



CHALMERS
UNIVERSITY OF TECHNOLOGY



Understanding production and capacity planning in healthcare

Master's thesis in Supply Chain Management

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CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2021
www.chalmers.se
Report No. E2021:085

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Abstract

Healthcare organizations and systems are increasingly facing many challenges, such as struggling with patients in ques, waiting to get an appointment for surgery. Most long waiting times are only getting worse because of the COVID-19 pandemic. More so, the COVID-19 pandemic has led to cancelations of thousands of surgeries and the care burden is growing large. The flow efficiency in Swedish hospitals is in need of improvement and has been a well-known problem on a national and regional level for years. Low flow efficiency has been hard to improve due to the existence of variation in demand as well as in production and capacity at various system levels.

More specifically, understanding and balancing variation over time regarding demand (i.e., the inflow of patients) versus the production and capacity to manage these patient flows is key to an improved flow efficiency on an operational level. Based on the empirical material, possible areas of improvement are suggested to better plan production and capacity so that it matches inflow. This thesis was conducted by developing a theoretical framework consisting of literature regarding variations, flow theory, Lean Healthcare and Improvement Science. Moreover, questionnaires and semi-structured interviews were performed with an aim to develop conceptual understanding of the healthcare environment.

This study agrees with the common idea that an adequate flow efficiency is difficult to achieve, as well as a sustainable production and capacity planning (PCP), due to the presence of variation. Amongst several findings, communication and collaboration between various professions has shown to be a barrier when trying to achieve a well thought out PCP. At the same time, communication, collaboration and understanding of each other's professions is key to be able to conduct sustainable improvements. Practically, this study has identified barriers regarding PCP in healthcare and suggestions of how to come to terms with these. Theoretically, this study has illuminated the shortage in Lean Management, Lean Healthcare, as well as Improvement Science literature regarding soft values, such as collaboration and communication. Also, there was no clear connection between Lean Management, Lean Healthcare or Improvement Science regarding PCP. Moreover, this paper provides evidence that there are still different, sometimes conflicting, perspectives in healthcare. The findings of this study are relevant for various healthcare organizations as well as for researchers in the area of PCP and Improvement Science in a healthcare context.

Keywords: Production and capacity planning, Healthcare, Lean Management, Lean Healthcare, Flow efficiency, Improvement Science

Acknowledgements

This master's thesis was performed at the Technology Management and Economics at Chalmers University of Technology, Gothenburg, Sweden, as a part of the Supply Chain Management Master of Science programme. The study was performed during the spring semester of 2021 and was assigned by Skaraborg Hospital Group (SkaS).

We would like to thank SkaS, and especially Svante Lifvergren, for all the support, interesting discussions and feedback throughout the process. Also, Hanna Lindahl, who has helped and guided us throughout the entire project with lots of interesting inputs. More so, the site visits would not have been possible without you! Anders Plantin has also given us ideas and useful input. We are grateful for all the support and help from the internal project at SkaS and the rest of the hospital as well. We are very grateful for having the opportunity to write our master's thesis at SkaS and all for all the respondents who took part in the questionnaires and interviews. The thesis would not have been possible to execute without you.

Lastly, we would like to kindly thank our supervisor from Chalmers University of Technology, Erik Eriksson, researcher in Service and Quality Management in the public sector, for supporting us during the entire process and giving us the tools to proceed. We have been truly grateful for your knowledge within the healthcare sector!

Jessica Bengtsson & Ida Edenholm, May 2021

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Nomenclature

| | |
|---------------------------|--|
| <i>Productivity</i> | The ratio between the output volume and the volume of inputs. |
| <i>Efficiency</i> | The state or quality of being efficient or able to accomplish a task with the least waste of time and effort; competency in performance and/or the capacity to produce the maximum output with a given input. In a healthcare context, efficiency can be explained as the achievement e.g., in terms of patient quality and medical outcomes, put in relation to the proclaimed costs. |
| <i>Flow efficiency</i> | The ratio between value-adding time and the lead time required to complete a process. |
| <i>Value-adding time</i> | The time when a person or a product is actively moving towards the completion of a target. |
| <i>Lead time</i> | The amount of time that passes from the start of a process until its completion, i.e., the time to complete the process. |
| <i>Process</i> | A series of actions or steps taken in order to achieve a particular outcome. |
| <i>Surgical specialty</i> | A department at the hospital which performs specific surgeries. For example, child and women's care, orthopedics and the urology department. |

1.Introduction

In the following chapter, a background is presented covering the current struggle with long waiting times in healthcare for surgeries and because of COVID-19, the already long waiting times are only getting longer. The Swedish healthcare system is further described and a brief introduction to the Skaraborg Hospital Group is presented. The aim, limitations and specification of issue under investigation follows.

1.1 Background

1.1.1 Healthcare in Sweden

Healthcare organizations are increasingly facing many challenges (Bergman et al., 2015). Long waiting times and queues of patients have been problems for many years (Jacobsson & Åhlström, 2010). Currently, the COVID-19 pandemic has led to cancelations of thousands of surgeries every week and the care burden is growing large (Dagens samhälle, 2021). In parallel, many countries are struggling with an aging and growing population, which increases the demand of healthcare (Lifvergren, 2013). Adding to that, elderly people need care for multiple diseases (Bergman et al., 2015; Eriksson et al 2020) and as the proportion of the elderly in the population is rising, the numbers of taxpayers are reduced and healthcare is thus jeopardized (Lifvergren, 2013). Some argue that healthcare is suffering from a lack of resources all over the world and that insufficient support from the government leads to deficient care (Jacobsson et al., 2010; Weisz et al., 2013).

The Swedish healthcare system is managed and divided between three political governing levels: the national government, the regions and the local municipalities. All levels are democratically elected every four years. The national government is responsible for policies related to the overall health and medical care, while regional and local authorities are responsible for the financial and provisional part. The regions obtain the main political responsibility for finance and provision and the municipalities have responsibility for the long-term care for the elderly and disabled people as well as psychiatric care (Socialstyrelsen, 2020).

Besides, there are several national authorities that are vital for the governance of the Swedish Healthcare system. One actor is the National Board of Health and Welfare (Socialstyrelsen), which is Sweden's agency of knowledge for health and social care. The Swedish National Institute of Public Health (Folkhälsomyndigheten) is another supportive agency, which develops and helps the society to favour health and prevent illness. The Swedish Region on Health Technology Assessment (Statens beredning för medicinsk utvärdering) has an innovative role by assessing healthcare and social service interventions. Further, SKR strives for improving regions and municipalities functions. They are a network in which knowledge exchange and coordination is one of the main functions (SKR, 2021).

Every region and municipality can levy income taxes on the population (Socialstyrelsen, 2021). Thus, the system is mainly tax-funded with minor patient fees. Sweden has 21 regions and 290 municipalities, which differ from each other in terms of area, number of inhabitants, economic structure and different cultural and political preferences. By taking the differences into account,

decentralization can contribute by bringing the population even closer to the government and adapting to the needs of the local people. However, by having healthcare decentralized, the healthcare system is governed from many different geographical levels and the situation may also turn complex and hospitals might to some extent miss out on the knowledge about how to divide responsibilities that is common in a centralized organization (Blomqvist, 2007). Furthermore, politicians, professionals and managers are fighting over power and control which makes the situation even more complex (Hallin & Siverbo, 2003; Mintzberg & Glouberman, 2001).

The aim for the Swedish healthcare system is to achieve good health and healthcare on equal terms for the entire population (SFS, 2017:30, Chapter. 3 1 §). The services are available either privately or publicly, and the healthcare guarantee is prevalent and grants the patient the right for specialist treatment within 90 days, primarily in the closest region and otherwise in other regions (SKR, 2021). Region Västra Götaland is the second largest region in Sweden, which provides the inhabitants with healthcare and medical treatment. Currently, the region operates 17 hospitals, 121 healthcare centers and 170 public dental care centers. Some care is provided by private clinics under contract with Region Västra Götaland. The objective is to strive for providing good health on equal terms (VGR, 2021).

Even though a lot of individual workers in healthcare provide dedicated and excellent work, the system needs to be optimized, and this is difficult due to the presence of sub-optimization within different departments (Weisz et al., 2013). According to a national inquiry (SOU, 2016), the experienced scarcity of resources is caused by the individuals and the healthcare system can be improved without adding more assets and by making better use of the ones at hand. However, Swedish healthcare is considered to have a weakness in slow patient flows and is encouraged to manage this challenge. Increasing the efficiency by having an overall view, making actors cooperate and implementing improvements along the patients' whole process is considered crucial to reach success (SOU, 2016).

The healthcare system in Sweden is argued to work quite well in many ways (Eriksson, 2016). Sweden is e.g. in the leading edge of cancer survivors' rates compared to other Western countries (Coleman et al., 2011) and doing fairly well in low infant mortality rates compared to other European countries and the United States (MacDorman et al., 2014). But the mentioned examples of positive medical outcomes in relation to other countries can be argued to not reveal the real picture within the diverse Swedish population regarding who benefits or who does not (Eriksson, 2016). Also, in general, the public sector in Sweden faces difficulties trying to manage efficient customer service of high quality. Public service organizations can be related to negative aspects of bureaucratic and exceedingly administrative (Engen et al., 2020).

Many reports indicate that the execution of healthcare in Sweden compared to other countries is low, due to low productivity and slow patient flows (SKR, 2015). Slow patient flows are extending waiting times, increasing queues and causing delayed surgeries and care for the population. Sweden is also experiencing a lack of involvement from the patient and scores poorly in informing patients and allowing them to take a more active role in their care (SKR, 2015). Of all OECD countries, patients in Sweden with complex care needs have shown to be

least likely to report perceptions of involvement in their treatment (Eriksson, 2016). Possibly, the increasing digitalization and high technology trend will open up for new ways of working and save societies and citizens (Flynn & Neto, 2019). A growing number of studies are reinforcing the value of more interaction with the patient and having well-informed patients for achieving a more efficient healthcare (Bergman et al., 2015; Eriksson, 2016; SOU, 2012). Additionally, the healthcare system is integrated and involves a large number of stakeholders, and it is a challenge to manage different interests and make them corporate in the same direction (Glouberman & Mintzberg, 2001).

1.1.2 Skaraborg Hospital Group

Skaraborg Hospital Group (SkaS) is an emergency hospital group that offers medical, surgical and psychiatric specialties in 30 various areas, whilst working with Research & Development and education as well. The hospitals are a part of Region Västra Götaland (VGR) and consist of four hospitals in the cities of Skövde, Lidköping, Mariestad and Falköping. The hospital is further built-up of different surgical specialties. The hospital has around 673 hospital beds, 4,400 employees and the hospital meet acute and planned care. The main objective at SkaS is to strive for the aim: “Together for good care and health to fulfil the patients’ needs” (Västra Götalandsregionen, 2021). In 2013, sustainability was a prioritized strategic theme to meet the challenges facing healthcare systems in Sweden (Kira & Lifvergren, 2013), but the ambitions of sustainability for SkaS is nowadays mitigated. Sustainability will be discussed in section 2.6.

1.1.3 Problem specification

Inadequate flow efficiency in healthcare has been a well-known national problem area for years. The productivity regarding surgical procedures on a national level has remained at the same level since 2013 despite many efforts to improve the system, for instance using principles and practices from Lean Healthcare and Improvement Science (Socialstyrelsen, 2019). In addition, the need for an efficient flow of patients has become even more critical as the COVID-19 pandemic has led to a grand build-up of patients waiting for cure and care. Many surgeries have been postponed or even cancelled due to the current healthcare situation. During 2020, 91 000 fewer surgeries were executed nationally compared to 2019 (SR, 2021) Obviously, the challenge is huge and current principles and practices to improve productivity and flow efficiency need further development.

On the local level, the Skaraborg Hospital Group has set an aim to increase the number of planned surgeries by finding new ways to improve flow efficiency, whilst not compromising patient safety, quality or working conditions.

1.2 Aim

The aim of the thesis is to understand how the combination of production and capacity planning (PCP) and lean practices at an operational level at the hospital in Skövde might contribute to improved flow efficiency. The aim is further condensed in three research questions, presented in section 1.4. The outcome will hopefully lead to an understanding of how to achieve a more efficient flow by combining principles and practices from PCP and Lean healthcare. The hospital strives to improve the planning horizon at the operational level. The study will focus on causes that are affecting the production and capacity planning and thereby the patient flow negatively to suggest areas of improvement. The surgery planning was first evaluated broadly, but the visible and tangible need from SkaS to investigate in terms of surgery registration formed the thesis on an even more detailed level.

1.3 Limitations

This thesis was conducted at the Hospital in Skövde, leaving the other three hospitals in the Skaraborg Hospital Group out of the scope. The studied flow was from referral to the start of surgery. The latter is defined as when the surgeon starts the surgery, includes preparatory “bloodless” surgery such as closed reposition and local anesthesia provided by the surgeon (SPOR, w.d; SFAI, w.d). Moreover, according to Glouberman and Mintzberg (2001), four different worlds exist in healthcare: cure, care, control and community. However, this thesis only considered the first three and not focus on the community world. This will be further explained throughout this thesis, in the theoretical framework as well as in the empirical case study and the discussion.

This thesis is mainly focus on planned surgeries, with that said, acute surgeries will still be taken into consideration, as these somewhat affect capacity planning regarding resources. Moreover, recommendations are suggested but not implemented, leaving the possibility to test and evaluate said solutions out of the scope.

In order to get a broader picture of surgery planning, it would have been interesting to evaluate and compare with other hospitals. But due to the time limit, benchmarking was not prioritized and therefore excluded. Possibly, this thesis can inspire and encourage other organizations and hospitals to perform similar investigations.

1.4 Specification of issue under investigation

The following research questions have been central throughout this thesis to be able to meet the aim.

RQ 1. How is production and capacity planning for surgical specialties currently performed?

RQ 2. What are the main success factors and barriers?

RQ3. How can the production and capacity planning be further developed and improved within surgical specialties?

2. Theoretical framework

In this chapter, a conceptual framework is illustrated to present the chosen literature and theories. Thereafter, variations are discussed, in general, in relation to flow efficiency and lastly regarding the healthcare sector. After that, the four worlds in healthcare are presented. Following are theories on flows and Lean Healthcare. Improvement Science is presented next, and the sustainability aspects conclude this section.

2.1 Conceptual framework

Papers presented on the so-called 4C model were used to give a starting point and an overview of how the healthcare sector is thought to operate with various professions and stakeholders. The findings from these papers led us to wanting to know more about communication and collaboration, as it was shown that the different professions in healthcare commonly do not see eye to eye, how healthcare should be executed. Since this paper is about hospital flows, Lean management was a given entry as well as Lean healthcare and with that, production and capacity planning.

To be able to suggest how to achieve possible improvements, Improvement Science was studied along Change Management. This was done to be able to detect what organizations need to conduct sustainable changes to their way of working. A common problem area detected was variation, which will be discussed recurrently throughout the paper. Variation, of course, has a connection to Lean management and therefore in turn, Lean healthcare. Improvement Science guided us into improvement methods that can be used to analyze and implement improvements. This thesis will partly bring up theories in general, as well as theories connected and adapted to a healthcare perspective. In addition, the sustainability aspect will be discussed.

It has been important to see if and how used models and findings are interlinked and how they can contribute to this paper. Besides that, it has been vital for us to see connecting points and differences in the gathered theories. The theory presented in this thesis is thought to match the empirical findings, meaning that we strived for a theoretical framework that illustrated the studied environment at Skövde Hospital and nothing more, or nothing less. The overview of how the theoretical framework was built is presented in Figure 2.1.

