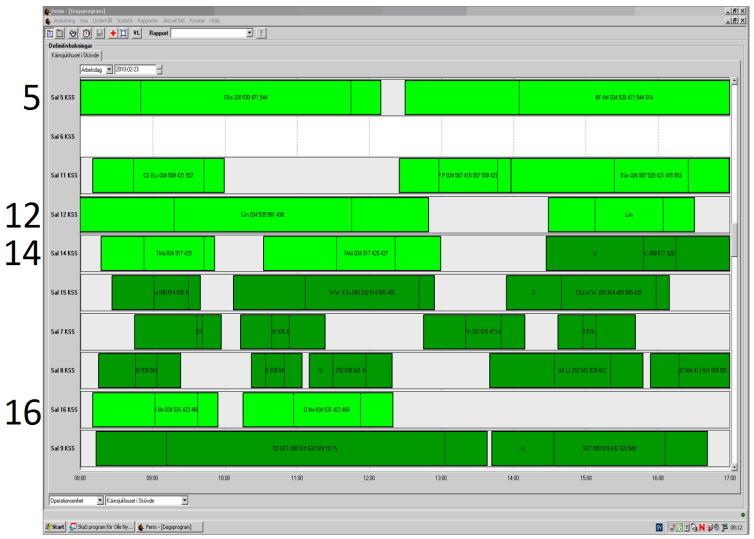
Figure 4.11: *Surgery detailed plan 2010-02-03. Available room numbers are shown to the left.*



Surgery planner's comments:
Theater 14 was available half day, but there was no surgeon.

Estimated extra operations: 3

Figure 4.12: *Surgery detailed plan 2010-02-08. Available theater numbers are shown to the left. However, theater 14 was available half day only.*



Surgery planner's comments:
Theater 5 was used efficiently. Don't know why nothing was done in theater 16 in the afternoon.

Estimated extra operations: 1

Figure 4.13: *Surgery detailed plan 2010-02-23. Available theater numbers shown to the left.*

Willingness and Competence to Operate

An issue put forward by the planners (their common view) is that some surgeons do not want to operate Inguinal Hernia, even if they are available according to the doctors' schedule. No actual data has been collected to support this claim, but the planners speak from many years of experience. Inguinal Hernia is just one of many type-operations, but it plays a decisive role for the overall filling of the surgery schedules. Since these operations are prioritized the lowest, they are the once scheduled last. Not all patients agree or are able to come in with a short notice, to make use of "last minute" gaps in the schedule. Hence, when a time slot is available in a surgery theater, doctors' are available, and there is a patient actually able to come in, it is most unfortunate not to make use of the opportunity.

The common belief (hypothesis) within the improvement team is that Inguinal Hernia is a non-challenging and perhaps low-status operation to perform. It was also discussed whether the problem could in fact be competence related. For this reason a review of all surgeons was made. Out of the 30 surgeons at the dept. surgery 27 surgeons had the skill. The distribution of Inguinal Hernia operations (2009) over the 27 surgeons are shown in figure 4.14. Roughly 30% of the surgeons made 70% of the operations. This distribution may however be the result of a natural learning curve among doctors and should not interpreted as a reflection of a varying willingness to operate Inguinal Hernia.

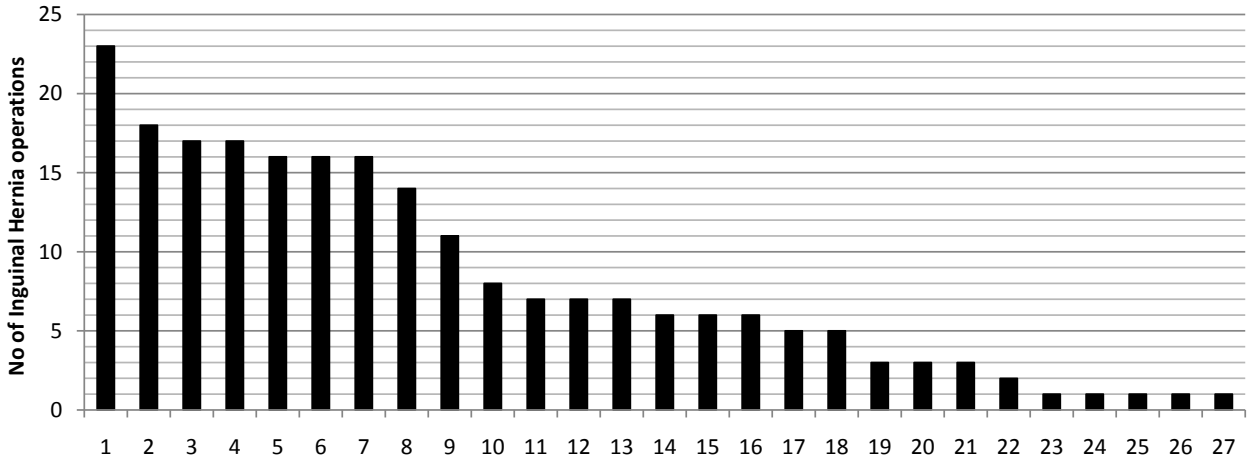


Figure 4.14: *Number of Inguinal Hernia repairs, per surgeon 2009, at the KSS dept. surgery (all teams). In total there are 30 surgeons of which 27 have the skill to operate Inguinal Hernia.*

Shared Responsibility

The surgery of Inguinal Hernia is a responsibility shared among the teams within the dept. surgery. However, it is the team surgery planner of the Nedre Gastro team who makes the planning for Inguinal Hernia. In her experience, many teams (not all) tend to prioritize their team specific undertakings, leaving the Inguinal Hernia cases to the other teams and the Nedre Gastro team in particular. The team surgery planner establish that more cooperation is needed between the teams.

4.5.4 Registration Visit (Process step 6.1)

It has been discussed that the registration visit could potentially be merged with the doctor's visit. This would however require that the lead time between the doctor's visit and the time of

surgery must not be too long, typically at most one week. Otherwise the patients safety can not be assured. Today that would not be possible, but in the future shorter lead times would open up for this option.

However, an important counter argument was put forward. If the time from diagnosis to surgery is too short there is a risk that "the soul does not catch up with the patient", meaning there is a risk of psychological side effects when a patient is not given the time to mentally digest what he/she will go through. Moreover, since the registration visits only apply to inpatient surgeries, only 10% of the Inguinal Hernia patients are affected.

This action is left as a future potential measure to shorten the overall lead time for the patient.

4.5.5 Doctors' Schedules

To a great extent, the unevenness in both doctors' visits and surgery (figure 4.7 and 4.8) are believed to be the results of uneven staffing of doctors. Basically all other resources, such as surgery theaters, nurses etc, run on fixed schedules. As said in section 4.5.3, the dept. surgery detail planner experience is that most unused time slots are caused by a lack of doctors scheduled for surgery, at the time of surgery planning. Arguably, the real problem is that resources have to be matched with each other and with the needs. Hence, the access of doctors could in fact be uneven as long as other resources were properly synchronized (i.e. not fixed). From that perspective it is all a planning issue. However, the complexity of synchronizing so many resources is expected so complex that it has not been considered. This is not to say it is has been proven impossible, it has just not been considered.

Table 4.3 is a compilation of the number of doctors[5] available February through March 2010. Monday through Thursday everything between 5-8 surgeons are needed on 4 theaters, but an evenness is still important for planning purposes. On Fridays only 1 surgeon is needed per theater since only simple outpatient operations are made then. Given this, we can study the table. Week 12 there were 2 surgeons Wednesday afternoon, on 4 operating theaters, which means there was a need of at least 3 additional surgeons. Week 13 Friday morning there were 7 surgeons on 3 operating theaters, meaning there were 4 surgeons too many.

Reviewing the doctors' schedules historically (2008-2009) indicates table 4.3 is a representative extract for many periods of time, even if there are also other periods when the schedules are seemingly well leveled.

There is a difficulty in scheduling, due to doctors' having plenty of time off, apart from the standard vacations, to compensate on-call duties. Little can be done about this fact. The real problem with the doctors' schedules are that they are not created to bring an even staffing of different competence profiles over time. The doctors' schedules are created first, and after that production is planned based on the schedule. Moreover, changes to the schedules, such when a doctor wants to go on a conference, are often made without enough consideration of production and staffing evenness.

The doctors' schedules are associated with long going traditions and the way they work are deeply rooted in the hospital culture. This have made it complicated to change the system. An elder chief surgeon stated "I have worked here for 37 years and we still work the same way we did the day I started".

[5]Only doctors who can operate independently are counted. I.e. interns are not included.

Table 4.3: *Scheduled doctors February through March 2010 (Monday 2010-02-01 to Friday 2010-04-02). Interns not counted. In parallel, the available surgery rooms (fixed scheduled) are shown, per AM and PM of each week day.*

	Monday		Tuesday		Wednesday		Thursday		Friday
Week	AM	PM	AM	PM	AM	PM	AM	PM	AM
5	7	7	3	3	5	5	6	6	5
6	4	4	4	4	6	6	7	4	6
7	3	3	3	3	3	3	4	4	4
8	8	8	5	5	8	8	8	6	6
9	4	4	5	5	5	5	4	3	4
10	7	7	8	8	7	7	6	5	6
11	5	5	4	4	5	5	7	3	4
12	4	4	6	6	3	2	6	5	5
13	5	5	5	5	5	5	5	5	7
Avg.	5.2	5.2	4.8	4.8	5.2	5.1	5.9	4.6	5.2
Available Surgery Rooms									
	4	4	4	3	4	4	4	4	3

4.6 Action Points

Step 5 of the 10 step model (see 4.3.3, p.30) was to "analyze and find possible solutions". The output from this step is presented as a bullet list below. Note that these are the possible solutions, or possible measures if you will, that has been found. Step 6, which is outside the scope of this case study, will test and evaluate the solutions before they are finally implemented. In the previous subsections some additional potential measures were also mentioned, but left for future discussions. These are not listed here.

- Aim for a leveled staffing of doctors'. As a first step create a fictive leveled schedule to investigate if, or prove that, such a schedule can in fact be laid with the current resources available.

- Have the planners to systematically monitor gaps in the surgery plans. This also includes declaring they have the mandate to make the surgery plan without first asking the available doctors' if they are willing to do the surgery. In this context, a doctor is considered available if he/she is scheduled for surgery and is capable of doing the surgery. As a comment, the author have suggested this change should be combined with an investigation of the doctors' situation, to make it a collaborative change.

- Every week follow up on the result from last week with regards to the usage of the surgery theaters. This shall be done on a team level by going through each scheduled day from last week discussing every unnecessary gap in the schedule. This should be the first thing on the agenda on every teams' weekly surgery planning meeting.

- Every week also follow up on the overall results from last week with regards to the usage of the surgery theaters, the current queues and which teams have produced what of the non team specific type-operations, such as Inguinal Hernia. This shall be done as part of the weekly department meeting.

Finally, it should be mentioned that there has been a lot of discussions on change management, especially concerning the need of changing doctors' schedules. This is however left to be discussed in the 6 Analysis chapter.

5. Reference case: The Department of Orthopedics at SUS Lund

Source information:
Where else is not cited all information presented in this chapter is based on presentations from the Lean Healthcare conference in Lund, march 15-16 2010, and two interviews made with the SUS Lund orthopedic department manager Pelle Gustafson, one on site may 14 2010 and one on telephone June 23 2010. Graphs, photos and data presented are all from materials provided by Pelle Gustafson.

Section 5.1 will give an introduction and brief contextual description to the case at the Department of Orthopedics at SUS Lund.

For all that matters, the process investigated is basically the same as for the main case. The findings made in Lund, along with what has been done are described in section 5.2. There are sub-sections (5.2.1 - 5.2.3) of findings that correspond to process steps. However, the last sub-sections (5.2.4 and 5.2.5) discuss topics that does not correspond to any certain process step.

Note that this reference case is described more briefly than the main case. Also note that from the perspective of the iceberg metaphor (section 3.1.6 p19), this chapter mainly addresses above waterline issues. Aspects below the waterline are discussed in the 6 Analysis chapter.

5.1 Introduction and Background

In the county of Skåne in southern Sweden, the University Hospital in Malmö and the University Hospital in Lund forms the Skåne University Hospital (SUS). The hospital director (CEO) Bent Christensen has clearly pronounced a long term strategy of implementing Lean, with two core principles; (1) "the focus must be on a fast, smooth flow of patients" and (2) "building structures to enable the hospital's working group itself to improve its working methods on a continuous basis" (SUS webredaktion, 2010).

At the Lean Healtcare conference, Ann Esain, Head of the Health and Service Group at Lean Enterprise Research Centre at Cardiff Business School (Wales, UK), presented a preliminary classification of Lean Healthcare in Sweden, UK, USA and Spain. In this, SUS Lund qualifies as one

of very few hospitals that has managed to implement Lean across organization boundaries. The classification is shown in Appendix E, p.77.

At the orthopedic department at SUS Lund the Lean work began in 2007. The driving force motivating change was (1) a lack of surgery capacity, (2) a great staff turnover and a shortage on personnel, (3) poor usage of available surgery theaters, (4) patient security issues, and (5) a general great frustration over the situation.

The purpose of this chapter is to contrast the findings made by the improvement team at KSS. The reference case represents another type of department, but the patient journey, i.e. the process, is basically the same, and the background problems motivating change (above) also have a lot in common with the main case at KSS in Skövde. The orthopedic department have 45 doctors and have access to 8 surgery theaters. The Lean work has so far been focused on 4 theaters that reside in the so called "central operation" at SUS. As for the department of surgery at KSS, the department here is also divided in teams, however referred to as sections. There are 7 sections, such as trauma, foot, back, children etc, each responsible for a number of type-operations. It is noteworthy to say that there is no shared responsibility for any medical condition. This may be one reason no specific medical condition, comparable with Inguinal Hernia, has been given any primary attention. Another difference is that no overall goal has been used at SUS. "We are method-driven, not goal driven" Pelle Gustavsson claims. This is discussed further in the 6 Analysis chapter.

5.2 Outcome of the Lean Work in Lund

5.2.1 Referrals Review

Uneven Flow and Unknown Demand

The incoming flow of referrals has been found to be very uneven from day to day. As an example figure 5.1 shows the number of referrals, for all conditions, for a certain patient flow at SUS Lund during a period 24 days in 2008. Which flow is not specified. The variation is considered somehow caused by the suppliers.

The yearly demand is very much unknown which is a problem when budgeting resources. Politicians order operations based on last year's statistics and the current queue. This is known to never add up correctly. Gustavsson believes demand can and should be predicted better. He makes a comparison with the way any sales organization makes market analysis and sales forecasts.

Even if the demand vary on an annual level, the weekly, or even daily demand is very even. This can be shown by looking at statistics for emergency visits Gustavsson claims. See figure 5.2 (section 5.2.2 p.46).

Quality of Referrals

Incomplete referrals is a common problem within outpatient healthcare Gustafson claims. To reduce this problem, a feedback letter has been created that is always sent back for every incoming referral. The letter template has check boxes to tell what is missing. There is also a check box to tell if the referral was complete and possible to judge. The template is in Swedish and can be seen in Appendix C, p.73.

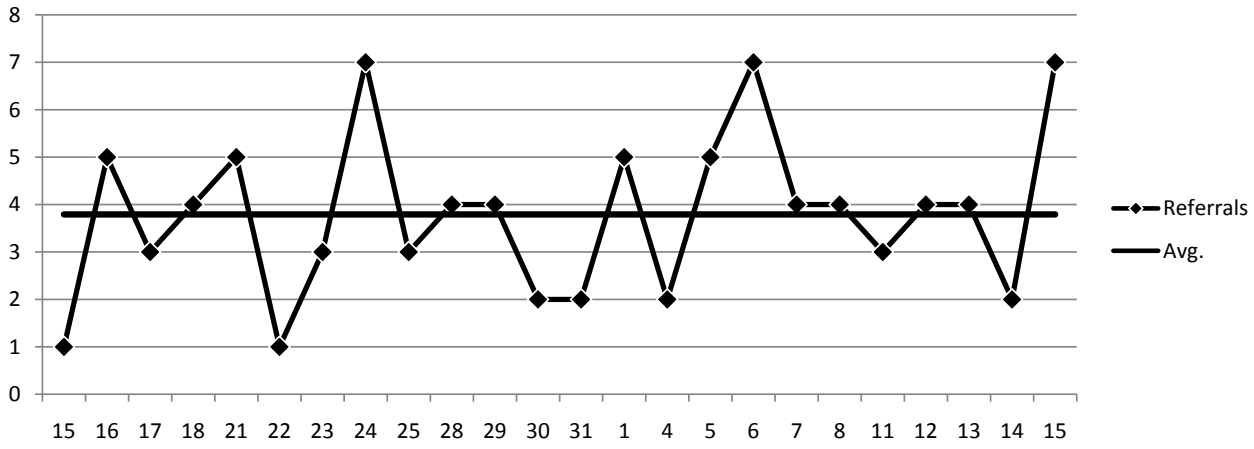


Figure 5.1: *Number of incoming referrals to a flow at SUS Lund during Jan 15 to Feb 15 2008. Which flow is not specified.*

5.2.2 Doctor's Visit

Uneveness in Doctors' Visits

There used to be a great unevenness in doctors' visits in SUS Lund. Figure 5.2 shows elective visits along with emergency visits for the department of orthopedics, for a period of 8 weeks in the beginning of 2008. Note how the elective visits varies from day to day, whereas the emergency visits are significantly more stable.

Figure 5.3 illustrates another important aspect to the variations. Both the incoming referrals and the new visits vary lot from day to day. Assume there was no queue in the beginning of the period and that the new visits curve correspond to the *capacity* of visits. Despite the average capacity per day match the average incoming referrals for this period of time, a queue would still build up. The reason is that for every day the capacity is greater than the demand + current queue, the surplus of capacity is forever lost. Figure 5.4 illustrates the resulting queue, for the same period, if the capacity would have been completely leveled, but the incoming flow of referrals would have been the same. The queue still grows slightly, which shows a minor queue must always be there unless the incoming flow is also leveled.

Patient Books Time

Normally 2-4 out of 10 patients call in to cancel or change the time for a previously noticed doctor's visit. Another 1-2 patients just do not show up.

At the children section of the department of orthopedics, a test was made where the patient families had to call in to book their time instead of them having a time noticed by mail. It was assumed that when every patient gets to suggest a time based on his/her own calender, that would be seen as an increase in the service ratio. It was also assumed the amount of cancellations, changes of time, and no-shows would decrease. Obviously, there would be at least one phone call per patient, but since fewer calls about changes and cancellations were expected, the total amount of data handling was assumed to decrease.