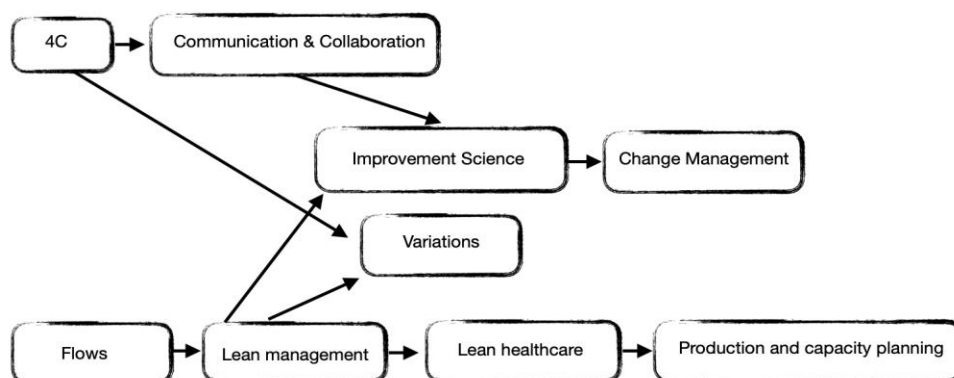


Figure 2.1: Conceptual framework

2.2 Variations

Firstly, variations in general are brought up. After that, variations related to flow efficiency are presented followed by variations in a healthcare context.

2.2.1 Variations in general

Variation is common in our daily life and when looking at the world, variation is found everywhere (Bergman et al., 2015). When something is not consistent, it varies (Rosenbäck, 2017), and everything that is observed and measured does so (Neuhauser et al., 2011). Uncertainty that originates from variation makes it difficult to predict the future. This means that decisions are sometimes made upon uncertainties and that those decisions are not always rational (Bergman et al., 2015). There is an important distinction between two types of variation, synchronic variation and diachronic variation. The first is variation between units, whilst not focusing on time and the latter involves the time aspect (Bergman et al., 2015).

Variation is a general problem in the industry, which compromises production planning as it decreases predictability regarding capacity and the flow in itself (Rosenbäck, 2017). The need to have predictable processes (Bergman et al., 2015) and to reduce unintended variation that is harmful leads to better performance (Neuhauser et al., 2011). As Ashby's law presents, the amount of control regarding a system is directly proportional with the amount of accessible data. In other words, there is a need for a substantial quantity to be able to control a system, regardless of what system. Commonly, variation is the result of variation in the inflow as well as variation created in the process. To manage a variation, one must understand the variation and its effect on the process (Rosenbäck, 2017).

To handle and reduce variation, one way is to distinguish between common and special variation. There are various methods to reduce or handle variation and the focus should lie on variation that is created. One way is to even out the inflow and another is to introduce capacity planning in order to make the production plan more stable whilst at the same time addressing variation. When prioritizing reduction of variation, variations that are of great volume, those that are hard to predict and variations that are a part of a change that will create a higher inflow should be addressed first (Rosenbäck, 2017).

2.2.2 Variations related to flow efficiency

Variations are almost impossible to avoid in processes and flows. The reasons for variation are more or less unlimited but can possibly be categorized into three different groups: resources, flow units and external factors. Resources in organizations obtain personnel that commonly have different knowledge, experience and values. Flow units as patients in healthcare have different needs and requests. The human factor is also important to bear in mind. The inflow of patients can arrive at the emergency hospital in uneven and seasonal intervals, and this has an influence on arrival time and the delivery time, which can lead to an increased lead time. Natural variation from humans is inevitable. Standardizing the handling of people is much harder compared to handling material or information. Consequently, the flow efficiency is challenged (Modig & Åhlström, 2011).

Kingman's equation partly illustrates the two factors: utilization and waiting time. The higher the utilization degree, the longer the queue. Eventually, the queue will approach infinity as the utilization approaches 100 %. Moreover, another factor is variation. The higher variation, the longer the queue. If the flow strives for a reasonable lead time and queue length, it should abstain from striving for 100 % utilization. The lower utilization, the shorter the lead time. E.g., the trade-off between good usage of resources and shorter lead time needs to be taken into consideration. Furthermore, reducing variation and trying to obtain faster lead times can be done by leveling, as in Lean Healthcare (Rosenbäck, 2007). Furthermore, Kingman recommends that when there is a high variability, lower utilization could be appropriate to attempt. Likewise, if high utilization exists, reducing variability is a reasonable way to go (Kingman, 1961).

2.2.3 Variations in healthcare

Variation is a common phenomenon in healthcare as all patients are different (Neuhauser et al., 2011; Rosenbäck, 2017), which is known by healthcare professionals. In other words, there is a great understanding of variation on an individual level (Bergman et al., 2015). Also, variation is even wanted to some extent, as up to date treatment and care process improvements lead to variation that is helpful as it should lead to new learnings (Neuhauser et al., 2011). Moreover, there are detected variations in healthcare connected to how well care is brought out in different regions and if you are born in Sweden or not (Eriksson, 2016).

Variation is looked upon differently from various healthcare actors, commonly leading to misunderstandings in the area. Managers in the healthcare sector are first and foremost interested in the care process performance over time whilst clinical and health service researchers are more concerned about the effectiveness of care and if the findings are generalizable as well. And last, patients are naturally concerned about their individual care and safety and therefore, they have a small understanding and need for generalizability (Neuhauser et al., 2011).

Variations affect the healthcare sector in various ways, and it is seen that low predictability can have an effect on patient safety and the quality of care (Rosenbäck, 2017). Thereby, there is a constant need to understand and manage variations regarding different timeframes and with various approaches (Neuhauser et al., 2011). When studying variational impact, it can be made clearer where to improve the way of working, making this a top priority within the organization. However, hospital employees have their main interest in attending patient needs, and there is little knowledge and will to analyze the production aspect and to handle registrations. When handling registrations insufficiently, the ability to analyze statistics will be compromised as there are not enough figures to draw conclusions from (Rosenbäck, 2017).

Variation in healthcare can arise from inflow variations such as response times from other actors within the process or the variation of examining methods. Variations along the process can be differences in surgical methods, surgery planning, personnel capacity, or employee

knowledge (Rosenbäck, 2017). Diachronic variation, i.e., variation over time, is vital when conducting healthcare improvements (Bergman et al., 2015).

The need to handle variation in healthcare should be highly prioritized since variation should be handled to be able to avoid chaotic days as a result of high variation at that specific time. It is also hard to detect other successful changes within an organization when variation is present (Rosenbäck, 2017).

2.3 The different worlds in healthcare, collaboration & value co-destruction

It is well-known that the healthcare sector is difficult to manage (Glouberman & Mintzberg, 2001). One explanation for this is that healthcare organizations are truly complex systems, which need to be broken down to elements in order to grasp and entangle the complexity. It has been stated that the more complex an organization is, the larger is the need to integrate said organization (Glouberman & Mintzberg, 2001). Also, as the complexity increases within an organization, the manageability as well as the predictability decreases (Bergman et al., 2015).

A framework is presented stating that the healthcare world, as mentioned, can be divided into four different worlds or organizations. These four worlds then have contrasting activities, ways of organizing and perspectives and as these four worlds have difficulties integrating, the system will remain as complex as it is if no actions are taken (Glouberman & Mintzberg, 2001; Andersson & Liff, 2017; Hamida et al., 2019).

One of the four worlds is *cure*, the medical community, supported by *care*, which consists mainly of the nursing staff and other specialists who provide basic care. These two worlds focus on the patients and their required needs. *Control* is another world, gathering people of administration who are responsible for the institution with regards to resource management and budgeting. These people are not directly involved in the operations. Last, is the world of the *community*. This world consists of trustees of the hospital and politicians (Glouberman & Mintzberg, 2001; Andersson & Liff, 2017).

These four worlds or organizations may work well separately but can collide in various ways when trying to operate together, meaning that the system needs to dissolve into a network with strong collaborations to function more efficiently. All functions are important, and dividing the work is indispensable, but there needs to be better integrations between the different worlds to possibly avoid a destructive atmosphere. After all, the matter of interest is common for all four worlds: Keeping the patients and population in good health (Glouberman & Mintzberg, 2001).

Glouberman and Mintzberg (2001) mention three forces which can be subject for integration, which may connect the four worlds, whilst also explaining their differences to some extent. The first being commitment to purpose (Glouberman & Mintzberg, 2001), which explains that people working in healthcare are most often truly dedicated to their work (Rosenbäck, 2017). However, this intrinsic motivation is not commonly used for organizing, which is unfortunate (Bergman et al., 2015). The second force is the knowledge aspect since research is vital and

common for all four worlds. The third force is urgency, which is fundamental in order to save lives and maintain good health (Glouberman & Mintzberg, 2001).

It is already known that good care often depends on a well thought out collaboration between various people, and likewise, improvements in the healthcare area tends to work best when people from different professions work together in teams with strong communication (Ferguson et al., 1993; Plsek, 1999). This wide-spread cooperation between different professions and employee-involvement is key when operating quality management, which can even be traced back to industrial practices in the 1940s (Juran, 1964; Ishiwaka, 1985). Working towards a common aim over different professions and organizations has shown to be quite powerful in the industry, but even so in healthcare (Plsek, 1997). Collaboration to achieve good and safe healthcare is a medicinal tradition and will benefit all actors working within the area, and subsequently, the patients benefit from better care (Plsek, 1999).

The main issue of collaboration seems to be miscommunication (Dudau et al., 2016). One factor of success, however, is flexibility, but it is difficult to achieve with the bureaucratic structure present (Willem & Lucidarme, 2014). Also, it may be beneficial if collaborations were informal, not hierarchically dependent, and with actors of equal status striving for consensus (O'Leary & Vij 2012).

Value can, besides from being created, also be destroyed (Osborne, 2018). It has been stated that value diminishment or co-destruction, can occur in the healthcare sector when providers, users and other actors interact (Cluley et al., 2020).

Value co-destruction occurs as various actors fail to interact with each other and to integrate mutual resources in a beneficial manner for both parties. This leads to the diminishment of value for one or more parties. Moreover, the loss of value may also occur if resources are used inefficiently or not in consonance and, this can be caused by either one actor, or multiple actors (Engen et al., 2020). Eight aspects have been identified as critical for value co-destruction. Absence of information being the first, followed by a lack of trust, mistakes, an inability to serve, inability to change, the absence of clear expectations, customer misbehavior and blaming (Järvi et al., 2018).

2.4 Flows and Lean Healthcare

This chapter contains the efficiency of flows in general, followed by the efficiency paradox and suboptimization. Following, theories in queueing theory will be covered and bottlenecks in flows and processes. Thereafter, Lean healthcare is presented followed by criticism against Lean Healthcare.

2.4.1 Efficiency of flows

As mentioned in 1.1.1, organizations in healthcare face increased pressure and expect higher demand to improve operations and to provide higher levels of quality and efficiency¹ in their organizations (Bergman et al., 2015). Flow efficiency is the ratio between value-adding time and the lead time required to complete the process. Because of earlier mentioned problems due to long waiting times for patients and slow flows, the flow efficiency for Swedish hospitals has become quite low. The time when a person or a product is actively working towards the completion of a target, is defined as the value-adding time (Modig & Åhlström, 2011). However, a flow efficient organization is a state of ideal and is extremely hard to accomplish because of the existence of variation (SOU 2012).

According to Modig and Åhlström (2011), the efficiency paradox arises when efficiency of the individual resources is pursued. This paradox illustrates a dominant focus on maximizing the efficiency of individual resources without regard to how the individual group of resource efficiency can be integrated into the entire system. Flow efficiency is needed to manage the problem. Also, Lean Management is one way to go. Lean Management is a strategy with clear visions and directions turned to the whole organization. With a mutual mindset, openness for endless learnings and continuous improvements, reducing waiting-times for patients is possible whilst at the same time not compromising quality (Rosenbäck, 2017). Lean Management and the adaptation to healthcare will further be discussed in section 2.4.2.

The efficiency paradox emerges when maximizing the efficiency of individual resources without due regard to evaluate the entire system. This way of looking at efficiency is called resource efficiency and can result in sub-optimization. An optimal flow efficiency implies the rate of 80 % of the resource efficiency, otherwise the throughput time will increase towards infinity. Through variation reduction in the entire flow, a higher resource capacity is acceptable in the same flow efficiency (Modig & Åhlström, 2011).

To avoid the paradox, organizations should focus on efforts for optimizing the flow of all the components in the system, rather than to seek to locally optimize the efficiency of individual resources within the system. This is the main objective of flow efficiency (Modig & Åhlström 2011). Also, low flow efficiency influences patient safety (Donaldson et al., 2014). The patients may be affected by the optimization of flow efficiency when they need a special treatment and care needs to be replaced in another department to optimize the flow. The patient may acquire a deterioration of care service ((Modig & Åhlström, 2011). In queueing theory, Little's law is about the average waiting time and the average number of items waiting for a service in a service system and are considered useful and essential measurements for managers.

| | |
|-------------------------|--|
| ¹ Efficiency | The state or quality of being efficient or able to accomplish a task with the least waste of time and effort; competency in performance and/or the capacity to produce the maximum output with a given input. In a healthcare context, efficiency can be explained as the effectiveness of a medicinal measure, put in relation to the proclaimed costs. |
| Effectiveness | The capacity of having the desired result or effect. |
| Efficacy | The capacity for producing a desired result or effect. |

<https://www.dictionary.com/e/effectiveness-vs-efficacy-vs-efficiency-when-to-use-each-word-for-the-best-results/#efficacy>

The waiting time relates to units and the average rate of arrival to the system (Little & Massachusetts 2008; Song Hee & Ward, 2003).

$$\textbf{Lead Time} = \textbf{Units} \times \textbf{Units per period of time}$$

A bottleneck is a process or activity that limits the capacity of the flow in the chain. Queues often arise before the bottleneck and capacity will be available after. Consequently, bottlenecks increase lead time, decrease the value-adding time and worsens the flow efficiency. No matter what, bottlenecks will always exist in flows. The attempt to add more resources will only lead to another bottleneck. However, managing and trying to handle bottlenecks should always be the objective (Modig & Åhlström, 2011). The identification of a bottleneck is the first and most important step towards the improvement of a business production capacity. It is the key stage of the continuous improvement process (Urban & Rogowska, 2020). Some argue that it is quite easy to identify a bottleneck for people and material, and that information units are considered harder (Modig & Åhlström, 2011). Bottlenecks mainly consist of because processes are placed after each other and existing variations, often caused by various needs (Modig et al. 2011). Variations will be discussed in section 2.2.

The healthcare system in Sweden is considered to have low flow efficiency compared to other Nordic countries (SOU, 2016). In practice, this implies low availability and long waiting times in the emergency department (SOU, 2016). In addition, studies indicate that the waiting times increase every year (Socialstyrelsen, 2015). As earlier mentioned, flow efficiency is the ratio between value-adding time and the lead time required to complete the process. In practice, the unit process is defined from the perspective of the flow unit. In the healthcare context, the unit is an individual patient at a hospital or waiting for a diagnostic evaluation. The value, on the other hand, is defined from the patient's perspective. It is also important to understand the patient's direct needs related to the diagnosis and the treatment as well as the indirect needs, which can be more related to the experience of the services. The value-adding time is assessed using both perspectives. Subsequently, flow efficiency is about determining the right mix and balance between the two different needs (Tay et al., 2017).

In many primary care hospitals, departments prefer to specialize a function that serves to meet the needs during parts of the patient care journey within the hospital. The focus tends to be on maximizing the use of the individual resources or functions at the specific departmental or sub-unit level. Thus, patients which require a diagnosis often must wait for long periods of time because each department strives to optimize their own resources. Consequently, the suboptimization of resources within each department leads to long throughput times, many flow units, needs of new patient appointments and many changeovers in hospitals. Therefore, how the resource integrates with other elements in the system is vital to consider. Another example is hospitals that will optimize the use of operating theatres in the surgical department by maximizing the booking of surgical time slots, without considering how the surgical department is connected to the wider hospital system, the overall service time for the patient will be longer (Tay et al., 2017).

Furthermore, the government and the decentralization within the healthcare system is highly divided and responsiveness is complex and many times undefined, which makes the flow efficiency even worse (SOU, 2016).