The test was followed up with a minor survey among 78 families, which showed that over 85%

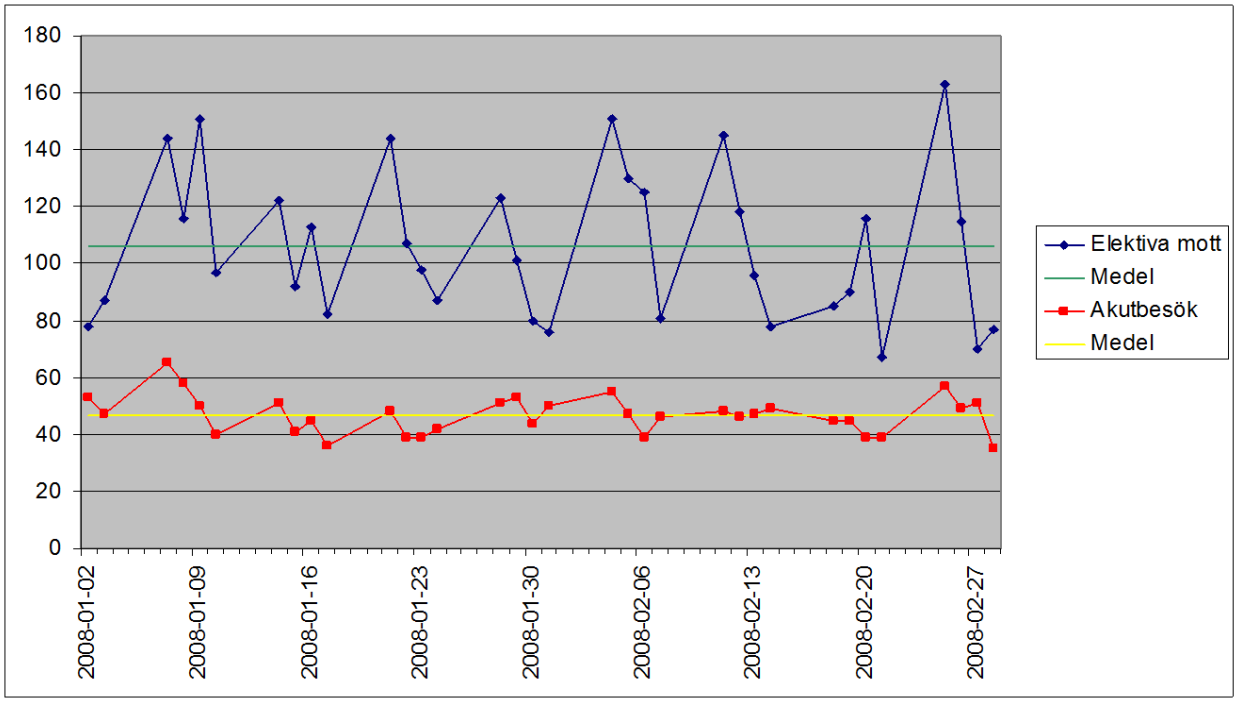


Figure 5.2: *Elective visits along with emergency visits for the department of orthopedics at SUS, for a period of 8 weeks in the beginning of 2008. The elective visits varies from day to day, whereas the emergency visits are significantly more stable.*

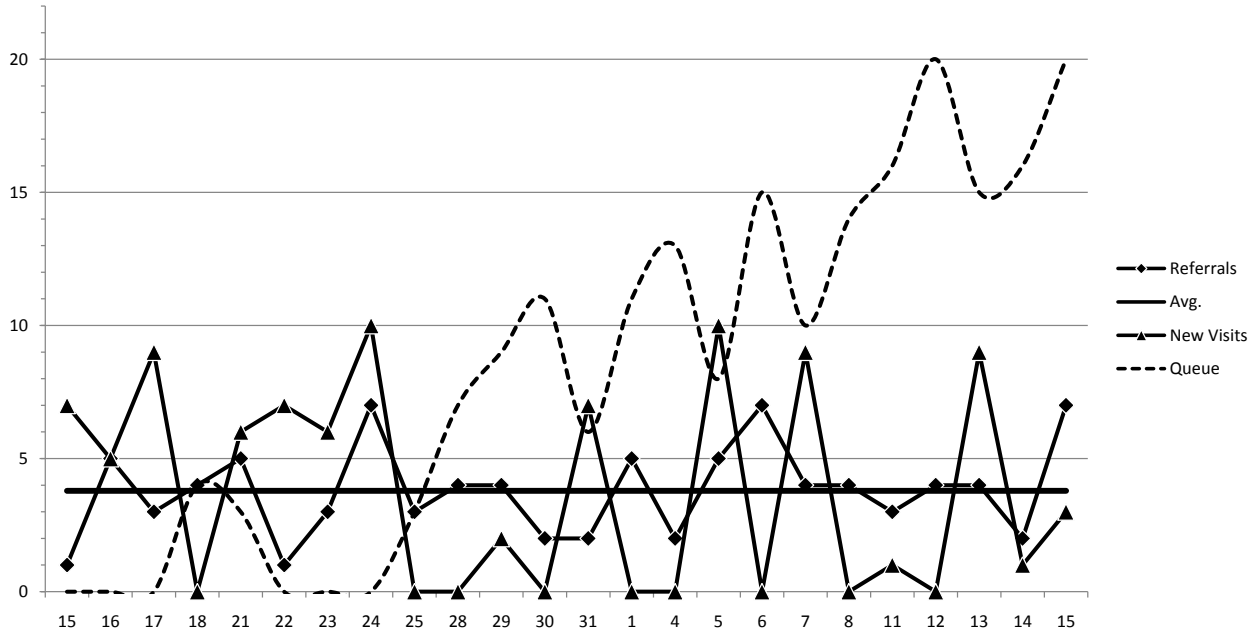


Figure 5.3: *Incoming referrals and new visits from jan 15 to feb 15 2008. With no initial queue, and the new visits read as the capacity, the theoretical queue would grow dramatically.*

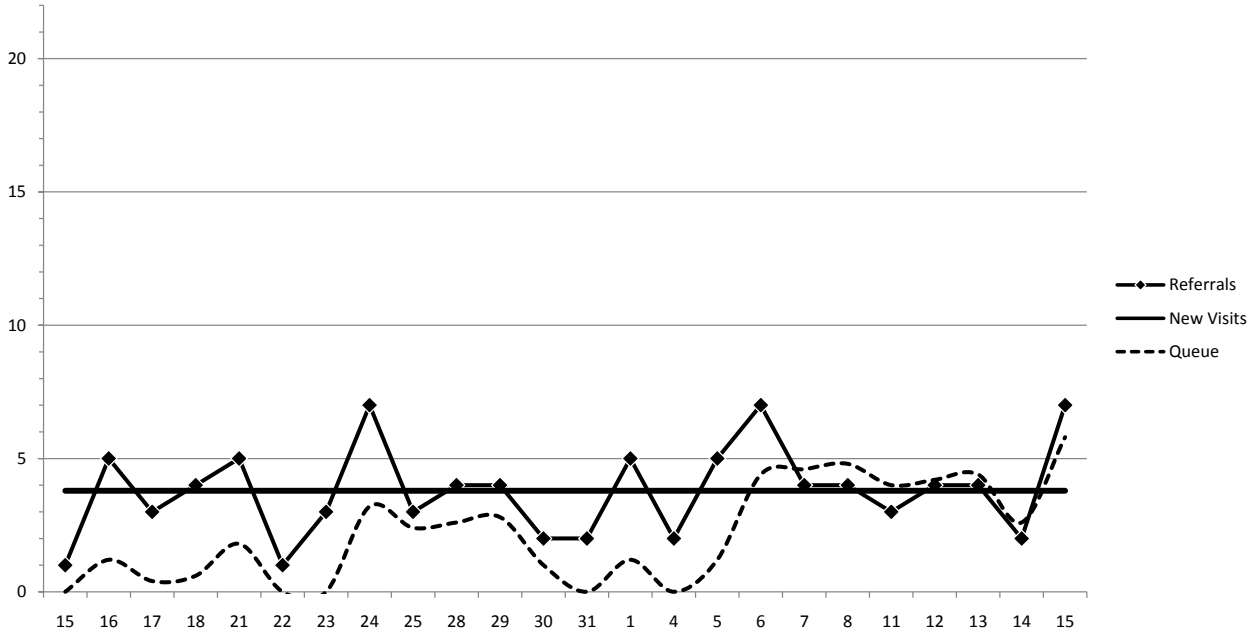


Figure 5.4: *With a leveled capacity the queue grows only slightly. This figure shall be compared with figure 5.3*

preferred the new way of booking. As expected the overall work of administration did not seem to increase. Early results also indicate a decrease in cancellations, changes of time, and no-shows.

From a broader perspective, the survey at the children section highlighted an important aspect of customer value. The customers, i.e. the patients, very much value an agreed-on time. It can in fact be a parameter equally important as queues and waiting times. What is the point of having a time in just a few days if you are not available?

5.2.3 Surgery Planning and Surgery

Much focus has been on the detail plans and the surgery procedure itself, where the goal was to increase the share of "knife-time". This is the share of time surgery is actually performed during the total time the patient is taken care of.

One problem was that a lot of time was wasted when different resources had to wait for each other, finishing certain tasks. When the overall work was investigated and mapped in a Gantt chart, it was found that many tasks could in fact be made in parallel.

Another problem was that there were often great deviations from the detail surgery plan. A detailed surgery plan include a complete coordination of resources and it defines the expected start and finish times for certain sub-tasks within each operation. When not followed it causes delays and the knife-time gets suffering.

Important measures were taken. The surgery theaters, starting with one, were organized as so called modules. A module is a cross functional basic set of people needed for operation. The people in a module always work together and acts as an improvement team of its own. The modules continuously follow up on the detail surgery plan, for every operation, after every day.

Moreover, one have moved away from "placing orders" between different functions, to "making agreements" on paper and eye-to-eye. Gustafson emphasize the value of using papers you can hold

in your hand instead of IT systems. The latter is fast but easily reduces coordination discussions and agreements to just "placing orders".

As a result the knife-time has increased by over 30%, while time has still been won to slow down, reflect, and spend time on further improvement work.

5.2.4 Visual Management

Visual management and 5S have been applied broadly at SUS Lund. As the theory behind these concepts emphasize, the purpose goes beyond just creating a clean and structured working environment. Since the introduction in October 2007, the employee turnover has decreased by 50%. 20 minutes have been released per employee and working period. The working pace has gone down and everyone feel the possibility to participate and make a change, Gustavsson claims. 95% of the employees have taken part in some sort of improvement work. Top results were shown in an employee survey 2008.

Below follows a few example pictures of the work. Figure 5.5 shows a most simple way of continuously capturing the mood of employees. A dot in a happy face means I had a good day, a dot in a sad face means I had a bad day.

Figure 5.6 shows a board with KPI's (key performance indicators) that helps everyone to see at a glance the status and what is going on.

Figure 5.7 shows a store at SUS Lund. Before the work with 5S, Gustafson tells "there used to be wheelchairs enough for an army in here, that we would never use". The room was so crowded it was hard to get in.