2.4.2 Lean Healthcare

The previously discussed concept, flow efficiency, is one of the fundamentals in Lean Healthcare. But the latter started in Lean Management in the Toyota Motor Corporation in the 1950s. The Toyota way or Toyota's Production System (TPS) was the starting point which provided what the *customer* wanted in an effective way and with little waste. It is considered as an alternative to the traditional method of mass production and batching principles for optimal efficiency, quality, speed and cost (Bhakoo et al., 2017). The approach includes a strong focus on the customer, continuous improvements and achieving a learning organization. Further, integrated upstream and downstream processes with minimized waste are highly in focus as a part of the Lean value chain. The performance benefits of these Lean systems are improved quality, lower cost and faster delivery. Thus, striving for standardized processes as far as possible and waste elimination are fundamental objectives. The philosophy stands for creating a true learning culture to reach a learning organization. Accordingly, the approach is based on effectively integrating people, processes and technology. All needs to be adopted, comprehensive and a coordinated effort for change and learning is vital across the entire organization (Lander et al., 2007).

Liker suggests 14 management principles that an organization should embrace. The Lean principles are; Base your decisions on a long-term philosophy, Create continuous flow, Use pull systems to avoid overproduction, Level out the workload, Stop and fix the problem, Work with standards, Make problems visual, Use only reliable tested technology, Grow your leaders internally, Develop exceptional people and teams, Respect your network partners, Go see for yourself, Make decisions slowly by consensus and implement rapidly and Use Hansei (reflection) and Continuous Improvement (Kaizen) to become a learning organization (Liker, 2009).

The Lean approach aims to remove wastes from processes. Waste is seen as any action or step in a process that does not add value for the customer and is classified in its most general sense and includes time and resources as well as materials. In the Lean philosophy, it consists of eight wastes. *Transportation* is seen as the movement of people, tools, inventory, equipment or products that are more than necessary. Consequently, excessive movement can lead to unnecessary work and take time from the value-adding activities. *Excess inventory* can lead to longer lead times, inefficient allocation of capital and problems being hidden in the amount of inventory. In-office inventory could be files that are waiting to be worked on and customers waiting for service. *Motion* includes all types of any unnecessary movement of e.g., machinery, equipment and people. To avoid this waste, the organization should make sure that the workspace is organized in an appropriate way (Liker, 2009).

Waiting is often caused by unevenness in the flows and can thus result in excess inventory and overproduction. Different types of waiting exist as people waiting for material, equipment or deliveries. But it could also be ineffective meetings, having files waiting for review or waiting for the computer to load a program. Effective flows with reduced waste can also be achieved by using standardized work instructions to level out the workload and developing multi-skilled employees that are flexible and can adapt to the changing work demands (Liker, 2009).

Overproduction implies an excess number of products or services. To meet the customer demand exactly in time, quantity and quality, the overproduction waste can be reduced by the just-in-time philosophy. *Overprocessing* implies having more steps or components than what is required to fulfil the customer's demand. To counter this waste, it is vital to understand the requirements of the customer and always have the customer in mind before making any action. *Defects* occur when the products do not fit or work for the intentional use. By redesigning processes and standardizing work, operations that do not deliver any value to the customer can be reduced.

The last waste is waste of *non-utilized talent* or 'Skills' of workers (Lander et al. 2007). The waste of human potential occurs when the skills of the individuals are not utilized and the co-workers do not get the possibility to contribute with skills and properties that the person has capacity for (Liker, 2009). Identifying and mapping an organization's waste is an appropriate way to accomplish more effective processes and flows (Meudt et al., 2017). Also, engaging the frontline workers and taking their ideas for improvement is a good way of improving. By engaging the whole organization, the reduction of waste will be more natural and become a part of the daily routine (Liker, 2009).

Service operations face the continuing challenge of matching customer demand with supply and healthcare services have thus been the focus of much concern and attention. Responsiveness to patient needs and availability are key priorities among healthcare improvements cited by The Institute of Medicine (2001). The interest in Lean healthcare is increasing and is an effective way of improving healthcare organizations, with a high number of good results from reports and support implementations. Advancements such as improved patient care, better clinical processes, improved safety, less delays and reduced costs are just some examples (Al-Hyari et al., 2016; Costa and Godinho Filho, 2016; D'Andreanmatteo et al., 2015; White et al., 2013). The staff empowerment and concept of continuous improvements in healthcare organizations fits the Lean approach well (Brandão de Souza, 2009).

Through Lean Healthcare, organizations within the healthcare section have increased their interest in flows (Machado et al., 2014). The way of working has contributed with satisfactory results in analysis of flows, different kinds of works of improvement and knowledge about how to work with continuous improvements within the organization (Al-Hyari et al., 2016). Moreover, the way of working has changed cultural and organizational structures as the departments have started to understand the importance of working together and cooperating to a higher degree over the working levels and departments (Cory & Hallam, 2018). Levelled patient flows and evening out the resources is considered to reduce the waiting times for patients. It is important to understand the in- and outflow of the process to be able to figure out how to schedule the supply to meet the demand. In addition, improving the channel of effectiveness is also a proactive way of working towards flow efficiency for healthcare organizations. Implementing Lean Healthcare is a challenge and organizations must manage difficulties and additionally, the required deep understanding of the approach is also vital to succeed (Al-Hyari et al., 2016; Rosenbäck, 2017).

2.4.3 Criticism against Lean Management

Throughout the years, Lean Management has been criticized from various stand points. There are on-going discussions whether Lean Management is applicable to other industries than manufacturing (Mast, 2004). Some argue that Lean is only related and can be applied in the industry, with a high volume of producing products (Lander et al., 2007). Also, some argue that in healthcare, no organizations have fully institutionalized Toyota's ability to design and improve work through experiments, sharing the resulting knowledge through collaborative experiments and developing people as experimentalists. The thought is that Lean is context-dependent and there is no shortcut to understand the underlying assumptions and elementary principles. Lean Healthcare takes a lot of time and effort and often a major upfront cost to work effectively. The entire origination must work in the same direction to achieve the set objectives (Rice, 2015).

One main aspect is that Lean Management is thought of putting a great deal of pressure on personnel working in the production system (Conti et al., 2006; Berggren, 1992). The personnel are more seen as resources than individuals (Conti et al., 2006). Another main criticism is that leanness leads to inflexible environments and lacks ability to react to new conditions, in other words, Lean may be easily affected by changing circumstances (Dove, 1999). Also, the just-in-time way of working causes congestion in the flow, which actually can lead to delays for the customers (Cusumano, 1994). Lean Management needs a stable platform to work at its best as well as an environment where the efficiency of scale can be maximized. As Lean focuses on perfection, highly dynamic conditions are hard to operate in (Andersson et al., 2006).

Lean thinking, with its management philosophy, has recently reached public service areas with hopes of contributing to new, non-traditional ways of working whilst at the same time stimulating improvements regarding performance. However, it has shown that this philosophy is commonly adapted, thereafter bit by bit fading away as time goes by (McCann et al., 2015). On another note, there are some worries that there are not enough studies that show that the work environment and the health amongst personnel is not affected negatively when implementing Lean, why this should be accomplished before initiating the concept in new, non-manufacturing organizations (Toivanen & Landsbergis, 2013). Stress is thought of by some as an unintended consequence of Lean Management, and it is claimed that there are no buffers to be able to handle unpredictable situations. This means that the personnel must work harder which puts a lot of extra pressure on them in this type of environment (Börnfeldt, 2009).

A chief physician, Eric Bertholds, provides negative aspects of the Lean concept when used in a healthcare environment. He mentions the problem of using Lean with its resource demanding ways when it does not have any proven effect in the context. He stresses the need for change to provide value for the patients and to avoid waste and the need to be able to measure if the changes made are for the better. However, he implies that Lean disregards other important aspects of the healthcare environment such as the importance of giving the patient the time needed to explain their situation and such, something that is not possible if the aim is to strive for efficiency and only measuring waiting times more than evaluating patient experience. Soft values are truly important in the healthcare context, and this aspect might go missing if the

organization chooses to focus on Change Management that only provides measurable data (Bertholds, 2010).

Lean Healthcare primarily focuses on flow efficiency in value adding streams mainly on an operational level. However, several scholars as well as practitioners have pointed out that a greater emphasis on production and capacity planning on various system levels using short-, middle- and long-term planning horizons are necessary ingredients to coordinate various patient flows throughout an entire healthcare system. Currently, the possible synergetic effects of combining PCP and Lean Healthcare principles and practices can be brought forward more (Ptak & Smith, 2018).

2.5 Improvement Science

Firstly, the following chapter presents change in general. Change is inevitable many times and organizations are in need to adapt and rearrange. In general, organizations are struggling to execute Change Management and motivation is explained as the will or drive to accomplish the challenge. Further change in healthcare is presented. After this initial section on change and Change Management, improvement principles and improvement methods will be explained. The suggested principles are communication, customer in focus, participation and developing a dedicated leadership.

2.5.1 Change and motivation

Over the last many decades, there has been a growing interest for change and learning within organizations (Ellström, 1996; Börnfelt, 2018). Change is seen by many as natural and unavoidable (Sveningsson & Sörgärde, 2019). Therefore, it is important to encourage change and make it a daily, inspiring part of the organization (Bergman et al., 2015). The common idea is that organizations need to be able to change, to match a rapidly changing environment in order to survive (Ellström, 1996; Jacobsen & Thorsvik, 2002). These environmental changes can consist of new technology, a competitive market, customer requirements, the economy and laws and regulations etc. (Börnfelt, 2018; Sveningsson & Sörgärde, 2019). However, changing an organization is difficult and does not often succeed (Sveningsson & Sörgärde, 2019), and it has shown that small continuous changes are easier to accomplish than large pervasive ones (Börnfelt, 2018). Also, being adaptable to change is beneficial as continuously working with improvements makes it even easier to take on more improvements. But as proficient employees are so hard-working, there is limited time at hand to find and implement such improvements (Bergman et al., 2015).

There can be two strategies to follow when conducting a change: The plan strategy and the process strategy. The former regards making a radical change planned by management and the latter consists of change growing continuously with participating employees. This latter type of organizational change means targeting routines and ways of working. Studies, mainly from Sweden, have shown that a combination of the two strategies are to strive for to accomplish long lasting change (Börnfelt, 2018). Furthermore, the various employee's knowledge is seen

as highly valuable for the organization and the learning process whilst conducting organizational changes (Ellström, 1996; Börnfelt, 2018).

Struggling with organizational change is, as mentioned, recurrent, and one of the reasons can be lack of realism, meaning that the organization does not have the time, knowledge or capacity to go through a change at that time. Another difficulty can be lack of commitment, will or knowledge amongst active participants (Sveningsson & Sörgärde, 2019). Also, when conducting organizational change, it is not unusual to notice resistance or conflicting interests. This is often seen as something negative but should, on the contrary, be seen as a valuable asset and force that can contribute to the process. This resistance can be categorized into different dimensions, and psychological, cultural and political resistance is often discussed (Sveningsson & Sörgärde, 2019). Moreover, other common reasons for resistance against organizational change area is fear of the unknown (Waddell & Sohall, 1998), which could be considered as psychological resistance (Sveningsson & Sörgärde, 2019), lack of communication or miscommunication (Stewart & Kringas, 2003) and experienced lack of utilization of competence (Kanter, 1985).

Motivation can be seen as the will or drive to accomplish a certain goal (Sveningsson & Sörgärde, 2019). One common theory is that there are two approaches when looking at motivation, theory X and theory Y. Theory X assumes that a person is unwilling to work and will avoid working at all costs. Theory Y, on the contrary, means that a person is willing to work and is driven by achieving goals that motivate her. The type Y person is creative, seeks responsibilities and has self-control (McGregor, 1960). One main idea is that the employees' goals can be integrated with organizational goals, leading to the conclusion that the organization will benefit from making sure to fulfil the employee's needs, ambitions and sought-after goals (Börnfelt, 2018). In other words, creating a local feeling of meaningfulness is key (Sveningsson & Sörgärde, 2019). Moreover, intrinsic motivation has been seen with high importance and how to put this into systematic use (Bergman et al., 2015).

2.5.2 Change Management in Healthcare

Change is influenced by the context (Dopson et al., 2008). Healthcare organizations have problems with the implementation of change initiatives due to the gap between execution and strategy and people may die because of slow processes and errors. Hence, healthcare organizations are forced to adapt to the development in technology, relationships, and medical information. Accordingly, the healthcare sector is exposed to continuous change. Therefore, at the same time healthcare organizations are forced and pushed to improve the quality and performance and patient satisfaction. By applying the Lean approach, mentioned in 2.4.2, healthcare organizations can improve performance, patient satisfaction, quality of care, efficiency, and patient safety (Brandao de Souza and Pidd, 2011; Dickson et al., 2009).

Leadership, culture and systems are key drivers for transferring and developing organizations in the right direction. Implementing change is the challenge. Science is aware of what to do but it is a knowing-doing gap, which kills and harms patients. Thus, a leadership system is the key to developing a good culture and safety. When the leaders spend time and effort on subjects

and areas, the organization gets informed of what is important and prioritized. Thinking long-term and aligning the organization's beliefs, behavior standards and values with commitment to healthcare excellence and use recognition is preferable to highlight the desired behavior. The healthcare professionals are not the problem since they are highly motivated to provide good care. Focusing on the mentioned factors will deliver a high level of quality, decrease errors and improve the environment, saving money and increasing patient satisfaction. Thus, leaders are responsible for creating and sustaining the organization's high-performance culture. Safe, nurturing and learning culture are essential to strive for when improving patient satisfaction. Moreover, it is important to fix both bad organization systems and not only try to fix people (Bodilson, 2005).

Success factors of change within the healthcare sector have been discussed. But focusing on culture and values, business processes and people and engagement are considered essential for an organization to succeed. In the healthcare sector, the importance of the human resource function is especially a focal point. Also, alignment of culture and values with change and processes within the business that facilitate access to information and effective communication, to achieve change initiatives (Bita et al., 2014).

2.5.3 Improvement principles

To strive for improvements, quality and having the customer in focus are essential cornerstones according to Bergman and Klefsjö (2012). Further, the culture must manage processes in order to manage the customer focus and work with processes. It is also important to encourage participation and dedication through the entire organization. Consequently, communication is vital to enable the customer in focus (Bergman & Klefsjö, 2012) and to identify the customer needs. But communication is also the key to successful Change Management internally (Eriksson, 2002). There are a lot of factors to consider when conducting, informing about, and implementing lasting changes, such as: Who should inform about the change and how should the information be spread (Balogun & Hope, 2004).

Communication can take and come from different directions (Kaufmann & Kaufmann, 2005). When implementing improvements according to the plan strategy (Börnfelt, 2018), the communication is considered to be downward, as the information is spread from leader to employee. The leaders can inform about instructions of how to proceed or targeted aims etc. (Kaufmann & Kaufmann, 2005). When using the process strategy (Börnfelt, 2018), upward communication is considered to be used as the information is spread from a lower hierarchical level of the organization to a higher level (Kaufmann & Kaufmann, 2005).

One issue with organizational change is that employees often assume that change is for the worse (Sjöquist, 1990). This is why communication is truly vital in order to set a clear aim for the process and explain why it is done to create a common idea amongst the affected employees (Sjöquist, 1990). A problem with communication is the misunderstandings that can occur between sender and receiver (Kaufmann & Kaufmann, 2005). There are three common and critical phases when these misunderstandings and disturbances can occur. The first being when the sender codes the message. This issue concerns the sender not being able to get the message across in a suitable manner to the receiver to interpret. The second phase is the choice of communication channel. The channel of choice can be verbal or in writing and disturbance can occur in regard to how well the message is received. Also, the channel of choice can affect how

well feedback is given. Lastly, the third phase is when the receiver decodes the message. There are various factors that can disturb the decoding such as the receiver's perception of and attitude towards the sender (Jacobsen & Thorsvik, 2002).

Dedicated leadership is essential to achieve a culture opened for quality development and improvements. To incite the dedication of employees, leaders on different levels must be reliable, clear and skillful to communicate and meet the employee with respect (Bergman & Klefsjö, 2012). Furthermore, the dedication of leaders and manners are crucial for the improvement of success, and it has been shown that its insufficiency is one of the most common reasons for failure. The organization's managers influence the employee's experience and actions during changing conditions (Bergman & Klefsjö, 2012).

2.5.4 Improvement methods

Data can be collected and analyzed in various ways and often begins with wanting to know the answer to a specific brought up problem or question (Plsek, 1999). Today, more than ever, healthcare workers experience the need to efficiently learn from collected data (Perla et al., 2010). Check sheets, interviews and surveys are common methods used and allow the data to be analyzed directly from the form. When analyzing data, it is important to keep simplicity in mind so that the results are easy to grasp for everyone, and one way to go is visualizing the results graphically. Visualizing data presented in time order has shown to have great value for healthcare professionals (Perla et al., 2010). Another tool for visualization is a flowchart, which can visually explain steps in a process. It can be used to monitor and understand the flow of patients, information or material. This often illuminates problem areas and is a simple method that can help evaluate cause-effect situations (Plsek, 1999). With a flowchart as a foundation, process design or redesign can follow to make the process a good or better fit in order to meet customer demand. The process can then be viewed step-by-step and optimized accordingly (Plsek, 1989).

The need for change and improvement can appear from various scenarios. Common sources are creative thinking and also critical thinking about current work methods and systems. The ideas can also come from a hunch, or by observing the process (Plsek, 1999). Undoubtedly, improvement methods work. Over decades, many organizations and companies have used various methods with great success when trying to achieve continuous improvements. What has shown to be both most effective and efficient, is to choose the method most applicable for the organization, and thereafter training all the people in it to use said method (Quick, 2019).

2.5.5 Improvement principles and methods in healthcare

Techniques for improvement in healthcare are increasingly brought out. Quality management is structured with features such as using system thinking, data analysis, improved processes and a reduction of variation (Carlin et al., 1996; Berwick & Nolan, 1998). There are many methods for improvement used in the healthcare area such as group work, flowcharting, collection of data and analyzing data graphically. However, there is a need for rapid change in healthcare, why the methods used should be as such (Plsek, 1999).

Classic industry quality improvement methods have been seen to work well even in the healthcare area, although the complaints are that the methods are a bit slow-moving. Therefore, the methods have been adapted to make a better fit in order to speed up the improvement process (Plsek, 1999). To be able to up the pace, it is vital to be cautious when choosing the topic of improvement, and to optimize management in regard to time and meetings as well as only collecting the data truly needed (Aleml et al., 1998).

2.6 Sustainability

The general main aspects in sustainability will first be introduced. Thereafter, the management's adaption of sustainability for SkaS will be presented and discussed.

2.6.1 Sustainability in general

Sustainability is a broad concept and there are many definitions (Arowoshegebe & Emmanuel, 2016). One of the most noticeable common denominators to the definitions are the three elements: community and individual human beings (People), environmental protection (Planet) and economic considerations (Profit), also known as The Triple Bottom Line (TBL) (Global Reporting Initiative, 2006). The social line of TBL refers to conducting beneficial and fair business practices to the community, labour and human capital (Elkington, 1997). The economic line of the TBL framework refers to the business impact of the organization's practices on the economic system (Elkington, 1997). The environmental line of TBL refers to engaging in practices that do not compromise the environmental resources for future generations.

The United Nations have set up 17 goals to sustain and manage economic, social and ecological development in 2030 for companies and organizations. All goals are tackling climate change and fighting against poverty and other deprivations. For this thesis and with SkaS in mind, five specific involved goals are highlighted, Good health and well-being, Quality education, Gender equality and Decent work & economic growth. Lastly, Responsible consumption and production is considered important for SkaS (United Nations, 2021).

2.6.2 Sustainability at SkaS

In similarity with TBL (Johnson, 2021), the management at SkaS has developed the quadruple-bottom line or so called, the sustainability spiral. The model consists of areas such as: Clinical, Economic, Ecologic and Social/Human. Therefore, all five mentioned goals are covered and SkaS is striving to achieve these. The management hopes are that the perspectives are fully integrated and connected in all problems or opportunities. Thus, the hospital has valued the well-being of employees and the regeneration of the resources as important factors in the work system of sustainability. Management argues that there is a circular relationship between employees' well-being and sustainability. Keeping an open dialogue for sustainability between all stakeholders and generating engaging co-works, enables continuous improvements of care as an iterative process (Kira & Lifvergren, 2013).

In 2013, sustainability was the most prioritized strategic theme for SkaS to meet challenges in healthcare systems in Sweden (Kira & Lifvergren, 2013). The goals stated that the care processes must be continuously improved to satisfy the needs of its customers and implies a focus on continual process development from the patient's perspective which meet the goals good health and well-being and gender equality. Therefore, high-quality service and patient safety are in focus and to further obtain sustainable resources, both physical and human resources are important.

Likewise, the long-term ambition of SkaS is to constantly grow and improve its value-adding activities in the care processes for the customer, to achieve sustainable outcomes from a clinical as well as a social, ecological and economic perspective. To accomplish this, it requires full commitment from managers to support, develop and empower employees at all levels in the organization. In the last decades, efforts and intensives have been taken to increase the competence structure within sustainability and improvements (Kira & Lifvergren, 2013).

The sustainability paradigm promotes work-systems and their employee's capacity for adaptation and development. Sustainability does not mean stability or longevity. It is a dynamic process during which various resources regenerate or develop (Kira & Lifvergren, 2013). For work-system sustainability, cognitive development and the general well-being of employees are a must. Also, work-systems may encourage well-being and development when sustainability is considered prevalent (Kira & Lifvergren, 2013). Decent work and economic growth as well as good health and well-being are thus covered.

Moreover, employees can focus on social, ecological and economic impact only when they are satisfied at work (Spreitzer, 2005). Also, the employees need to be adaptive and open to change. Moreover, the system for sustainability requires the participation of various stakeholders (Bradbury, 2009). To achieve empowerment of sustainability, all involved parties need to be open to change and understand the mindset (Kira & Lifvergren, 2013).

3. Methodology

Firstly, the setting is introduced and explained briefly, thereafter, the research method and design of the study is presented. The collection of empirical data is described and thereafter, the research quality is discussed. The two following sections discuss ethical considerations and potential improvements.

3.1 Setting

SkaS is a hospital group in VGR, which is one of the 21 regions in Sweden and consists of 49 municipalities. The region's common vision is "The good life" that aims to reinforce the whole region's competitiveness and attractiveness. The region consists of democratically elected politicians and has over 50 000 employees, which makes it one of Sweden's biggest employers (Västra Götalandsregionen, 2021).

In Skövde, an emergency hospital is located that offers care in medical-, surgical- and psychiatric specialties, where the largest volume of surgeries at SkaS take place. The hospital has surgeries of all kinds except heart surgical procedures and eye surgeries. At an operational level, an on-going project is running to increase the number of surgeries at SkaS by eliminating disruptions in the flow of the process but at the same time keep the same level of quality, safety and resources. We have been involved directly in this project, but also worked alongside. Consequently, proposals and recommendations are presented for the hospital in Skövde for how to better plan production and capacity at an operational level with reliable planning in the planning horizon of two weeks.

The project has been running for about one year and aims to decrease the long patient waiting times by identifying reasons that prevent low flow efficiency that cause delayed surgeries. In addition, the aim is to improve the planning horizon for weekly planning, to handle this appropriately and to improve the current work procedure to achieve a leveled and efficient flow of patients. One of the key persons is the unit manager at K6, who has been the contact person, together with the development director at SkaS. This thesis will alongside investigate and evaluate the project as it proceeds. An evaluation of the project will be conducted in Skövde by first performing an observation of the process and getting an understanding of the current situation to be able to find further suggestions for improvements regarding the production and capacity planning.

3.2 Research method & design

As a foundation, a literature study was conducted covering relevant topics and areas such as variation, healthcare organizations, flow theory, Lean healthcare, Improvement science and sustainability. Initially, the literature study worked as a foundation to grasp the healthcare context and to be able to build the scope and proceed with interview questions.

To get an overall understanding of the current situation and problem areas, qualitative data collections were initiated, starting off with project group meetings. People involved in these meetings were the development director at SkaS and a unit manager. As the problem areas

became defined, a questionnaire was sent out to gather more information about the problem area. The questionnaire can be found in Appendix A. Following, another questionnaire which can be seen in Appendix B, was sent out to gather more information about problem areas detected from the first round. Questionnaires were sent out to physicians at the departments to evaluate routines for surgery registration. The answers were further summarized and analyzed. Following, interviews which can be seen in Appendix C were set up with surgeons to further explore information brought forth in the questionnaires. These interviews were semi-structured. The information was collected about the ongoing project to understand which state the project currently was in and to clarify the common aims, strategies, and goals within the project group. Thereafter, process mappings over the current situation were studied to be able to detect the main problem areas regarding PCP. The literature study and the collection of the empirical data occurred simultaneously.

Moreover, the collection of data, choice of methods and theoretical framework has been an iterative process, and not at all linear. So has the aim and validity, as all of these areas are interlinked as seen in Figure 3.1 below, inspired by Maxwell (2012). Therefore, altering a specific area, has led to altering in the other interlinked areas as well. The research questions have affected and been affected by all parts of the process.

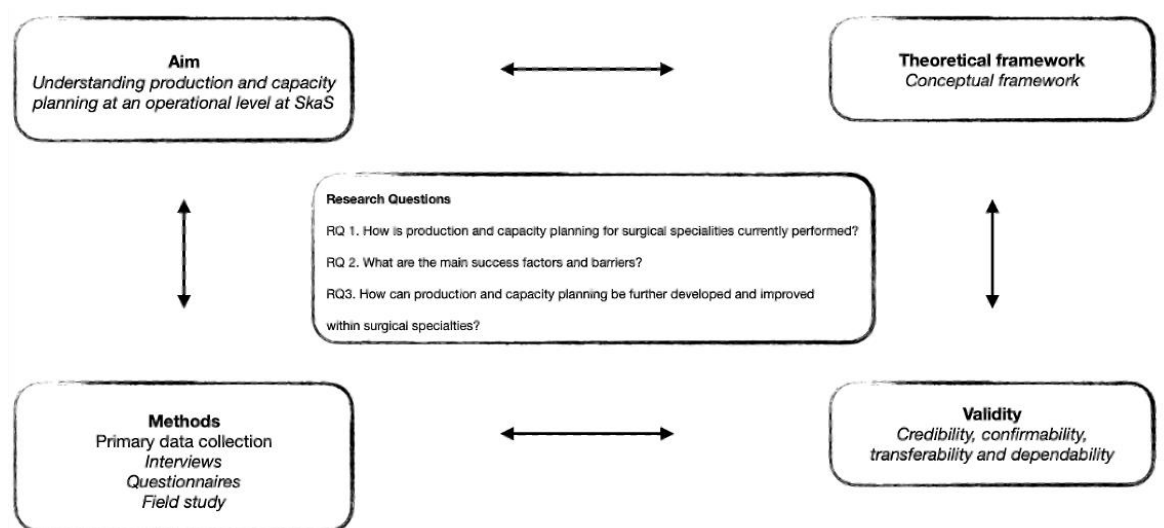


Figure 3.1: An integrated method model

The first site visit at the hospital in Skövde was conducted in order to get a full understanding over the production and capacity planning regarding patients in this particular surgery ward. The site visit occurred over a day where the unit manager of K6 (the surgical specialty) gave a tour, pointing out the way of working, problem areas, well-working areas and the overall planning process. Near the end of the project, one more site visit took place over a day. On that day we got the opportunity to talk to two surgery coordinators in order to get a wider picture of how capacity was planned at Skövde Hospital. Moreover, we met once again with the unit manager at K6, where we got the chance to study Orbit, the planning software. It was of great

value to be able to see the software as a large part of the barriers are to some extent connected to the program, as will be discussed in the analysis.

Continuous meetings were held with the unit manager at K6, and a development director, supervising this thesis from SkaS. These meetings were to keep all stakeholders updated. Also, meetings with the entire project group were running during the spring.

3.3 Collection of empirical data and analysis

The following section describes the primary and secondary data that was collected and analyzed in this thesis to answer the research questions.

3.3.1 Primary data

All meetings, conversations and dialogues with personnel are assessed as situations when primary data was collected. Surveys in terms of questionnaires were conducted during the project and interviews were performed to gather primary data. The questionnaires can be found in Appendix A and Appendix B. The interviews were semi-structured interviews and can be found in Appendix C. Mainly, it can be said that all data gathered was subjective.

To gather reliable data, purposeful sampling is fundamental by selecting and finding appropriate cases and individuals (Bell et al., 2018; Light et al., 1990). Samples may consist of people but also settings, events and processes (Maxwell, 2012). In particular, this is especially important in qualitative selection decisions (Bell et al., 2018). Obviously, the selected individuals for questionnaires and interviews had to be able to contribute to the research questions. Therefore, the sampling for this thesis was carefully conducted. As we were a part of the project group, we had a lot of input regarding which people would be suitable for interviews and such. In the different choices of samples, the research questions were constantly in mind to find the answers and make it time efficient. Nevertheless, data collection methods, focus areas and purposes were considered during the whole process and also iteratively chosen, as one interview could point us in a new direction in need of investigation.

As mentioned, questionnaires were used to collect primary data. When forming questionnaires, the degree of simplicity was high to avoid misunderstandings and obscurity. Since there is no interviewer in the administration of the self-completion questionnaire, the formula needs to be easy to follow and the questions must be easy to answer. Compared to structured interviews, self-completion questionnaires are recommended to have fewer open questions since closed ones are used to be easier to answer and have an easy-to-follow design to avoid misunderstandings. The questionnaires should also be shorter to decrease the risk that the respondent loses the willingness to answer the questions. Further, questionnaires have advantages over structured interviews e.g., cheaper and quicker to administer, no interviewer variability and convenience for respondents due to the possibility to answer when the person prefers and the preferable answer speed (Bell et al., 2018).

In this thesis, a questionnaire was performed to detect problem areas at Skövde Hospital regarding production and capacity planning in general, regarding the planning system Orbit and with an aim to target problems with surgery registrations and surgery cards. To access as many answers as possible, the unit manager informed the surgeons beforehand, stressing the importance of the study. The papers were selected to be shared at morning meetings when all physicians were present. By doing so, the answer frequency was high. We were aware that factors such as age, cultural background, gender, competence and education may have a deviant effect on how the person will interpret and answer the question. To achieve a high answer rate, it is vital to have a clear purpose and the interview person should feel chosen and important (Igelgård, 2005). Therefore, the purpose was informed to the participants via their unit manager. It was emphasized that the questionnaire was conducted in order to make changes for the better regarding their everyday work. The surveys were intended to be both qualitative and quantitative material to both cope with numbers and words (Bell et al., 2018). Likert scales were used to facilitate the analysis of the answers (Igelgård, 2005; Bell et al., 2018). We believe that it was beneficial to use Likert scales as this made it easier to grasp and to evaluate the answers. This was also recommended by the development director as similar methods had shown to be useful before, in a similar context. By sorting the answers according to the Likert Scales, the data was analyzed and categorized at the same time. This provided an overview that was beneficial when proceeding to analyze the answers provided in text.

The results of the questionnaire were further analyzed with inspiration from the Gioia model (Corley & Gioia, 2014) and can be seen in 4.4.2. The first order concepts, second order themes and aggregated dimensions were used to be able to detect common problem areas brought forth. When analyzing the questionnaire according to the Gioia model, the various text-answers were firstly looked upon by themselves (the first order concepts), and thereafter sorted into answers with common ground into second order themes. Lastly, these second order themes were once again reduced into three aggregated dimensions to be able to detect a smaller amount of problem areas to attend.

The decision to achieve open and closed questions lead to having semi-structured interviews. The interviews were mainly conducted together, with some exceptions where one of us was not able to attend. However, this was not seen as an issue as the interviews were recorded. By asking open questions, the respondent could reply however the person prefers and the respondents can contribute to unexpected aspects and new ways of thinking. Consequently, new areas and ideas can be explored. Closed questions are often presented with a set of fixed alternatives from which the person must choose an appropriate answer. The answers are often easy to process and enhance the comparability of answers by making it easier to show the relationship between the variables and to make comparisons between the answers. Disadvantages are e.g., a loss of spontaneity in the answers and in some cases, respondents can be irritated if they miss a category that they feel applies to them (Bell et al., 2018). Therefore, semi-structured interviews were chosen.