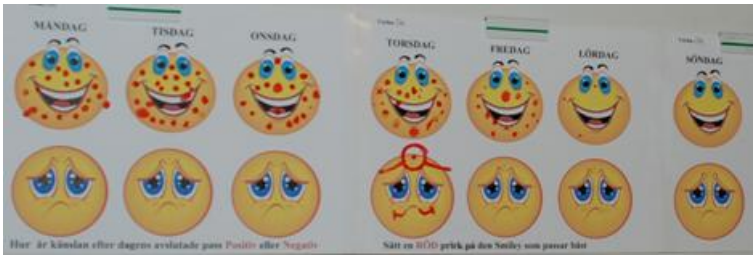


Figure 5.5: *A simple way capturing the employees mood, per day of the week.*

5.2.5 Doctors' Schedules

The Doctors' Schedules used to be laid out the same way as at KSS, where production is adapted to the schedules instead of the opposite.

Today this has changed and the schedules are laid based on a number of so called schedule-rows, that each correspond to a certain competence profile. Each row, i.e. each competence profile, then have to be evenly covered over the time of the schedule. The competence profiles are fairly rough, so when each row is covered, the planner makes manual adjustments to really assure the right compound of competence is always available. An example of the new schedules is provided in Appendix D, p.75.

There was a great resistance to the changes, which it is also at KSS and SkaS. A discussion of this is left for the analysis chapter.

Figure 5.6: *A board of KPI's, allowing to see at a glance the status and what is going on.*

Figure 5.7: *A store a SUS Lund, that previously was hard to enter as it was over crowded with wheel chairs.*

6. Analysis

This analysis chapter will in its first section (6.1) compile what concrete measures for increased flow has been taken at SUS (Lund) and what measures are considered to be taken at SkaS (Skövde). This is discussed from the perspective of different Lean concepts from above the waterline of the iceberg metaphor, discussed in section 3.1.6 p.19. The section ends with a discussion on how the different measures combined actually improve patient flow. Hence, this first section addresses the first part of the research question, i.e. "How can you, based on the concepts of Lean, improve the patient flow through a surgery department?".

Section 6.2 discusses people-related issues from below the waterline of the of the iceberg metaphor. According to theory, these areas are the ones critical for sustainability. Note that many of these issues are by nature tied to the overall management of the hospital. However, each department is still locally very dependent on this management to allow a sustainable lean transformation. This section addresses the second part of the research question, i.e. "How do you ground for a long term lean transformation of the whole hospital?".

6.1 Above The Waterline

Comparing the main case and the reference case shows they have a lot in common, even if SUS has reached further in their Lean work. Many of the problems found are the same, as well as the measures taken (at SUS), or considered to be taken (at KSS).

There are however two main things that differ:

- SUS has worked hard to increase the knife-time. Within the current improvement cycle at KSS, knife-time has not been considered. The potential is not denied, but the overall patient journey has been chosen to be investigated first. In fact, KSS has previously made some efforts on increasing the knife-time, but with poor sustainability.
- In contrast to SUS, KSS have paid extra attention to one certain condition, Inguinal Hernia. The only reason for this is the urgent problems with the Inguinal Hernia queues. The overall aim is however to improve the flow for all medical conditions, which is also the case at the dept. orthopedics at SUS.

Table 6.1 is basically a compilation of chapter 4 and 5. It shows what problems have been found in the different basic process steps along with what has been done (or considered to be done) to address the problems. There is also a column that maps, in broad outlines, the problems and measures to Lean concepts. Below, the two cases are commented by different Lean concepts, a discussion that in most parts will relate to table 6.1.

Table 6.1: *Compilation of problems and measures at dept. orthopedics at SUS and dept. surgery at KSS, with a mapping to Lean concepts.*

Process step	Problem		Measure (taken or considered)	Lean concept	SUS	KSS
Referrals review	Uneven incoming flow (weekly)		Somehow cooperate with suppliers to help them level their supply.	Heijunka/Leveling	√	√
	Unknown demand (yearly)		Actively analyze the "market" to predict demand.	Heijunka/Leveling	√	√
	Bad quality referrals		Feedback letter for every referral.	Jidoka	√*	(√)
Doctor's visit	Uneveness in Doctors' Visits		Level out the doctors' schedules.	Heijunka/Leveling	√*	√
	Patient cancellations and no-shows.		Have the patient *always* call in to suggest a time that suits him/her the best.	Voice of the customer	√*	(√)
Surgery Planning	Gaps in the overall surgery plan	Missed surgery opportunities and surgery cancellations	Capacity planning and Resource synchronization	Pull driven flow	√*	(√)
		Doctors' are often missing	Level out the doctors' schedules.	Heijunka	√*	√
		More attention needed for some medical conditions: - Shared responsability - Possible unwillingness to operate	Continuously follow up on the overall surgery plan after every week. Both on a team level and a department level.	Jidoka		√
			Increase the planners mandate to make the surgery plan without first asking the available doctors'.			
Surgery (detailed surgery planning)	Poor "knife-time" on planned surgery time	Detailed surgery plan not kept.	Introduction of modules, i.e. surgery theaters with fixed cross functional surgery teams, continously improving.	Teamwork/Kaizen	√*	
			Have the modules continuously follow up on the detail surgery plan, after surgery.	Jidoka		
			Making agreements on paper and eye-to-eye, between different functions and individuals before an oparation. Also general agreements.	Standardization / teamwork		
		Unnecessary waiting times between different resources.	Parallelize as many tasks as possible.	Waste reduction (waiting)		
All	Dissatisfied, stressed, frustrated (etc) employees.		Move away from command-and-control management.	Philosophy / culture	√*	√
			Involve everyone in continues improvement efforts, with bottoms up approach.	Teamwork/Kaizen		
			Use time that is won to slow down, reflect, and spend time on further improvements.	Philosophy / culture		
			Broad application of workplace organization.	Visual Management		

√	Consensus in the value / importance of the measure.
√*	Measure implemented.
(√)	Great interest in the measure.

6.1.1 Mura and Heijunka

Both cases have shown the same type of dramatic unevenness (Mura) in several process steps. However, the incoming flow of emergency cases were shown to be, or claimed to be, very stable in both cases. This is a typical pattern according to Haraden & Resar (2004). Most variation is created inside the organization or at the suppliers. This can be addressed, in contrast to the yearly variations in demand, which can only be predicted better.

In both cases the doctors' schedules have been identified as a major source of variation. At SUS, where the schedules have today been leveled, the variations (Mura) have decreased to be "much better" and the workload (Muri) for the personnel has decreased. However, there are no numbers to describe the contribution from this individual measure alone.

A comment put forward at KSS regarding the doctors' schedules is that their unevenness is in fact often a greater problem for nurses, and other "supporting" personnel, than for the doctors. Doctors work when they are scheduled, while the workload on nurses varies very much with the presence of doctors. This is a concrete example of Muri caused by Mura.

Hines et al. (2008, p71), describes problem solving as peeling an onion, where peeling one layer uncovers the next layer. In a complex system this means that when a change is made, such as leveling the the doctors' schedules, unexpected problems may arise whereas other seemingly unrelated problems may disappear. This is said since leveling the the doctors' schedules is indeed a major change, and when the change is made, everything (i.e. the whole process) should be iteratively re-evaluated.

6.1.2 Muda

Removing activities, even ever so small, that do not add value is a core part of lean.

At SkaS, there are complete process steps that can potentially be either skipped or merged, for certain conditions. Specifically, these were the referrals review (4.5.1 p.35), the doctor's visit (4.5.2 p.35), and the registration visit (4.5.4 p.39). Removing process steps when possible obviously has an immediate effect on flow and lead times (Fillingham 2007). A risk for psychological side effects from too fast patient flows, was however put forward, and the interest in these measures was fairly low.

In the Discussion chapter, section 7.2, a potential way of avoiding the side effects by segmenting the patient journeys is discussed.

6.1.3 Capacity- and Production Planning

At the very first meeting at KSS, a chief surgeon stated that "most of our problems comes down to planning". As it would show, he was very much right.

The planning of doctor's schedules are different between KSS and SUS, see 5.2.5 and 4.5.5, respectively. At KSS today, resources are not planned to match an expected or scheduled production. Instead production planning is today made based upon what resources (or capacity) happens to be available. This creates a very uneven production. Moreover, different types of resources (surgeons, nurses, surgery theaters etc) are planned with no, or too little, coordination. Hence, the different types of resources are poorly balanced. Consequently, the utilization of resources suffers, eroding

the overall capacity and creating even more unevenness in flow. At SUS the actual demand is considered and competence profiles per schedule-row ensure the right compound of competence is always available.

6.1.4 Jidoka

Jidoka is the principle that quality issues must be surfaced and addressed immediately (see 3.1.2).

This is applied at SUS where the planned detailed surgery schedules are compared daily with the actual surgeries performed. In this, all possible improvements are captured to be implemented immediately. At KSS, it has been decided to continuously follow up on the overall surgery plan weekly, both on a team level and a department level. Also the referral feedback letter can be seen as an example of Jidoka. When one referral is incorrect this is immediately addressed.

6.1.5 Standardization

At SUS, the importance of mutual agreements on paper (standardized operation procedures, SOP) are emphasized. Not only is this an example of standardizing work; the way it is done eye to eye is also important to move away from "placing orders", and instead build a cooperative environment.

6.1.6 Visual Management

Visual management and 5S has been seriously discussed at KSS, but so far only a few fragmented projects have been implemented in the organization. At SUS it is implemented broadly.

These tools can play an important role in a Lean transformation of an organization. Hines et al. (2008), introduce a term called "pillars and platforms". When introducing lean concepts in an organization, that is often done with a "pillar" approach, meaning a limited number of process steps are selected on which several Lean tools or techniques are applied, such as 5S, Visual Management or SOP's (standard operation procedures). This has the benefit of quickly showing benefits of Lean, which increase the credibility. However, employees in unimproved areas may easily feel isolated and disengaged from the program. An alternative is the "platform" approach, where a limited set of tools, typically Visual Management and/or 5S, are applied across the whole process. This approach takes longer time to produce results but is engaging for the whole workforce. Hines et al. concludes that a judicious combination of the two approaches, possibly starting with a pillar approach, is required for a sustainable change.

My interpretation is that this type of combination is actually applied at SUS, and a similar approach can and should be taken at KSS.

6.1.7 Integrated Logistics

Cooperation with suppliers is advocated within lean and is mentioned in both cases, to help reduce the unevenness of incoming referrals. At KSS, cooperation with suppliers is also put forward as a way to actually allow a removal of the referrals review, and perhaps even the doctors' visit, for certain medical conditions. These are interesting opportunities even if cooperation with suppliers is not yet on top of the agenda.

6.1.8 Not Lean - but Necessary

Increasing planners' mandate in making surgery plans at KSS, is a change of the power structures in the organization. This may be necessary at this time, but in the long run the real Lean solution should be a change towards a collaborative culture, where power structures is more of a formality. This comment was also made by the Nedre Gastro team surgery planner (see 4.5.3 p.39)

As a way to ground for a collaborative change, a mutual understanding is needed between doctors and planners. For this reason I have put forward that the doctors' situation must be investigated (see 4.6 p.41). What do their days look like? Perhaps the root cause of some doctors' avoiding certain operations is in fact related to stress and overburden.

Conclusively - forcing new power structures is not a sustainable Lean solution, but collaboration and reduction of stress and overburden is.

6.1.9 Creation of Flow

In the above sub-sections the identified problems and measures taken at KSS and SUS, were compiled. The relation to Lean, for each measure, was also discussed.

But how do the different measures actually add up to an improved patient *flow*? Figure 6.1 is an attempt to illustrate how flow can be improved, given the findings at KSS and SUS. However, the figure must be seen as a simplification. The causal links between the many measures and problems are complex. Lean is a structural system of principles rather than a set of measures, as described in the theoretical framework. The arrows in the figure should be read as *"in order to..."*.

Note how the different measures all boil down to less waiting time, improved resource utilization and a greater evenness in flow. The importance of the latter was discussed in section 6.1.1. Unevenness (mura) is the root cause behind most waste (muda).

The findings are in line with previous research. Jacobsson (2010) lists (1) capacity planning, (2) teamwork, (3) standardization, (4) visualization, (5) separation of flows, (6) synchronized flows, and (7) reduction of process steps as common practices in lean hospitals. In this study the first four has been core areas of discussion. In the Discussion chapter, section 7.2, it is discussed how a separation of flows (5) could be used as a way to allow the removal of certain process steps. Apart from that, separation of flows has not been discussed much though. The purpose of separating flows by different patient groups, is that they get easier to streamline by their specific characteristics. Standard operation procedures gets easier to develop and different flows will not as easily disturb each other, thus be more predictable and stable (ibid). Separation of flows also separates the "common" patient from the "rare" patient. Hines et al. (2008) uses the terminology of "runners, repeaters and strangers", to classify products by their volume. Synchronized flows (6), has been discussed in terms of collaboration and communication between departments, and in terms of coordination measures in the staffing surgery teams. Reduction of process steps (7) has been discussed (6.1.2), even if it was left as a more future potential.

Finally, creating a *sustainable* smooth and lean patient flows require more than the concrete measures listed here. We need to consider the behavioral science aspects of lean, that goes below the waterline of the iceberg metaphor.

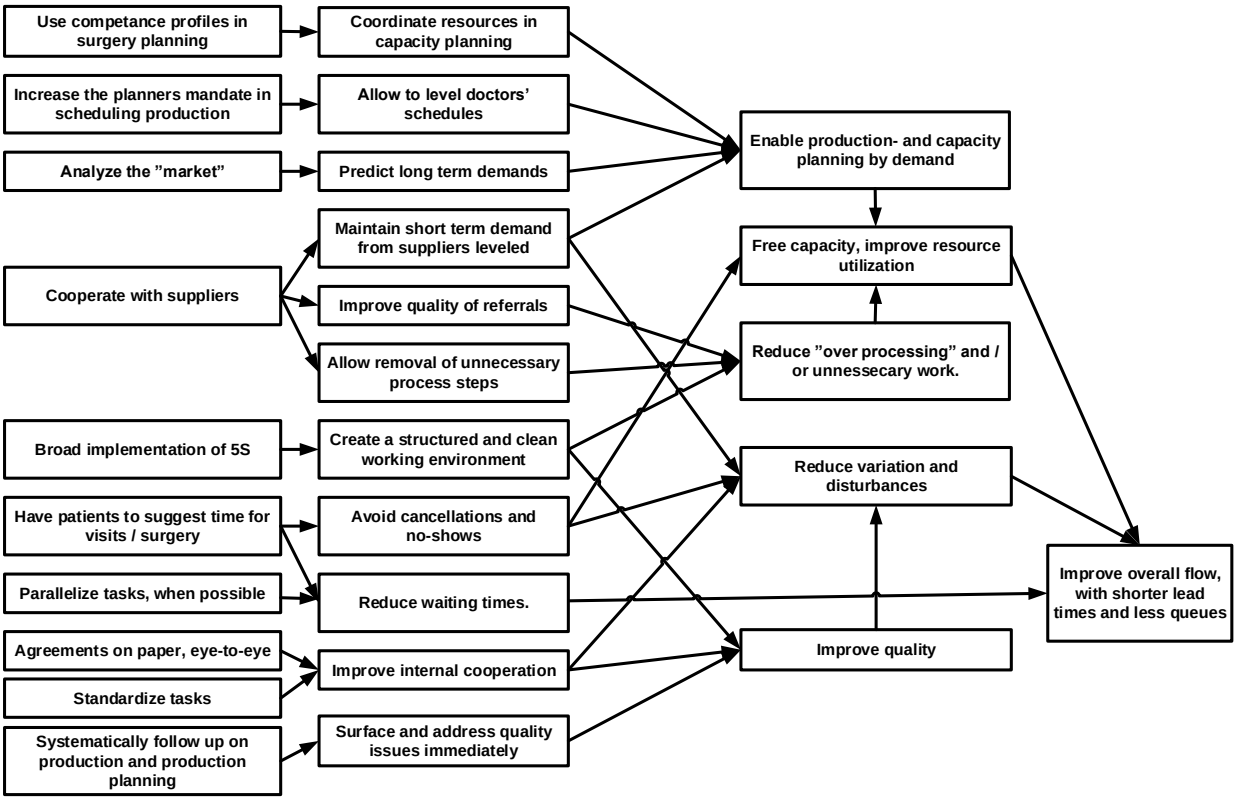


Figure 6.1: *An simplified illustration of how flow can be improved, given the findings at KSS and SUS. However, the figure must be seen as a simplification. Arrows should be read as "in order to".*

6.2 Below The Waterline

Previous research at SkaS and KSS concludes that the main obstacle to change at SkaS is the organization itself (Hellström et al. 2010). At SUS, the dept. orthopedics manager Pelle Gustafsson claims "so much of what we have done here comes down to behavioral science". These conclusions are well in line with the iceberg metaphor.

This sub-section provides an analysis focused on the main case, given the framework of the three enabling features of Behaviors and Engagement, Strategy and Alignment, and Leadership (introduced in section 6.2.2 - 6.2.1). There is also a sub-section discussing what to consider when evaluating results from improvement efforts. The analysis shall however not be read as a complete analysis or description of any of the cases. As the iceberg metaphor also illustrates, much of what goes on under the waterline is hard to observe.

6.2.1 Behavior and Engagement

As described in section 4.2, SkaS has a history of poor sustainability with previous improvement efforts. According to theory (section 3.1.6), that should be related to managerial issues. However, one should not jump ahead on simple conclusions about "bad management". Hospitals are big and complex organizations where change takes time. Resistance to change of all types are seemingly common. The individualized resistance stands out as the most apparent, even if not necessarily the most significant. Many times, members of the improvement team have described how discussions on improvements often end up in a question of "what's in it for me". A chief surgeon even stated,

somewhat hardened: "A problem when you discuss improvements is that all doctors want to be best in class. And what's worse is that some of them actually believe they are."

On the first meetings at KSS, the improvement team setup, with its predefined Six Sigma roles was discussed. Resistance to change, attitudes, engagement etc, was carefully considered. A table was made on the whiteboard to categorize potential improvement team members by power and interest. See table 6.2. People with the combination of low interest and great power was critical to avoid. At the time, this concern seemed excessive, but as it would show when investigating the reference case (SUS), they described a similar concern in selecting people. The learnings from their initial work, which in fact collapsed, was that they had not paid enough attention to roles and who was given what responsibility. They also realized they had too much of a top down approach.

Table 6.2: *Conceptual table made to categorize potential improvement team members by power and interest.*

	Lot of power / influence	**Little power / influence**
Great interest	<name> <name> ...	<name> <name> ...
Low interest	CRITICAL SQUARE <name> <name> ...	

As it seems, carefully selecting people, and even avoiding certain people, may initially be a necessity for some improvement efforts. However, in the long run avoiding people does not comply with a true Lean transformation. This is why the enabling feature of Behavior and Engagement (see 6.2.1) is so important to work on. This takes us back to the discussion of Pillars and Platforms, introduced in section 6.1.6. Specific improvement efforts represent a pillar approach which has the benefit of quick wins that bring credibility for the improvement work. However, to engage the whole workforce and enable a sustainable change, this must be judiciously combined with a systematic platform approach. When this understanding has been put forward to the improvement team at KSS, it has been received with great consensus. The importance of this concern can however not be overstated. SkaS have worked a lot with Six Sigma, which has been criticized to fail in creating conditions where everyone in an organization is involved (see section 3.2).

6.2.2 Strategy and Alignment

Behavior and Engagement also depends on how well overall strategy and purpose is communicated and understood. At SkaS, the "SkaS guide" (Lifvergren 2008*a*) intends to describe the principles and approaches SkaS have chosen to work with to reach set goals. The guide is comprehensive, but having read it carefully, it still tends to leave the reader unclear on the main strategies for the future. This matter was discussed with the improvement team members who shared this view. In short, the guide explains the following:

- **Vision:**
  The vision is "Good care in development"[1], based on a value system[1] of everyones right

[1]Own translation

for: (1) Respect and honesty, (2) Care and security, (3) Participation and fellowship, and (4) Development and understanding.