Various interviews were performed during the project with different purpose and focus areas. Due to the circumstances in the society because of the COVID-19 pandemic, most of the

interviews were held online for social distancing. Also, the COVID-19 pandemic has led to an even larger pressure on healthcare organizations than before, and therefore, not as many surgeons as wished for could participate in interviews due to lack of time. On the other hand, this was beneficial as it was easier to plan interviews with great regard to the surgeons' schedules in Skövde, as we were stationed in Gothenburg, with less need to travel back and forth, saving time and leading to an increased time mobility. Moreover, this type of interviews was thought to work as well as common interviews face to face, since the video camera made it possible to see facial expressions and get a picture of how the interviewed person felt about brought up issues. However, as some interviews, due to lack of time, were held by phone or email contact, facial expressions went missing. Also, when communicating in writing, the answers were somewhat compromised in length and perhaps also in how freely the participants felt that they could express dissatisfaction.

The performed interviews, as well as all meetings and conversations with personnel at SkaS were analyzed in somewhat similar ways. As we were two people performing the interviews, and recording them as well, it was possible to take notes during the interview, meaning that the transcription occurred somewhat simultaneously. Interesting quotes were gathered and noted, whilst building on these to ask more questions, why, once again, it was preferable that semi-structured interviews were used. The meetings were also performed on social platforms, why these also felt like interviews to some extent, but in a freer manner. When analyzing the answers, it was important for us to find common grounds and if there were any connections to the performed questionnaires.

To sum up, various methods were used as earlier mentioned questionnaires, but also interviews on social platforms, over the phone and face-to-face. The data was analyzed close to the performed questionnaire, to be able to proceed forward in the suitable direction. The mix between questionnaires, and semi-structured interviews is considered valuable and common (Bell et al., 2018). The first questionnaire conducted was used in order to grasp what problem areas were common at the hospital in Skövde and can be found in Appendix A. As three problem areas became clear when analyzing according to the Gioia model, interviews were held to develop a deeper understanding of said problem areas. Interview structure can be found in Appendix C. After that, the second round of questionnaires, which can be found in Appendix B, contributed to get a somewhat objective understanding of how much the problem areas affected the delay of surgeries. An overview of the performed primary data collection is illustrated in Table 3.1 below. The table consists of contacted respondent(s) (showing by n=... how many people were contacted), choice of data collection method, focus area, purpose (in regard to answered research question) and main relevant literature.

Table 3.1: Primary data collection

| Respondent | Data collection method | Focus area | Purpose | Main relevant literature |
|---|---|--|----------------|---------------------------------|
| Involved stakeholders at SkaS (n=4) | Interviews through social platforms | Current overall capacity planning | RQ1 | 2.2, 2.4 |
| Physicians (n= 48) | Questionnaires | Surgery registration & cards | RQ1-2 | 2.2, 2.4 |
| Development director, physicians, nurses (n=5) | Interviews through social platforms | Lean, change, PCP | RQ1-2 | 2.2–2.6 |
| Operation planners/coordinators, unit manager (n=3) | Interviews through social platforms | Surgery registration & cards | RQ1-2 | 2.2, 2.4 |
| Anaesthetist, surgery nurse, assistant nurse (n=42) | Questionnaires | Surgery planning/ Surgery registration & cards | RQ2 | 2.2–2.6 |
| Unit manager (n=1) | Field study | Surgery planning | RQ1-3 | 2.2–2.6 |
| Physicians (n=3) | Interviews through social platforms and by email or phone | Surgery registration & cards | RQ2-3 | 2.2–2.6 |

3.3.2 Secondary data

The secondary data was gathered to both get an overview of the healthcare context, related concepts and models, but also to dig into details. The research and information gathered related to structure, vision and government of the hospital were mostly extracted from SkaS webpage. Moreover, a sustainability report from SkaS was used to find what efforts and expectations the hospital is striving for. To find inspiration and to understand the world of healthcare, the literature study was collected from scientific articles, web pages, reports and relevant literature. The scientific articles were mainly sourced by using the Chalmers library database and Google scholar. The areas and concepts were developed and extended over the entire process. A structured way that was used to find new references was snowball sampling, by looking at titles and references of already selected literature (Wohlin, 2014). This contributed to new insights and views to continue the collection of literature.

When analyzing the secondary data, the snowball sampling came at hand as a tool to be able to find relevant information effectively (Bell et al., 2018). Reading one theory or paper and analyzing the main message of said source, lead to the need for new sources that could confirm or contribute to read findings. More so, as all the literature was read by both of us, various aspects were covered as we found different theories more or less able to contribute to our theoretical framework.

3.4 Research quality

Below, research quality is discussed in terms of reliability, replication & validity.

3.4.1 Reliability & replication

Reliability concerns if the study is *repeatable* or not. In other words, if it is possible to recreate the study, (Yin, 2014). This criterion is closely related to the criterion of replication. The criterion considers if it is possible to follow the procedure in such detail, that the study can be replicated. This can be done for various reasons, such as if a researcher feels that the study does not match other studies or evidence of the sort (Bell et al., 2018). The reliability and the possibility to replicate this study have been considered by being consequent with the used research methods throughout this thesis and describing in detail how the study is conducted as well. Also, the three different Appendixes show which questions were answered. However, replication may be more difficult to achieve when a case study is conducted based on semi-structured interviews. Interviews are often unique in their mood, pronunciation of questions and follow-up questions (Collis & Hussey, 2014). Consequently, the interviews in this thesis may not document and register all data needed for performing the same interview again. Participants' opinions and values may also change over time. More so, all the meetings with the development director and unit manager at K6 were hard to describe precisely, as there always were great amounts of information at the same time, not knowing which information was used only for further actions and not presented with words in this report.

3.4.2 Validity

Thought of to be the most important research quality by some, is validity. Validity is about the integrity of the conclusions and final arguments of the research. Validity and reliability have struck as being even more appropriate for quantitative data and not so much as for qualitative data. However, the criterion used for quantitative data have been translated into aspects concerning qualitative data, making it useful for this type of data validation (Bell et al., 2018). *Credibility, confirmability, transferability and dependability* can be used to evaluate the trustworthiness of the qualitative data. Credibility involves how believable the findings are, confirmability involves if the researchers have been objective or allowed personal values to interfere with the study and transferability considers if the findings are applicable in another context. Lastly, dependability concerns the time aspect, discussing if the study can apply at other times (Bell et al., 2018).

The validity in this report is touched upon regarding the mentioned criterion. The credibility aspect is handled as the literature study, together with the empirical study, will lay as a foundation for the findings whilst also discussing their relevance in the latter chapters of this thesis. One difficulty when gathering theoretical information has been to evaluate the relevance of various sources and likewise the relevance of various models and previous theoretical findings. To do so, the conceptual framework was brought up, visualizing the way some theoretical findings lead to the need of other theoretical areas and such. This was done along the project, as it was not clear initially which theoretical areas and models would be applicable to this thesis.

It was truly important to gather experiences from various stakeholders at Skövde Hospital. This was done to illustrate the actual problem, taking all different professions into consideration to avoid presenting recommendations and solutions that are suboptimal. The ambition was to not only gather qualitative data, but also complementary quantitative data by the second questionnaire, to be able to evaluate the empirical findings as truthful or not and also to be able to measure possible improvements in the future, not only subjectively but also objectively.

As for the confirmability aspect: information, theoretical and empirical, have been gathered from many different sources with various contexts to be able to get a fair picture of the problem area. However, the result and objectiveness has most likely been influenced by those involved in the internal project, supported mostly by the care side at the hospital. Consequently, some personal values and professional judgements may have affected the angle of the problem. Finally, for transferability, the prospects are that the findings in this study will be applicable in other contexts, i.e., at other hospitals that are experiencing similar issues both national and international. In particular, the findings of this study are thought of to contribute to all the hospitals using this type of production and capacity planning, with surgery registrations and surgery cards, and with Orbit as the software. However, such discussions will be presented in the final chapters of this thesis. Likewise, the dependability aspect considering timing is thought of in the same manner. Meaning that hospitals having issues with their planning, might be able to use the findings from this thesis, to be able to improve their own way of working. Even though they might not be using the same software, some findings regarding other aspects might be helpful. However, if the hospital is not experiencing any issues at the time, these findings might not be of the same value. Finally, the research quality aspects are summarized in Table 3.2 below.

Table 3.2: A summary of research quality criterion and connected difficulties

| Area | How we met the criterion | Difficulties of meeting the criterion |
|---------------------------|---|---|
| Reliability & replication | Clear and detailed research method & enclosed appendixes | Conducting semi-structured interviews (subjectivity) & difficulties reflecting all meeting precisely |
| <i>Validity</i> | | |
| Credibility | Theoretical framework with many various sources bringing up the same findings & the empirical study at SkaS | Evaluate used sources of information, both theoretical and empirical |
| Confirmability | Various used sources to allow many different opinions | Conducting a qualitative study that includes subjectivity |
| Transferability | Believed to be applicable in other contexts since more hospitals use capacity planning and Orbit. This is not SkaS specific | Might not be as applicable for hospitals using other systems |
| Dependability | Believed to be applicable in other contexts since more hospitals use capacity planning and Orbit. This is not time specific | Might not be as applicable for hospital with no current issues regarding capacity planning and/or Orbit |

3.5 Ethical considerations

Ethical considerations can be discussed not only when evaluating the process of how the research is conducted, but also what purpose it serves. This means not only examining the relationship between the researchers and participants, but also the relationships at large (Buchanan & Bryman, 2009). This study is conducted in the healthcare area, a mainly tax-funded public sector, why it can be of importance to consider if, and what value this thesis can bring to society at large. Moreover, other various ethical considerations mentioned below must be taken into account prior to this thesis as patient safety and secrecy is of the utmost importance.

Some aspects to bear in mind are *informed consent*, *privacy*, *confidentiality*, *anonymity* and *reciprocity* (Bell et al., 2018). Informed consent is the need to fully inform the participants of research consent whilst participating. The purpose is mainly to protect vulnerable participants.

In this thesis, participants of surveys and interviews were well informed about the conditions through email in advance.

Privacy involves how to protect subjects of research from invasion. In the field study, observations and analysis were evaluated but private details were obviously sifted out. Confidentiality assures individuals, groups or organizations that the research data is not disclosed to other parties than agreed upon. Confidentiality and anonymity can often be used to explain the same aspect. Yet confidentiality is to avoid disclosure of information gathered from the individual or organization as anonymity is the disclosure of the participants identity and personal information (Bell & Bryman, 2007). In this thesis, questionnaires and interviews were fully optional and anonymous. However, as the unit manager at the surgical department was the one presenting the questionnaires as vital, some employees might have felt the pressure to fill in said forms.

Furthermore, as the area of study is at a hospital, patient secrecy is also to consider as it implies that personal information cannot be discussed or shared to anyone that is not involved in the patient's care. Even so with colleagues that also have professional secrecy (Åberg, 2019). Prior to the study, secrecy agreements were signed. Personal patient information was not needed for this thesis as it is not of relevance to the scope. Specific patient illnesses were never touched upon.

Few qualitative research designs allow full anonymity whilst gathering data. Personal information is then used to identify relationships amongst participants or to get an overall picture of the respondent (Bell & Bryman, 2007). The survey presented to the surgeons to gather empirical data was filled anonymously and so were the following interviews to some extent, as personal information is anonymized in this report. However, it is important for the study to be able to identify the interviewees occupation and specialization as this can affect needed actions to take and to evaluate who is responsible for that action. Moreover, this information is thought of as relevant as it makes it possible to connect the answers in relation to each other and draw conclusions. This was informed prior to the interview.

Reciprocity means that the research should contribute to both researcher and participant, providing some sort of active collaboration or participation (Bell & Bryman, 2007). This study achieved results such that nurses, surgeons, physicians, and other project stakeholders played an active part when gathering empirical data which later on built the foundation for future recommendations.

Lastly, the ethical considerations became truly applicable in the two field studies as we were exposed to patients and also employees throughout the two days. Initially, the unit manager at K6 stated the importance that we should report if there was anything that we saw or heard that did not feel ethically executed or said. Moreover, it was important for us that the presented findings we explored during the field studies were relevant to this thesis, leaving additional information or experiences included in the signed secrecy agreements out.

3.6 Potential improvements

During the process of gathering data, we have seen the issue through the eyes of the people being studied. Therefore, we are aware that the data and information have been influenced and angled from the studied person's perspective. Accordingly, the data gathered is dependent on the individual. In the internal project, we have been involved mostly from the care perspective, through support and guidance from the unit manager. We have also observed and painted up our own picture of how stakeholders are collaborating and networks of relationships. It can be concluded that subjective data exists in the report, both from involving stakeholders at the hospital and caused by ourselves. However, it is unavoidable that people have their own interpretations and reflections, but by having a relatively high number of samples, a fairer perspective of a phenomena is obtained, and a lower number of new interpretations will show up during the forthcoming interviews.

More so, since neither of us conducting this thesis have prior knowledge in the healthcare area more than lightly touched upon in courses, there was a need to have a lot of data to grasp the environment where the study was conducted. In other words, the subjective dimension is considered important to understand the studied situation from the relevant stakeholder's perspective. It is essential to understand the unique and subjective aspect to understand how the work is executed in practice. Having a higher number of samples and involving more participants with different views, knowledge and opinions would have improved the quality of the final result.

In addition, there may be a lack of transparency in the report in terms of ambiguity surrounding why the specific individual participated in surveys, how data was analyzed and how the study's conclusions were brought forth.

4. Empirical study

The following chapter illustrates and describes the current production and capacity planning, success factors and difficulties of activities in the preparation phase of surgeries. Lastly, suggested improvement areas from stakeholders will be presented. The collected data is gathered from performed interviews and questionnaires, with the employees from the hospital.

4.1 Surgical specialties

Figure 4.1 below illustrates the different scopes of practice at SkaS. K1-K6, S1, M1-M6 and FoUUI represent all the areas of practice whilst patient safety, economy, Human Resources, communication and the department for quality and development are staff functions supporting the organization.

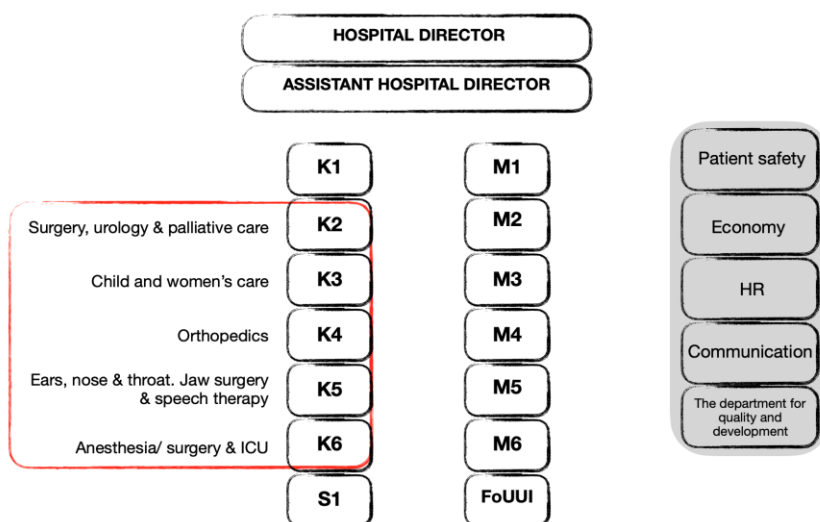


Figure 4.1 Skaraborg Hospital Group, organizational chart

For the sake of simplicity, only the affected scopes of practice are named in the organizational chart. As seen, the surgical specialties K2-K6, are the departments touched upon in this thesis.