- **Goals:**
  Balanced scorecards, revised yearly, are used to describe the long term strategic goals as well as short term goals, expressed as critical success factors. This is made in the four perspectives of (1) Patient, (2) Process, (3) Employee/Learning, and (4) Economy. For the process perspective (as an example), there is a "Strategic Plan for Process Development" (Lifvergren 2009) that defines a "target state for 2012", for which 8 critical success factors have been identified.

- **Strategy:**
  The principles of Offensiv Verksamhetsutveckling, translated and interpreted for the activities at SkaS, sets the direction on *how* SkaS shall improve and evolve. Note that Offensiv Verksamhetsutveckling is considered equal to Lean at SkaS. Also see figure 4.1, p.27.

- **Overall view:**
  There is also a strategy map (figure 6.2), that intends to link everything together, in *what* has to be achieved and *how* this shall be done.

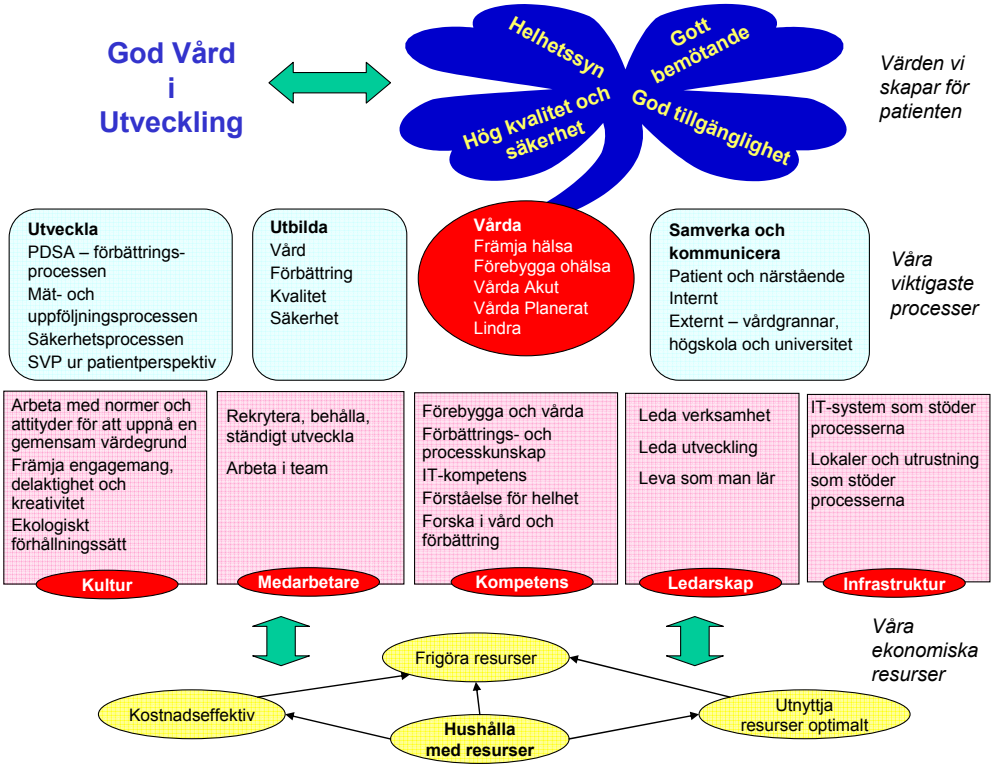


Figure 6.2: *The SkaS strategy map (in Swedish), from the SkaS guide (Lifvergren 2008a).*

Analyzed from an A3-thinking perspective (see 6.2.2, p.57), the 90 page SkaS guide with complementary documents takes too long time to digest to be easily accessible. It should be condensed and preferably complemented with an A3 paper summarizing what directions are set. Another problem, that needs to be investigated, is if everyone really knows of the guide. In the improvement team there was a chief surgeon who had never heard of it.

Obviously, top management engagement is more important than any guide or A3 paper. However, the way strategies are communicated at SkaS, in forums other than the SkaS guide has not been

investigated specifically.

An observation at SUS is that the hospital director (CEO) have pronounced their long term Lean strategy very clearly (also see 5.1 p.43).

6.2.3 Leadership

In the interview with Pelle Gustavsson at SUS, the situation at KSS was also discussed. When discussing different issues of resistance to change, he only agreed and said they had experienced the same type of problems. Specifically, the change of the doctors' schedules, as described in section 4.5.5, was discussed. The change of the schedules has been implemented at SUS, but remains to be done at KSS/SkaS. The surgery division manager at SkaS claims "there is nothing that brings out so many feelings as discussing surgery planning." At KSS, it has been put forward that doctors' can only be convinced with hard fact data. Gustavsson, who have experienced the same type of resistance, had a different view, and said: "If you want to criticize someone, you need data - if you want to change someone, you need a value-system". But then what if the value-system is considered bunkum? "If a value-system is considered bunkum that is because you do not use it", he replied. At SUS everything made is based on the value-system, which is: (1) Patient first, (2) Respect the individual, (3) Continuously improve. The use of the value-system must be consistent. As a simple example I was told of a situation at SUS when a doctor requested a new office chair. At the same time a sofa was needed in the patients' waiting room. With reference to the value-system, the doctor was asked to wait until a new sofa was first bought for the patients. In my interpretation, this is an example of Lean leadership building a Lean culture.

6.2.4 Measuring Results

What is under the waterline is also called enabling conditions. As the word "enabling" implies, no immediate results should be expected. Above the waterline, single improvement efforts can show measurable results, but even here measurable results should not always be expected. However, while two measures perhaps can not yield any result alone, together they may. Monden (1998) describes how everything made must be seen in a systems view, and how different measures within Lean always interplay and depend on each other. It is the long term synergy effect of several measures that will yield the true results. In these matters, Lean separates greatly from Six Sigma, as discussed in section 3.2 (p.22). Six Sigma projects are not supposed to be even started as long as expected financial earnings can be shown.

At SUS, I asked if they can tell what impact the changes of the doctors' schedules have had on the overall flow, in comparison to other measures taken. The reply was "we cannot, we are method driven in our improvement work, not goal driven", meaning they pay less attention to concrete goals and instead rely on principles and methods they believe in to deliver long term results. This is however not to say thorough investigations are not made before changes are made. KSS describes their improvement work as "data-driven and evidence based". However, the difference to SUS has not been discussed. It could simply be a question of wording.

My conclusion in this matter is that measuring results must be done most carefully, so that it promotes long-term philosophies and value systems. An article for further reading is "Measuring lean initiatives in health care services: issues and findings", by Kollberg et al. (2007).

7. Discussion

Section 7.1 argues why a certain entrepreneurial dimension may need to be emphasized in a Lean transformation.

Section 7.2 discusses whether patient journeys could be more customized to suit the individual patient. It is also argued why the hospital could benefit from this.

7.1 Entrepreneurial Dimension

Liker (2004) claims most people and organizations spend too little time investigating problems before actions are taken. He describes how Toyota and many other Japanese companies differ from the typical American company, with very slow and thorough decision processes. The Toyota principle for smooth and often flawless implementations of new initiatives is: "Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly" (Liker 2004, p.237).

There are a few comments I would like to make on this matter, from the perspective of the healthcare industry.

Given their long experiences with medical studies, I believe healthcare organizations understand the importance and concept of thorough investigations very well. This means requesting thorough decision processes will in most cases be kicking in open doors.

Moreover, there is a national dimension. Liker's book is written from an American perspective, where the culture and national characteristics are quite different from the Swedish. Hines et al. (2008, p.39), discusses the European and Swedish culture in comparison to the North American. In north America, entrepreneurship is a core part of the business culture, seen as the process of discovering and evaluating opportunities. There is a pragmatic approach to problem solving, meaning a great willingness to take risks and "have a go". European organizations in general, and Swedish in particular, are much less entrepreneurial. Sweden has a consensus culture with a higher long-term orientation. The culture dictates that everything must be discussed thoroughly before gaining consensus and decisions for action can be taken.

Altogether, I would ask if perhaps there is a risk of *too* thorough decision processes, at the expense of the entrepreneurial drive? If so, this would have an impact on the overall progress and development of an organization.

I cannot say this is an issue at KSS/SkaS. Only an evaluation of the improvement work over a longer time could tell. A few related observations have been made, but these are left for discussions with KSS. For Swedish healthcare organizations in general, I would anyhow request an attention to the balance between thorough decision processes and entrepreneurial drive.

7.2 Customizing Patient Journeys

As part of the outcome of the improvement team's work at KSS, it was found that there are process steps that can potentially be either skipped or merged, for certain conditions. Specifically, these were the referrals review (4.5.1 p.35), the doctor's visit (4.5.2 p.35), and the registration visit (4.5.4 p.39). An important counter argument of a risk for psychological side effects from too fast patient flows was however put forward.

Then I ask: would it be possible to customize patient journeys? Depending on the medical condition and the patient's sensitivity to (and interest in) fast treatments, the optimal patient journey should not look the same. This would not only be valuable for the patients, but also for the hospital which can have the overall work reduced. Suppose a young man (or woman) who wants an Inguinal Hernia repair in May before going on vacation in June. If he can make *one* visit at the district health care center and then be scheduled for surgery, that would be most valuable for him and the hospital would have escaped a referrals review and a doctor's visit.

Obviously, this raises a series of questions:

- Can patients be classified by their sensitivity to fast treatments? How?
- What medical conditions are suitable for "fast tracks"?
- What type of cooperation agreements are needed with suppliers (such as district health care centers) to enable this flow?
- What medical risks are involved?
- What requirements are put on information systems and supporting processes?
- etc.

Even if patient journeys are different, they are all sub-sets of the main process, defined in section 4.4.2 p.30. Hines et al. (2008) uses the terminology of "runners, repeaters and strangers", to classify products by their volume. Runners are big volume products that may justify a separate production line (or surgery theater).