K6 is the surgical specialty in which all surgeries are performed. K2-K5 “reserve” time at the operation theatres by filling in registration forms. These forms are most often filled in by the surgeon performing the surgery, but sometimes, the surgeon can be altered along the process. As can be seen in the chart, these areas have been highlighted with a red marking, representing the area of focus. It is not common that various surgical specialties use the same operation theatres as is done in Skövde. Commonly, each specialty operates in their own theatre. The advantage of organizing the way that Skövde does is thought to be the benefits of having all instruments and supporting personnel at the same place, meaning that only the surgeon must physically leave his or her scope of practice. Also, this organization of activities makes it possible for surgeons to perform more various surgeries over time, keeping the cure profession stimulated. This can also be seen as a problem, since the surgeons do not perform the same surgery over and over, making them very proficient and efficient at that specific surgery.

4.2 Overall planning process

The following section will present the overall planning and capacity process by firstly elaborating on the current flow and planning system. Lastly, internal problems and bottlenecks are discussed.

4.2.1 Current flow

When a patient needs surgery, a referral is sent to the hospital. Thereafter, the patient is evaluated and prepared. The next step, where the scope of this thesis has its first connection point to PCP, is when a surgeon places a surgery request. From that moment on, there are quite a few steps of planning such as patient evaluation, surgery planning, an enrollment visit followed by the surgery, where this scope ends. From that step, the patient is placed in after care and has a follow up sometime in the future. This process is visualized in Figure 4.2, where the scope of this thesis is marked by a red line.

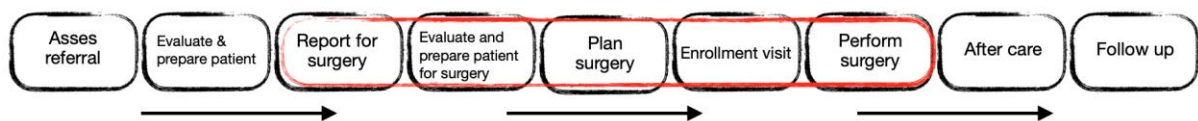


Figure 4.2 Illustration of the current flow

4.2.1.1 Orbit

The system used for production and capacity planning is called Orbit. This system provides information about the patient, what type of surgery will be performed and how long it will take, by which surgeon it should be performed, what type of equipment and instruments are needed and so on. This system also provides information about all upcoming surgeries, which makes it possible for the coordinators to plan ahead. Also, it registers the outcome of the surgery regarding various time measures, making it possible to withdraw statistics from the system. This system is seen as quite inflexible by both surgeons and coordinators, who state that the system is not always user-friendly. They experience that it is difficult to use the system, especially when filling adequate information needed to provide sustainable planning, which will be further evaluated in 5.2.2.

4.2.1.2 Resources

Today, there are 18 operating theatres present at Skövde Hospital. However, they are not all in operation. Two of the theatres are dedicated to eye surgery, not operated by K6. One of the theatres is currently used for COVID-19 patients due to ventilation prerequisites. Three of the theatres are too small to be able to use for surgery and are currently used to store equipment. This leaves 12 theatres for K6 to perform surgeries in. Moreover, two theatres are intended to only be utilized for the emergency flow. Each theatre needs an anesthesia nurse, a surgical nurse and assistant nurse which K6 provides.

Moreover, the lack of time in the operation theatre within the time set out regarding the patient's medical priority. Lack of communication or miscommunication with the patient can lead to the patient not being available at the time for surgery or no longer wanting to proceed with the

surgery at all. Another main problem area detected from the respondents is staff shortage. The coordinators are planning without knowing how much personnel is available at the time, leading to the idea that surgical wards are not the only bottleneck in the flow. Further, it is stated by the coordinators that it would be truly valuable to be able to see how much personal is available to achieve a more well thought out planning.

In this thesis, both emergency and elective flow are taken into consideration. The emergency flow is planned at a daily and operational level, while the elective level is planned on higher levels. There are four different levels of emergency, and the elective flow must adapt to the emergency flow. In addition, elective surgeries do not occur at nighttime, but emergency surgeries might take place at all hours. The FIFO system (First In, First Out) is used for emergencies. However, the type of diagnosis or accident varies from day to day, and it is hard to figure out the type of demand in advance. The variation considering type of diagnosis for the elective flow is usually under more control and rather predictable but no rules without exceptions.

4.2.2 Internal problems

At hospitals in Sweden, the three general main bottlenecks are the surgery phase and resources, radiology and ICU, which are dynamic, meaning that only one bottleneck exists at the same time. These three, are considered to have the lowest takt per time unit. The care after surgery is not considered to limit the system and it is unusual that surgeries must be cancelled because of shortage of places for care, but it may happen. Currently, there is a need for surgery nurses and anesthetists, but no high need for ordinary nurses. During the pandemic of COVID-19, the Skaraborg Hospital Group has 9-10 operation theatres on-going. 17 theatres were common before the pandemic and 7 theatres are closed every week because of COVID-19. This results in around 25-30 canceled surgeries every week.

“The limited number of operation theatres is currently the bottleneck for everything in this process during the pandemic. Otherwise, they would be available and open.”
(Development director)

The hospital is striving for no queues and a higher number of available operation theatres. The aim is to manage the inflow and meet the demand. Some employees at SkaS, in particular people from the Control world, argue that with a higher number of operation theatres, it would be possible to manage the inflow and at the same time decrease the queues gradually. Both queues before COVID-19 and queues built up afterwards.

As mentioned, slow patient flow is a general problem and delayed surgeries at the hospital are assessed as a root of the bigger problem and cause consequences.

“The fact that surgeries do not start in time has many consequences for patients. Besides, the operational level is affected. Delayed surgeries, replanning, duplication of effort, waste and so on.” (Nurse K6)

The following main reasons for delayed surgeries are identified for the hospital. Internal communication between the different stakeholders is not optimized. The physicians are pointing out that the daily communication with the rest of the surgery team is not that regular as before.

According to contacted physicians, lack of competence and knowledge in the surgery registration is a problem. Further, the exposed variation of competence in the surgery team is an issue but also individuals of the surgery coordinators differ from each other. The teaching and the educating of personnel are considered insufficient and need reconstruction and more effort. Some days, the surgery flow is well-working and some days, it does not work at all. Some operation coordinators argue that it depends on the person who is planning.

The respondents from the survey informed that skills of routines are also considered to be dependent on who is performing the work. The differences are noticeable for the surgery cards, where there is a surgery code for different surgical procedures with various time-consumption and physicians choosing different cards. Also, there are multiple cards for the same surgical procedures, which confuses the involved parts. Moments of disruptions and irritation during surgeries and in the preparation-phase are also highlighted as reasons for delayed surgeries.

The mentioned internal planning system Orbit is argued to not be optimal and is needed for restructuring by many employees as SkaS, such as unit managers, physicians and coordinators. Routines of surgery registration and filling in information about the patient before surgery do not work in an optimized way. The data is assessed insufficient with errors. The high variation of patients' needs and demands have a big impact on the data. Changing surgery registrations at the last minute and delayed patients in the operation theatre because late surgery starts.

4.3 Surgery planning

To be able to grasp how surgery production and capacity planning is conducted at an operational level, surgery registration and surgery cards are discussed below. There is an important distinction between these and how they are used. This planning method has shown to have various problem areas, which will be brought forth in the following chapter, 4.4.

4.3.1 Surgery registration and surgery cards

When the surgery decision is made, a surgery registration of the patient needs to be executed in Orbit as a first step in the planning process. The surgery registration can be seen as an order to fulfil the patients' needs and concerns. The registration is performed by the surgeon. The surgery registrations contain anamnesis, which is the patient's medical background, and the choice of anesthesia. It also contains miscellaneous information related to the patient's case such as medical priority, hospital, surgeon and how to place the patient etc. Information is transferred from the medical system Melior, which is the electronic medical record system currently in use at the hospitals in the Western region. Melior contains functions for documenting medicines, referrals, certificates and much more.

The specific surgery card is also included in the registration. The surgery cards are planning cards within the hospital and belong to the detail level for the production and capacity planning. The surgery card concerns diagnosis, planned action, medical method, picking list for the specific surgery and standardized care plan (SVP). An illustration of the surgery registration and surgery card can be found in Figure 4.3.

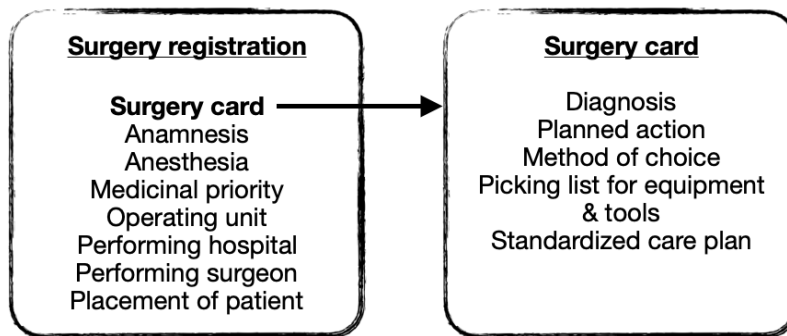


Figure 4.3: The surgery registration and surgery card

The information in the registration is aiming to provide an exhaustive material and foundation for the patients coming future.

After the surgeon has filled in the registration, the surgery coordinator receives the registrations, and firstly checks that all information needed is adequately filled in. The required information is an up-to-date ECG (Electrocardiography, which is a process when the activity of the heart is measured), what type of medical samples the patient needs to submit before the surgery, information about possible infection, information about whether there is a need for an X-ray appointment and if there is a surgeon that can perform the specific surgery. After that, the coordinator looks for an available time in the operation theatre within the set-out time for the patient regarding medical priority. Lastly, information about the surgery and the need to submit samples beforehand are sent out together with a set time for the surgery. Figure 4.4 below visualizing a representation of the process.

Hereby, the coordinator is the central connection point regarding the surgery registrations. However, this person does not have expertise in all medical knowledge, meaning that if patients have questions regarding such, a nurse must attend to the issue. Currently, this type of employment consists of planning two to three days a week, leaving the rest of the time to type notes dictated from doctors. The contacted coordinator at K2 expressed that it would be appreciated to separate these two tasks, and to only be responsible for the planning, as it takes a lot of effort and is something they enjoy doing.

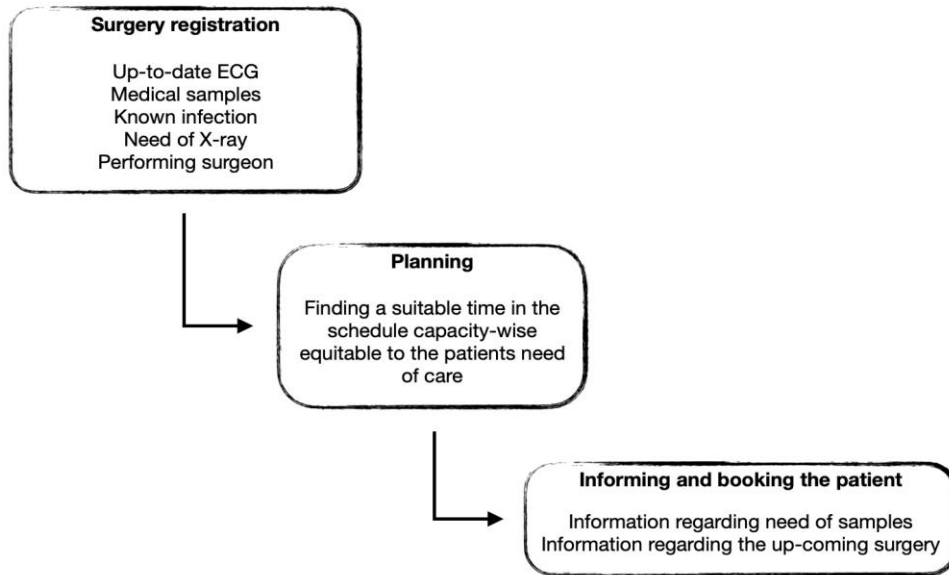


Figure 4.4: The optimal surgery planning process for coordinators

The surgery registrations are needed for all patients, both in the emergency flow and the elective flow. K6 has weekly meetings where upcoming elective surgeries are discussed with surgeons and other affected personnel to make sure that the schedule is feasible. The patient is almost required to have been signed up in the system before treatment, but there are exceptions to every rule. In crucial or life-threatening cases, the emergency patient needs to take a shortcut and the registration is executed after treatment. There are four different levels of emergency. The surgery registrations and cards are planned for different planning horizons, strategic, tactic and operational levels.

Another area of usage for the surgery cards is that these are used as a foundation for coming surgeries of the same kind. In other words, the time used for a specific surgery is registered and then used to know how long this type of surgery needs for the next time planning for it. To make a fair assessment of this, Orbit calculates this with regards to surgeons and the type of surgery to receive an average. The time included here is the time at the surgical ward which consists of preparation, the surgery and the finishing work performed by the surgery personnel. This is explained visually by Figure 4.5.

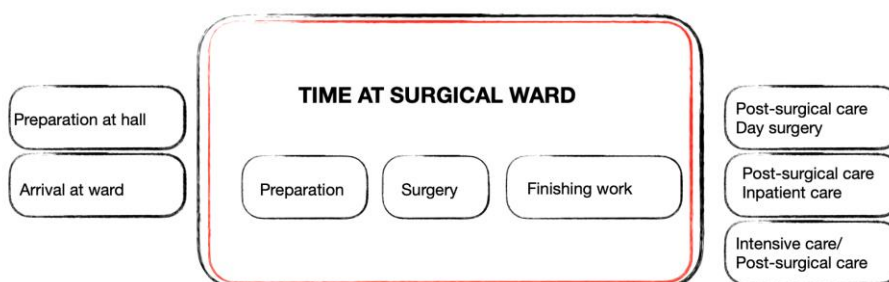


Figure 4.5: A visualization of the surgical process

4.4 Success factors and barriers

Success factors and barriers concerning the production and capacity planning at Skövde Hospital according to the employees at SkaS is presented below. It is important to identify what is working well but also identify the problems.

4.4.1 Success factors

As stated, there are problem areas regarding PCP. However, it is also important to find areas that work well and evaluate why. The surgery registration and surgery cards, whilst being problematic, have some beneficial aspects. According to respondents, they do provide some guidance for the planning and the structure in which they are designed, and provide a framework which can be efficiently used, if filled and executed correctly. During standardized and common surgery procedures, the system is considered to work appropriately by the coordinators and the surgeons follow the routines quite well. After working in the system for a while, the surgeon got the knowledge of content and routines. In addition, the system is considered to always be in process by the unit manager at K6 and by several surgeons.

What has been seen throughout this thesis, is the dedication amongst the majority of employees at SkaS. Dedication to their work and well-being of patients has stood out during the process, making it one of the greater success factors for achieving a well-functioning and efficient flow of patients.

“I have been wanting to do this project for years...” (Unit manager)

What has been a large barrier according to the unit manager at K6 is that people from different specialties fight over the use of operation theatres, meaning that their patients are in the most need of surgery and should therefore have a higher priority. This type of sub-optimization is quite common according to the unit manager at K6. However, during the COVID-19 pandemic, the personnel at SkaS have started to collaborate more extensively than before. Now, people from different surgical specialties, K2-K5, have started to plan more as a unit, meaning that there is a greater understanding of the system.

“Before COVID-19, all surgery specialties fought over time at the operation theatres and would not give up time that was dedicated for them. Now, people work more as a team and try to fill the schedule in the best way possible, taking other clinics' patients into consideration.” (Unit manager)

Moreover, there seems to be an understanding that inner motivation is a success factor when it comes to organizational change as it is emphasized by the development director multiple times throughout the empirical study.

“We need changes that come from inner motivation, the employees need to feel that they want to strive for a better environment, and that they are able to participate in the process of change.” (Development director)

One contacted coordinator works a lot from inner motivation. This person has developed a personal system in which aims are set to be able to make the waiting lists as short as possible. The belief is that you can achieve short waiting times, but you must actively work for it. This example, amongst many others, has shown that people working in the healthcare sector are truly dedicated to their work.

“I want to work with patient-focus, and I am a firm believer that when a patient is in need of a surgery, we need to make sure that that happens.” (Surgery coordinator)

Even though there is resistance to change and improvements, dedicated and motivated employees are the majority.