A related topic that has been briefly discussed is the degree to which security margins shall be used when scheduling surgery. Compare this to the airline industry. Aircrafts are systematically slightly overbooked to ensure the filling rate of seats. Passengers are of course frustrated when they get delayed because of overbooking, but very few are prepared to take the extra cost for a guaranteed seat. If properly informed, would patients accept the risk of having their scheduled surgery canceled, in return of shortened queues and faster treatments? Probably some would accept it and some not. Again, we are back on segmenting patients and customizing the patient journey - a topic I would suggest for future research.

8. Conclusion

The concrete measures identified on how to improve the patient flow, are very similar between KSS dept. surgery and SUS dept. orthopedics, despite they are not the same type of departments and do not share the same history of improvement work. What has been found is also well in line with basic Lean concepts. See table 6.1 on page 52. This suggests that other Swedish hospitals, who are in the beginning of a Lean transformation, should have much to gain from studying the findings from others. Obviously, this is not to say it is possible to make a rip off from any other hospital as a silver bullet for fast results. The local context must always be considered.

Regarding ways to ground for, or "enable", long term sustainability with a Lean transformation, the challenge is to achieve a cultural change in behaviors and attitudes. In literature, Lean transformations are illustrated with an iceberg as a metaphor, where the cultural change and the many people-related issues it involves, represents the the large part of the iceberg, under the waterline. These areas are hard to see and easy to underestimate. In both cases (SUS and KSS), there has been a great awareness in these matters. However, SUS has a seemingly more systematic and consistent approach in addressing them. This includes how Lean strategies are communicated (see 6.2.2), how all employees are systematically involved in the Lean work (see 6.2.1), how system values are consistently used as the main argument for change (see 6.2.3), etc. This is probably what accounts for SUS's success in being classified as one of Europe's most successful Lean hospitals (see appendix E, p.77).

The main findings in this study can be translated into a set of key success factors:

- There is much to gain from studying other cases. As argued above, the two cases in this study indicate that the basic flow problems are likely very similar in different Swedish healthcare organizations.
- Early on, have a systematic approach to address cultural change. It must be put on the agenda as a topic of its own, to be discussed and planned given a structured framework, such as the three enabling conditions and the concept of Pillars and Platforms discussed in section 6.2 p.56. Also see Hines et al. (2008). If, for example, employee involvement is only discussed as an "aspect" on other problems (like concrete flow problems), there is a risk of empty talk and little action.
- The way the Lean strategy is communicated must be very clear and distinct. Preferably, adopt Toyota's A3-thinking. Top management's engagement in the Lean work is crucial.
- Also be very clear in communicating the value system. "If you want to criticize someone, you need data - if you want to change someone, you need a value-system" (Pelle Gustavsson, SUS) Use the value system consistently for evaluating all decisions - and it will be a powerful tool in motivating change. If not used consistently it will turn into bunkum.

- Be careful in expecting results from every improvement/change alone. It is the synergy effect of several actions that will improve flow and effectiveness the most. Measuring results is important, but beware that a goal driven approach such as advocated within Six Sigma, may lead to sub-optimizations. Notably, at SUS a method driven approach is advocated, hence the work is guided by Lean principles. At its essence, this is the Lean principle of "...long term philosophies, even at the expense of short term financial goals". See section 6.2.4 p. 59.
- Given the consensus culture as a national characteristics of Swedish organizations, and healthcare organization's long tradition of thorough medical studies, the risk of rashed decisions is arguably low. Attention should be paid to the balance between the thoroughness of decision processes and entrepreneurial drive. See section 7.1 p.61.

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A. Appendix - KSS Dept. Surgery.

ÖVRE GASTRO

TUMÖR	GALLA	ÖVRIGT	
☐ Esofaguscancer	☐ Gallsten	☐ Pancreatit	☐ Pancreas övrigt
☐ Ventrikelcancer	☐ Choledocussten	☐ GERD	☐ Lever övrigt
☐ Pancreascancer	☐ Cholecystit	☐ Obesitas	☐ Esofagus övrigt
☐ Gallvägscancer	☐ Colangit	☐ Ulcussjukdom	
☐ Levercancer	☐ Galla övrigt	☐ PEG	
☐ Duodenal cancer		☐ Ventrikel övrigt	

NEDRE GASTRO

TUMÖR	IBD	PROCTOLOGI	ÖVRIGT
☐ Coloncancer	☐ Crohns sjukdom	☐ Hemorroider	☐ Appendix
☐ Rectalcancer	☐ Ulcerös colit	☐ Analfistel	☐ Divertikulos/it
☐ Analcancer	☐ Proctit/Ulcerös proctit	☐ Analfissur	☐ Ileus
☐ Appendixcancer		☐ Perianalabscess	☐ Obstipation
☐ Abdominal cancer UNS		☐ Rectalprolaps	☐ Diarré
☐ Benign tumör colon		☐ Marisker	☐ Tarmischemi
☐ Benign tumör rectum		☐ Anal stenos	☐ Stomipatient
		☐ Inkontinens	☐ Enterocutan fistel
		☐ Anal övrigt	☐ Stomibråck
		☐ Anal polyp	☐ Tarmblödning

PEBB

BRÖST	BARN	PLASTIK	ENDOKRIN KIR
☐ Cancer mam	☐ Bråck	☐ Melanom	☐ Malign thyroideatumör
☐ Tumör mam	☐ Hydrocele	☐ Malign hudtumör	☐ Struma
☐ Bröstbedömning	☐ Retentio testis	☐ Bröstplastik	☐ Giftstruma
☐ Genetik	☐ Barn-övrigt	☐ Brännskada	☐ Hyperparathyroidism
☐ Bröst övrigt		☐ Plastik övrigt	☐ Carcinoid
			☐ Endokrinkir övrigt

KÄRL

ARTÄR	VEN	
☐ Kritisk ischemi	☐ Varicer med inflammation	☐ Bensår
☐ Claudicatio	☐ Varicer med bensår	☐ AV - fistel
☐ Aortaaneurysm	☐ Varicer utan bensår	
☐ Arteriellt övrigt	☐ Venöst-övrigt	

EJ TEAMSPECIFIKT

BRÅCK	ÖVRIGT	
☐ Ljumskbråck	☐ Bukutredning	☐ Buksmärtor UNS
☐ Navelbråck	☐ Hidradenit	☐ Cutan förändring
☐ Ärrbråck	☐ Nageltrång	☐ Subcutan förändring
☐ Recidivbråck	☐ Pilonidalcysta	
☐ Bråck övrigt	☐ Bukabscess	

Swedish	English
övre gastro	section for gastro intestinal surgery
nedre gastro	collerectal section
pebb	section for breast and endocrine surgery
kärl	section for vascular surgery

B. Appendix - Initial Hypothosis on Inguinal Hernia Surgery Queues.

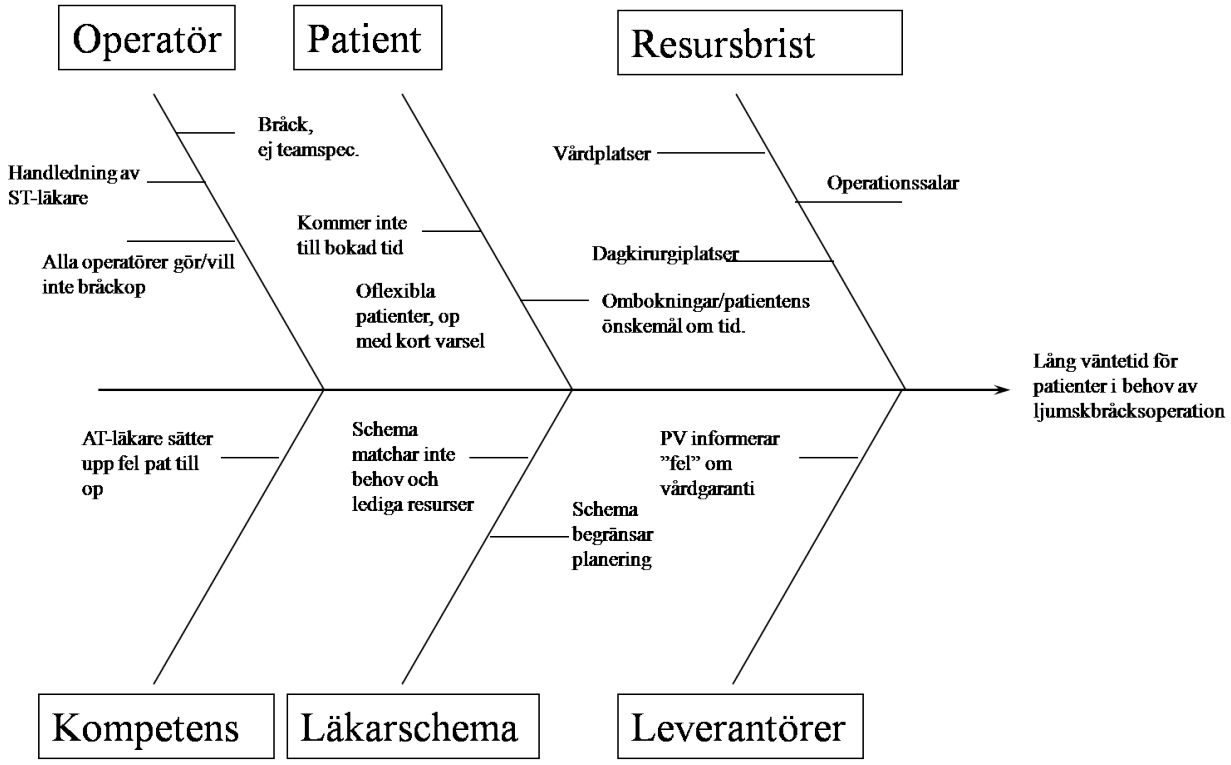

Figure B.1: *Original fishbone diagram (in Swedish) of the initial hypothesis on the Inguinal Hernia surgery queues.*

C. Appendix - Feedback On Referrals

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Dnr

Bästa kollega,

Tack för Din remiss till knä-höftsektionen vid VO Ortopedi USiL!

Inom sektionen pågår ett förbättringsarbete för att optimera omhändertagandet av våra patienter. Vi strävar bland annat efter att minska handläggningstiderna, så att alla patienter kan bedömas inom vårdgarantins gräns.

Som en del i detta arbete granskar vi inkommande remisser avseende ett flertal parametrar, där målet är att kunna bedöma en helt komplett remiss första gången.

Detta brev bifogas för att ge återkoppling på Din remiss och för att upplysa om vilken information vi vill att den ska innehålla. En sida bifogas från ”Vårdprogrammet för ledvärk-artros” (http://www.skane.se/templates/Page.aspx?id=184077) som är utarbetat i ett samarbete mellan primärvården i Skåne och ortopedklinikerna i Lund och Malmö. Vi hänvisar också till ”Remisshantering i Skåne, God klinisk praxis”.

Vi kommer under en tid framöver att ta hand om även ofullständiga remisser, men på sikt planerar vi att returnera ofullständiga remisser för komplettering. Då detta blir aktuellt kommer vi att i god tid meddela detta.

Din remiss bedömdes:

□ **vara helt komplett och bedömbar**

Följande brister identifierades:

□ **för lång tid från remissdatum tills vi fick remissen (över 5 arbetsdagar)**

Följande information saknades:

□ **bifogat och utskrivet röntgensvar med verifierad ledsjukdom – höft och / eller knä, högst 1 år gammalt. Det måste också framgå var patienten är röntgad.**
□ **aktuell vikt / BMI**
□ **tydlig allmänmedicinsk bedömning med aktuella symtom / duration**
□ **given icke operativ behandling / artrosskola**
□ **om patienten är villig att genomgå operation**

Med önskan om fortsatt gott samarbete!

Pelle Gustafson
Verksamhetschef
VO Ortopedi USiL

Ansvarig läkare för remissbedömningen

Adress: Universitetssjukhuset i Lund, S-221 85 LUND.
Besöksadress: Getingevägen 4. **Telefon:** Växel 046-17 10 00. **Internet:** www.usil.se
Bankgiro: 5403-3428. **Organisationsnummer:** 232100-0255.

Utdrag ur "Vårdprogrammet för ledvärk-artros"

Remissindikation till ortopedspecialist

En eller flera av nedanstående punkter ska vara uppfyllda samt att patienten ska vara positivt inställd till operation.

o betydande inskränkning i sitt dagliga liv (belastningssmärta / kort gångsträcka / inskränkt rörlighet / instabilitetsproblematik, sjukskrivning).
o vilovärk / störd nattsömn.
o smärta / värk som INTE svarar på analgetika i adekvat dos.
o kvarstående eller förvärrade besvär trots omhändertagande enligt detta vårdprogram.
o som regel besvär i mer än 3 till 6 månader.

Alla remisser ska följa riktlinjerna i "Remisshantering i Region Skåne, God klinisk praxis".

Vid Egenremiss till Ortopedmottagning rekommenderas återsändning till Närsjukvården.

Vårdprogrammet "Processen för Ledvärk - artros, höft och knä" är utarbetad i samverkan mellan Primärvården i sydvästra, mellersta och sydöstra Skåne och ortopeder från Universitetssjukhusen i Lund och Malmö.

D. **Appendix**
- Schedule from SUS Lund

v 45-1	November				December					Januari	
Vecka	45	46	47	48	49	50	51	52	53	1	2
Administration											
Verks.chef	PG	PG	PG	PG	PG	PG	PG	PG	-	PG	PG
Ställför. Vc	HLP	HLP*	HLP	HLP	-	-	HLP	-	HLP	HLP	HLP*
Ställför. Vc	HE	HE	HE	HE	HE	HE	HE	HE	HE	HE*	HE
Artroskopi											
1	PH*	PH	DR	DR	PH	DR	DR	DR	PH	IOK	PH
2	DR	DR	-	IOK	IOK	PH	-	-	-	-	DR
3	-	IOK	-	-	DR	IOK	-	-	-	-	IOK
AXEL	-	JÅ	JÅ*	JÅ	JÅ	JÅ	JÅ	JÅ	JÅ	JÅ	JÅ
ST	MAL	-	MAL	-		MAL	-	-	-	-	MAL
Barn											
1	HLP	GH	HLP	GH	GH	GH	HLP	GH	HLP/MP	HLP	GH
2	MP	KD	MP	HLP	MP	MET	MP	-	-	-	KD
3	MET	MET	-	MET	MET	-	-	-	-	-	-
Knä / Höft											
Lu 1	UHN	MSU	MSU	UHN	UHN	MSU	AA	UHN	MSU	MSU	GF
Lu 2	UK	SVK*	UK	AA	-	UK	SVK	-	-	GF	UK
Lu 3	SVK	-	GF	UK*	-	SVK	-	-	-	UK	-
Lu ST	-	-	EM	IK	-	-	-	-	-	-	-
Tbg 1	AA	UHN	SVK	MSU	GF	UHN	UK	-	-	AA	MSU
Tbg 2	GF	AA	UHN	-	MSU	GF	UHN	UK	-	-	AA
Tbg ST	IK	IK	-	EM	EM	IK	IK	-	-	EM	-
Reuma / Fot											
R1	BB	UR	UR	UR	UR	UR	UR	UR	UR	UR	UR
R2	KK	KK	KK	KK	KK	KK	KK	KK	AST	KK	KK
R3	AST	BB	BB	AST	BB	BB	BB	-	-	BB	BB
R4	-	AST	JLI	JLI	JLI	JLI	JLI	-	-	AST	JLI
F1	SR	SR	SR	SR	SR	SR	SR	AST	SR	SR	SR
F2	JLI	-	-	-	-	-	-	-	-	-	-
Rygg											
1	TE	BJ	BS	LTN	RJ	BJ	LTN	-	-	LTN	BJ
2	RJ	RJ	BJ	BS	PAX	BS	BJ	RJ	PAX	PAX	LTN
3	-	-	LTN	-	-	RJ	PAX	BS	LTN	BJ	-
4	BS	TE	-	PAX	LTN	-	-	-	-	-	BS
5	PAX	PAX	-	BJ	BS	-	-	-	-	-	RJ
Randare	-	-	-	-	-	-	-	-	-	GS	GS
Trauma											
1	IÖ	IÖ	PON	JN	PON	IÖ	JN	IÖ	JN	PON	IÖ
2	PON	PON	JN	IÖ	IÖ	JN	IÖ	PON	IÖ	PB	JN
3	-	PB	JJ	JJ	-	PON	PB	-	-	JJ	JJ
Avd 11	JN	JJ	EB	ES	JJ	EB	EB	BB	GF	ES	ES
Avd 12	EB	EB + KP	KP	KP	KP	KP	KP	KP	MAL	KP	KP
Tumör											
1	FVS	FVS	FVS	FVS*	FVS	FVS*	FVS	PG	FVS	FVS	FVS
2	ARM	ARM	ARM	ARM	ARM	ARM	ARM	-	-	ARM	ARM
3	-	-	ES	-	-	ES	ES	-	-	-	-
Amanuens/Jour											
Amanuens	HW	HW	HW	HW	RVV	RVV	HW	HW	-	HW	HW
Dagbakjour	JÅ*/PH*	LTN	MET	MP	JN	JJ	MET	IOK	JJ	RJ	MET
Dagjour	RVV	RVV	RVV	RVV	EB	MP	IOK	PB	RVV	EB	IK
NJ 1	EM	MAL	IOK	SVK	IK	FS	JJ	EB	JLI	MP	EM
NJ 2	IOK	JLI	IK	PB	MAL	EM	RVV	SVK	IK	MAL	EB

E. Appendix - Preliminary Classification of Lean Healthcare

Table E.1: *Preliminary Classification of Lean Healthcare, by Ann Esain, speaker at the Lean healthcare conference in Lund 2010-03-16.*

	Point to Organisational End to End	**Organisational End to End to Systematic**	**Across Org. Boundaries**
Sweden	Karolinska hospital, Stockholm: Sahlgrenska hospital, Gothenburg	St Göran Capio hospital, Stockholm	Lund university hospital
UK	Guys and St Thomas' (Dr Fosters 2009 High Patient Safety); Good Hope Hospital (Graban, 2008); Luton and Dunstable (NAO, 2009). *53% English Hospitals claim some lean initiative* (Burgess et al, 2009)	Southport and Ormskirk; Blackpool, Flyde and Wrye (Shingo). *Brighton and Sussex (Dr Fosters, 2009, High Patient Safety); Shrewsbury and Telford; Plymouth; Blackpool Flyde and Wrye* (Burgess et al, 2009)*.	Bolton (Burgess et al, 2009), North East (Erskine, et al, 2009), Royal Devon and Exeter (Shingo), Gwent (Esain, et al. 2008; Dan Jones)
USA	University of Pittstsburgh Medical Center (Spear, 2009), Massachusetts General Hospital (Spear, 2009), Allegheny General Hospital (Spear, 2009), West Penn Allegheny Hospital (Spear, 2009)	The Mayo Clinic (Spear, 2009, Leapfrog, 2009),Virginia Mason Medical Centre (Leapfrog, 2009; Spear, 2005; 2009, AQS), Seattle Children's (AQS), Park Nicolett (AQS), Avera McKennan (AQS), Deaconess Medical Centre (Leapfrog, 2009)	Ascension Health (Spear, 2009), Intermountain, Kaiser Permanente (leapfrog, 2009), Thedacare (Shingo, AQS)
Spain		Fundacion Hospital Calahorra	Catalonia Healthcare network with acute, chronic and social care institutions

* Spear 2005 'in healthcare, no organisation has fully institutionalised to Toyota"s level the ability to design work as experiments, improve work through experiments, share the resulting knowledge through collaborative experimentation & develop people as experimentalists". Used to classify Hospitals -'systemic'