“We have to point out that we are not going to change, we are going to improve.” (Unit Manager)

To sum up, there are some success factors regarding the planning such as the guidance and framework that the surgery registration provides, the expertise amongst personnel at the hospital and the dedicated people that strive to deliver efficient care with high quality. Most of these success factors are soft values based on human interaction and willingness for change, not so much as technical aspects, such as enabling a higher number of available operation theatres.

4.4.2 Barriers

The large, overall problem area, already detected at SkaS, is that surgeries fail to start at the scheduled time and one reason for this is speculated to be caused by the surgery registrations. Moreover, there are quite some problem areas when it comes to production and capacity planning. Mainly, it can be said that the overall barriers are variations and faulty communication. Thus, the lack of information is visible through all identified barriers. During the thesis, variation has been observed as a large challenge when it comes to PCP and is detected in multiple areas.

4.4.2.1 Variation amongst employees in areas such as knowledge, performance and preferences

According to many respondents, variations regarding the surgeon's various levels of knowledge and competence, leading to surgeries take different time to perform. Some surgeons are faster at performing than others and vice versa. Also, different surgeons can be right- or left-handed, meaning that if this is not mentioned in the surgery registration beforehand, the operation theatre must be altered to match the surgeon's prerequisites. Respondents claim that different surgeons prefer different ways of operating, and the same type of surgery can be performed in various ways. As of now, a surgeon is responsible for filling in the registration

form. However, this surgeon does not have to be the operating surgeon, and this can change close to the start of surgery. This is problematic as the operating surgeon does not always wish to operate as is stated by another surgeon in the registration.

The survey found that there is also variation in time of filling in the surgery registration. This differs both between surgery and surgery but also surgeon and surgeon. Some cards are assumed to take less than one minute to fill in but some registration takes a lot more time than that.

“Sometimes it takes more than 30 minutes to fill in a registration, before or after the surgery to make it correct and well filled in. Sometimes it takes more time than performing the actual surgery.” (Surgeon K4)

Delayed surgeries are a problem at the hospital, but also, some of the respondents point out the negative aspects that the surgeries start too early, and some do not agree.

“All involved have to know when the activity starts and when all needs to be in place. This is a precondition for a well-working production and capacity planning system.” (Cure)

4.4.2.2 Missing routines and work standardization

Also, there is variation in how well the surgery registration forms are filled in. A lot of registrations lack vital information about the patient, and this leads to no standardized way of working for the operation planners and coordinators according to the respondents.

“The fact that surgery registrations are not filled in well enough affects both the work environment for employees and leads to waste, since people are performing the same work multiple times.” (Unit manager K6)

According to the responding coordinators, approximately, every other card needs to be adjusted to be able to plan accordingly and it takes a lot of time and effort to do so. A well-informed coordinator can detect a card that needs altering and thereby, for example, adjust the time needed for the surgery as the set time is not always correct. Moreover, information is frequently missing in the registration. The information missing is often medicinal treatment, infections or if the patient has an updated ECG. Also, there might not be a surgeon available to perform the surgery. According to the coordinators, well filled-in registration forms make the planning more efficient, and these cards are also more enjoyable to work with. One belief is that to accomplish well filled-in forms, the registration and card should have many mandatory fields to fill in and that it should not be possible to send in a form that lacks information in these fields.

One difficulty when it comes to the planning is that there might not be an available theatre in the physician's set out time frame, as stated by the coordinators. Lastly, problems that can occur in terms of contacting the patient is that the patient might not be available at the set-out date or

has altogether decided upon not having the surgery. Figure 4.6 below recognizes what information can be missing in the surgery registration and card, what can be problematic regarding planning and also, struggles when informing and booking the patient.

The surgery coordinator is not responsible for filling in the form and should only conduct the planning part. However, the coordinators state that they do not have the optimal prerequisites to be able to plan sustainably. Since the registrations are often so faulty that the coordinator spends a large part of the day correcting and adding information so that the surgery is possible to perform at the decided date. Planning is not able to proceed until all the needed information is found and registered. This type of work is most often performed by the coordinators anyway since it is necessary, and this is a task some enjoy doing.

“I am somewhat of a detective when a registration or card is not filled in enough, looking for all the missing information on different platforms to be able to plan the surgery. It is difficult, but fun!” (Surgery coordinator K2)

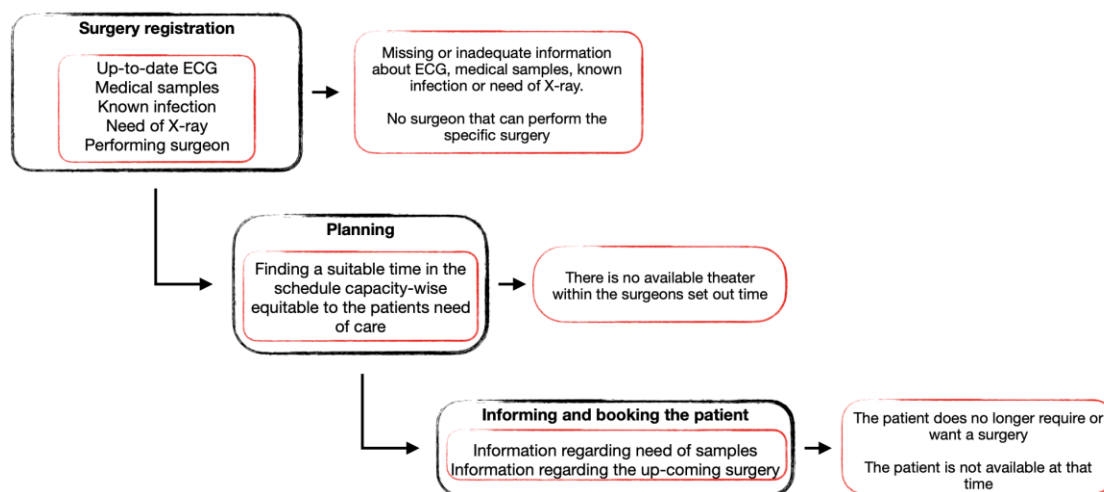


Figure 4.6: Problem areas during the planning process

4.4.2.3 Late information changes in Orbit

The surgery registration and cards are as mentioned, a tool to conduct capacity planning. One identified barrier found in the survey was that the registrations or cards are changed close to the surgery. The surgery cards are many times filled in by a surgeon who is not going to operate, leading to changes in method and tools etc. This is especially done for the emergency surgeons. In the survey it was found that the surgeon is also many times aware that the information will change when the card is filled in. The surgeons argue that it is prioritized to register the patient than that everything is in place in the registry. The samplings indicated that 56 % of the survey cards are changed the same day as the surgery will be performed and 16 % the day before. Consequently, 72 % of the surgery cards are changed the same day or the day before surgery.

“The surgery needs to be re-prepared if the surgeon changes the card too close before the surgery starts. This causes a higher workload for the surgery personnel in terms of duplication of efforts and affects the work environment negatively.” (Unit manager K6)

The unit manager is striving for two days' last revision of the cards by the physicians. By not having sufficient standards and surgeons filling in different ways, leads to misunderstandings and discontent.

“We need to know when the patient is ready for us and no obscurity is acceptable.” (Unit manager K6)

4.4.2.4 Patient variation

The different changes to the surgery registration and cards are crucial on different levels related to the time aspect. For instance, an up-to-date ECG sample or a remittance to provide a sample is a quite small addition to the surgery registration according to the coordinators and some surgeons, but important. More crucial changes could be adding information that the patient is taking blood-thinning medicine which can be life-threatening for the patient if the surgery coordinator misses this medicinal treatment. In the questionnaire, all reasons for changing the registration from two weeks before to the same day as the surgery were identified. This can be seen in Figure 4.7.

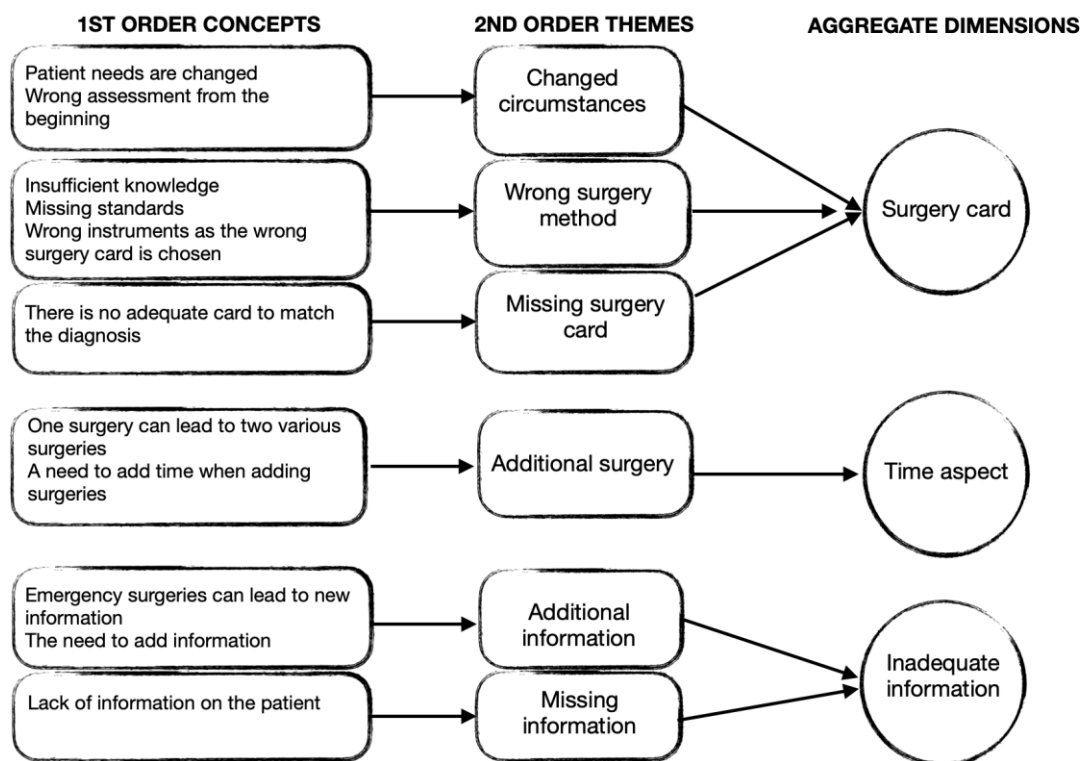


Figure 4.7: Summarized questionnaire result

Starting off, the first order concepts explain what needs to be changed in the registration form. Thereafter, the second order themes above narrowed it down to six themes for changing the registration as follows: changed circumstances, wrong surgery method, missing surgery card, additional surgery, additional information and missing information. Lastly, this resulted in three aggregate dimensions of changes that need to be made in the surgery registration: The surgery card, time aspect and inadequate information.

Changed circumstances could be that the patient's needs are changed, which is unavoidable and can be hard to anticipate when this occurs close to the surgery. The surgery method can be wrongly chosen due to lack of sufficient knowledge, missing standards and wrong instruments informed when the wrong surgery card is chosen. A problematic area regarding surgery registrations in general and surgery cards in particular is that there is not always an adequate card for a certain type of surgery. Adaptations to the specific patients are often needed e.g. extended overall surgery time because of additional action. The cards are not specific enough and a card with the right diagnosis can be missing. The surgeon may have decided on a method or procedure, but then an existing surgery card is missing.

“The cards are standardized, but the healthcare world is not standardized. It is hard to find the right surgery card.” (Surgeon K4)

The former mentioned themes are related to the aggregated dimension “surgery card”. Moving forth, the following themes are related to the aggregated dimension “time aspect”. Additional surgery happens because one surgery can lead to two different surgeries. It can also happen when there is a need to add time when adding surgeries. The evaluation of the patient may have occurred months before.

Additional information is hard to avoid because dealing with emergency surgeries can lead to new information. The need to add information can arise when unexpected events come up. However, when dealing with elective patients, this should be avoidable. Missing information can arise when there is a lack of information about the patient. These themes are connected to the aggregated dimension “inadequate information”.

4.4.2.5 Orbit, as an inflexible planning system

Much competence and experience are required when filling in the surgery registrations and cards according to both coordinators and physicians. The earlier mentioned changing reasons (first order concepts) in Figure 4.7 are thought of to be avoidable and just a few are impossible to avoid according to the unit manager at K6, such as new critical information about patients from the emergency hall. However, the questionnaire indicated that far from all surgery cards are correctly filled in and that a clear standardization is missing.

“Surgeons with not so much experience have big problems filling in registrations and cards. Even though surgeons with much experience and high competence have problems filling in the surgery card when the diagnosis is specific and not so common.” (Surgeon K2)

As this is problematic for the surgeons, they often fill in a card that is somewhat right to achieve an emergency solution at the time. When this is done, it is difficult to fend off that the card needs altering close to the start of surgery, which is not optimal for PCP.

“The cards are fixed and not flexible enough. The system is more like a storage system than a surgery system.” (Surgeon K4)

The changed patient information in the surgery card, e.g., type of surgery is undoubtedly a problem. Nevertheless, the fact that the cards are changed at the last minute or too close in time before surgery, result in delayed surgeries because of changing conditions in the preparation phase. This leads to many consequences such as surgeries being delayed throughout the day, leading to long working hours for the personnel or in the worst-case scenario, cancelled surgeries at the end of the day.

4.5 How can production and capacity planning be changed or improved within surgical specialties?

It has shown, throughout the project, that there are quite some thoughts from the personnel at SkaS on how to improve PCP to make it more efficient and sustainable. The ongoing project has led to new ways of thinking alongside ideas from various professions. Of course, there is a common belief that more resources would have beneficial outcomes. However, there is also a belief that using the present resources in a more efficient manner would lead to positive effects.

One idea is that there are enough resources present to operate in one more theatre at SkaS. This can very likely be achieved with the human resources available and is thought so by the development director as well as the unit manager. The belief is that one more theatre would be enough at the time to achieve a more efficient flow of patients. Nevertheless, this is not possible with the current COVID-19 situation and will hopefully be tested in the future.

“If we efficiently use the surgery resources with an even flow and takt time, we will achieve a higher number of surgeries per resource and thus increase the flow efficiency. This is our goal!” (Development Director)

Capacity planning is brought out on various time horizons and in order to get as durable planning as possible, one must consider both strategic, tactical and operational planning according to the development director. As this study is focused on planning on the operational level, this will be further discussed in the analysis. However, as the development director suggests, all levels are needed to achieve an efficient flow.

“The patients must get the opportunity to receive care when they need it. A system aiming for planning on a long, medium, short view is our goal.” (Development Director)

When interviewing the surgery coordinator, it becomes clear that the personnel in Skövde are not working with tasks that match their specific skills some of the time. It is common that nurses have to do administrative work in order to ease the workload for doctors, surgeons or other medicinal personnel. This is not something to strive for as there should be people educated in administrative work conducting these tasks so that the nurses can do what they do best, provide care for the patients.

“The nurses should do what they are best at and not administrative work it is all about having the right person at the right place” (Surgery coordinator K2)

Moreover, the interviewed coordinator states that it would be perfectly fine for people at this position to take over some of the responsibility to fill in surgery registrations to ease the workload from surgeons. Especially since these types of tasks are most often already performed as they must add information to faulty cards. But to be able to do so, there needs to be time set for this and other administrative tasks must be passed on to someone else. On the other hand, the surgeons are more skeptical. It is a risk of double documentation, but the change is not considered impossible.

For the surgery registration, there is an interest to find a better way of filling in the registration as well as the specific card. According to the surgeons, there is an interest in education to understand and gain knowledge of routines and values of how to fill in the registration to avoid variations. The multiple cards and insufficient number of cards are considered both problems. It would also be a better research system to search for codes and diagnosis to avoid misunderstandings and facilitate the procedure for all stakeholders involved. Another suggestion is to limit the visualization on the surgery cards for each surgery specialty. Information in the health declaration is further suggested to be connected to Orbit to skip the transfer part. Also, to make the surgery cards more flexible, physicians are suggesting having one anatomical model to receive a list of available surgeries and procedures. This is an easy way to choose the right card from the beginning in a time-efficient way.

5. Analysis & discussion

The following chapter will provide an analysis and discussion regarding the three research questions. The production and capacity planning for each surgical specialty will be discussed and thereafter, success factors and barriers for the hospital will be analyzed. The last question is divided into three parts, achieving sustainable improvements, suggested improvements and expected gains of the proposals. The theoretical framework will be combined with the empirical findings and every question will be discussed and answered. Lastly, future research related to this thesis is discussed alongside our theoretical contribution.

5.1 Production and capacity planning for surgical specialties at SkaS

This section is presented to be able to address the first research question, *how is production and capacity planning for surgical specialties currently performed?* The planning at Skövde Hospital is mainly conducted to be able to meet the demand of patients in need of surgery. The aim is that patients should receive care within the time set for each patient's medical priority. Moreover, as Rosenbäck (2017) mentions, the planning can be used to make the production plan more stable, which in turn leads to the reduction of variation in the process. Variation is seen as a problem area regarding PCP, and this will further be discussed in 5.2 through 5.4.

When planning production and capacity at Skövde Hospital, two types of flows need to be considered, the emergency flow and the elective flow. The emergency flow is not able to plan ahead whilst the elective flow can be planned ahead. With that said, it has shown throughout this thesis that even the elective flow can at times, be hard to predict or match capacity with, which will be further presented in the following section, 5.2, where success factors and barriers regarding production and capacity planning are brought up for discussion.

The main resources taken into consideration for the planning aspect is the personnel and the available operating theatres. Although other resources such as operating equipment have been observed to sometimes be limited, it seems to be more urgent to focus on the personnel and operating theatres. There are currently 12 theatres available and to be able to operate these, an anesthesia nurse, a surgical nurse and an assistant nurse are needed at each theatre. Moreover, it is common that a specific operating specialty performs the surgery in a specific theatre.

The main stakeholders in the production and capacity planning process are the surgeons, both those who are performing the surgery and those who are filling in the surgery registration, the different operating specialties, the coordinators, and the personnel from K6. What these stakeholders all have in common is an aim of performing as many surgeries as possible. The patient is considered to be a customer according to Improvement Science but can also be seen as a stakeholder to some extent, but that perspective is not in the scope of this thesis in the means of personal experience. With that said, the patient is still in focus as production and capacity planning in ways is conducted to be able to perform safe care with a high quality.

As to the planning flow, the patient first meets a doctor that states a need for surgery. After that, the doctor, from K2, K3, K4 or K5, depending on type of illness or need of surgery, places a surgery registration in the planning system Orbit with information about the patient and a filled in surgery card, stating what procedure, methods, equipment's and tools are supposed to be used. The registration and the card reach the coordinator, who views the information and most often revises or adds information and thereafter finds a suitable time for surgery. When this is done, the patient is contacted with information about the surgery and the time for surgery. The patient might also be called beforehand to leave medical samples. The process for a patient from the emergency hall is much faster, sometimes, with little or no time for planning. At weekly meetings with the personnel at K6, the surgery department, upcoming elective surgeries are discussed with surgeons and other affected personnel to make sure that the schedule is feasible. Lastly, the unit manager at K6 informs the personnel at K6 which surgeries and theatres they are acquired to each day, which is visually presented on screens in the area. The surgery planning and preparation phase, including production and capacity planning process can be viewed in Figure 5.1.

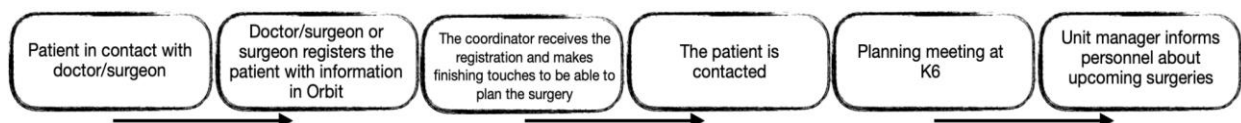


Figure 5.1: The production and capacity planning process at Skövde Hospital

The process is easier and faster to manage when the operation theatre is ready, all equipment prepared and the personnel in the right place and time according to the unit manager at K6. To be able to use the resources in the best effective way, the production is planned from this. However, it is important to mention that in the healthcare environment, resources may need to be redirected quickly in order to provide safe care. This means that personnel planning for one cause may need to attend another cause in short notice, which is why planning needs to be flexible and adaptable to some extent.

By having the resources planned and under control, the flow will be smoother and more even. The aim of planning is, besides to plan capacity, to be able to perform as many surgeries as possible. This is partly done by using the queue of patients as buffers, meaning that gaps in the schedule are filled with people waiting for care. This is possible to achieve only because the people working at K6 have great knowledge on how to do so, to fit patients with suitable requirements into gaps that can meet these specific requirements. Finally, as the common aim is to perform as many surgeries as possible at SkaS, this aim is targeted and discussed by illustrating areas that work well, and areas that need improvement. Also, how these improvements should be brought forth in order to work sustainably. These topics will further be investigated in the following sections, 5.2 through 5.3.

5.2 Main success factors and barriers regarding production and capacity planning

The following section will discuss and analyze the success factors and barriers for PCP at SkaS. This is done in order to address the second research question, *what are the main success factors and barriers?* The positive aspects of the planning system are highlighted and the soft values in terms of employee's dedication and strong will are discussed. Barriers such as variation and communication related to the planning system and variation and communication related to humans are brought up. To provide an overview of the brought-up success factors and barriers, Table 5.1 is presented below, summarizing the main aspects of the issue. These areas will be discussed through 5.2.

Table 5.1: The main success factors and barriers regarding production and capacity planning

| Success factors | Barriers |
|--|---|
| The guidance and framework provided by Orbit, the planning system | Orbit, as an inflexible planning system |
| | Missing routines and work standardizations |
| Soft values such as dedication and openness and willingness for change | Lack of or bad communication |
| | Late information changes in Orbit |
| | Patient variation |
| | Variation amongst employees in areas such as knowledge, performance and preferences |

5.2.1 Success factors

The guidance and framework that the surgery registration provides are argued as valuable for the hospital. It is a tool for information sharing and without a standard and structure, the planning and procedures would have been impossible to manage appropriately. To a certain extent, there are structures, procedures and identified responsibility areas for various parts to prepare the patients for the coming future. But according to the samples, the system and processes need more standardization regarding the execution, even though common surgeries are thought of to work quite appropriately. The planning system Orbit is also argued to function well in the terms of never breaking down, but simplicity and clarity is needed.

More so, there is a great understanding of the system amongst employees and most of the people working at K6 have planning expertise, meaning that they know how to fill in gaps in the schedule efficiently. To be able to fill gaps in the schedule, patients are used as buffers. Therefore, the unit manager states that even though it is not to strive for, there are some beneficial aspects with having a waiting line of patients meaning that the operation theatres never are empty, as they are used optimally. However, this great deal of “know how” is truly vulnerable since it is tied to specific people and personal contacts, meaning that it will go

missing if that specific person stops working there. Also, using buffers in this way for planning requires an excessive amount of time and effort, and how well it is performed, depends on how well a specific person has knowledge in the field as this is not a standardized method of working.

As seen in the empirical findings, most of the identified success factors are soft values that are based on human aspects such as dedication (Glouberman & Mintzberg, 2001) and openness and willingness for change (Bita et al., 2014). In the healthcare sector, the human resource function is a focal point, to achieve alignment of culture and values that can enable effective communication and information sharing (Bita et al., 2014). Therefore, it is of highest importance for SkaS to continue striving for the alignment and values thoroughly in the entire organization.

To achieve more efficient healthcare and be able to provide faster care with a higher quality, adding more resources to healthcare are desirable, but the limitation is partly the levy of incomes of taxes (Socialstyrelsen, 2021). However, the healthcare systems are considered to have some potential for improvements without adding more resources (SOU, 2016). Most of the employees have a strong will to improve and contribute to an efficient healthcare that provides and benefits the patient and it can be concluded that soft values in an organization is vital. However, resistance to change and conflicting interests exist at SkaS. Even though resistance can be valuable to consider (Sveningsson & Sörgärde, 2019), this is something that is preferred to be a low level of. The fear of the unknown and aspects of psychological resistance, miscommunication and lack of competence could be obstacles (Sveningsson & Sörgärde, 2019; Kaufmann & Kaufmann, 2005). At the internal improvement project at SkaS, two surgeons have left the improvement group, which implies resistance or lack of interest and miscommunication (Stewart & Kringas, 2003), but this is quite unusual for SkaS.

5.2.2 Barriers

In the empirical findings, a description of delayed surgeries is presented. The surgery registration and cards were from the beginning identified as a potential field of study in the planning flow related to delayed surgeries by K6. The barriers are thoroughly caused by different variations and faulty communication.

5.2.2.1 Variations and communication related to the planning system

It is important to fix organization systems and not only people (Bodilson, 2005) and it is vital to offer the employees at SkaS appropriate preconditions to be able to provide good care and health to fulfil patient needs. As explained in 4.2.1, Orbit, the planning system, is seen as inflexible and fixed by both surgeons, coordinators, nurses and management. Obstacles in terms of non-user-friendly and unsustainable planning result in many consequences. As mentioned, the more complex an organization is, the larger is the need to integrate the organization (Glouberman & Mintzberg, 2001). Accordingly, the healthcare world is huge, and Skövde Hospital is only a part of the entire flow. The planning system is mainly governed by Sahlgrenska University Hospital, which is an academic hospital in the Region of Västra

Götaland and one of the largest in Sweden (VGR, 2021). Therefore, SkaS has some limitations to change the system and this is considered a large problem by the employees.

Beside the fixed system, there is a lack of routines and structure when working with surgery planning. The low degree of standardization for the planning is argued to result in waste and inefficient systems (Liker, 2009). Accordingly, the differences in execution when filling in the surgery registration and all the different choices available for diagnosis and cards end up in many negative consequences. Orbit is from the beginning based on manual papers that have been translated to digital papers. Thus, the system and options have become quite fixed and not so open for customization and patient focus in Lean (Lander et al. 2007; Bhakoo et al. 2017; Liker, 2009). The system needs more frequent and effective internal communication. Moreover, one identified issue has been differences in the surgeon's performance to fill in mandatory fields in the surgery registration. Different departments seem to have received information and requirements that differ in terms of instructions for the mandatory information such as medical treatment with blood thinning medication, infections or if the patient has an updated ECG. It is important that the entire organization receive the same information to be able to work as a team, growing together to become a learning organization (Liker, 2009).

The fast-changing environment and the two different flows, emergency and elective, are causing the situation to become even more complex. There are changes in the information at the last minute in terms of the surgery registration and card. According to the gathered information, the last change would preferably happen at least two days before the surgery. Changes the same day and the day before surgery are causing consequences, especially for K6. The study showed that 72 % of the surgery registrations were changed the same day or the day before surgery.

The insufficient surgery registrations are causing problems. The surgery cards are in place to create value, but the value can also be destroyed (Osborne, 2018) and this is seen as a large waste when planning production and capacity. The multiple cards and missing cards in the surgery registration, decrease the quality of the information. This can lead to misunderstandings and misinterpretations. According to Järvi et al., (2018), there are eight aspects that cause value destruction. Five of the eight aspects have been identified for value co-destruction: the absence of information, lack of trust, mistakes, the absence of clear expectations and blaming. The surgeons are insufficiently informed about the requirements and the mandatory information within the surgery registration. Care (nurses) is blaming cure (surgeons) for not filling in the registration and card correctly. More so, this type of destructive atmosphere is not wished for, and integration between care and cure is sought after (Glouberman & Mintzberg, 2001).

5.2.2.2 Variations and communication related to humans

As mentioned, variations are unavoidable and common in the world. There are many examples of variations at SkaS and a challenge of how to manage and achieve a smooth and flexible system is the existence of variations of different types. Variations that are hard to predict should be prioritized (Bergman et al., 2015). The two types of variations, common and special should

both be handled, but the focus should be on the special variation. Methods can be used to reduce the special variation and even though some of these changes are considered to contain common variations from the patient's needs, some of the changes are also considered to contain special variation. By distinguishing and identifying the difference between common and special variation, the hospital can achieve a better performance. By doing so, it combines practices from PCP and Improvement Science. For the thesis, the following variations have been identified in the different areas.

The variation of patients' needs is important to consider in healthcare (Neubauer et al., 2011; Rosenbäck, 2017), but the common variation in a patient's needs is hard to get around. However, this needs to be handled and increasing the number of combinations for the surgery cards would better adapt to the patient's actual needs. Since Lean Healthcare advocates patient focus and strives for continuous improvements (Rosenbäck, 2017), SkaS, VGR and the entire system should strive for the same goal. The system needs to adapt to the conditions and try to handle the patients' needs and be clearer to avoid faulty communication through the planning system.

Knowledge and skills differ a lot from surgery coordinator to surgery coordinator and from surgeon to surgeon. There are also different preferences in methods and ways of working. Some preferences, such as if the surgeon is right- or left hand is classified as common variation. As mentioned in the empirical study, this is assessed as a problem since surgeons fill in the surgery registration even though the surgeon themselves will not perform the specific surgery and they do not have the right information about the other surgeon's preferences. This results in duplication of effort (Liker, 2009) in preparation since the operating theatre must be altered to adapt to the surgeon's preferences. The variation in time it takes to fill in the surgery cards is also interesting to consider. This time difference can be hard to avoid since some surgery cards are more complicated to fill in than others. But the difference in time is also because of the surgeon's various efforts and prioritization. Also, prioritizations, views and opinions are vital to handle between the professionals and within the professionals. In general, there are a lot of individual workers in healthcare that provide dedicated and excellent work (Weisz et al., 2013). As mentioned, this is even the case at SkaS but the system cannot be optimal due to the presence of optimization is a mix of common and special variation.

Variations related to the routines in Orbit are classified as special variations. These special variations are e.g. choosing different surgery cards for the same type of surgery. Accordingly, the weak routines and barriers in Orbit can be classified as waste from Lean. The 7+1 wastes (Liker, 2009) exist in the system and have potential improvement areas. When the system does not work, the dependence and requirements on well working communication are vital. It can be concluded that a high percent of the surgery registrations is changed the same day and the day before. The objective of having two days of unchangeable schedule is to strive for. According to Rosenbäck (2007), the variation that is hard to predict should be prioritized. Therefore, the surgery registrations that are changed in the last two days before surgery should be prioritized.

Variations can be classified as wasters (Rosenbäck, 2017). By evaluating the current preparation phase of surgery, several different types of wastes according to Lean are identified (Liker, 2009). An excessive amount of transportation and motion in terms of equipment and other preparation are in need of replacement when new information is provided in the surgery registration. Excess inventory is found in the overall patient queues. Waiting times are identified when employees are waiting for information and are trying to contact each other, but not succeeding. Duplication of effort occurs when the coordinators need to contact surgeons, double-check information and check out assignments that someone else is responsible for. Overprocessing and defects occur when misunderstandings and miscommunication happens, e.g., vagueness and differences in chosen cards can result in wrong surgeries.

Since the long-term ambition for SkaS is to constantly grow and improve the value-adding activities in the care processes, variations are essential to handle. An unsustainable system that differs in structure, routines and ways of working, leads to a bad working environment in terms of stress and pressure to solve problems fast to be able to complete tasks. The well-being of employees is a part of SkaS sustainability goals and needs to be taken into consideration. As mentioned earlier, the goals of decent work, economic growth and good health (United Nations, 2021) are desirable for SkaS and to be able to develop a better social environment.

During the evaluation, it is easy to make the conclusion that there are different views between the professionals at SkaS. The need to provide good care and health to fulfil the patient's needs seems thoroughly known in all professions at the hospital, but all have different prioritizations and strategies to accomplish this, which is in line with Glouberman and Mintzberg (2001). To achieve improvements, care (the nurses), is preferring to focus on the operational parts such as planning, information sharing and communication. By contrast, cure (the physicians) prefers to change the system and in some cases also improve the current system. In general, control (management) strives to increase and make the capacity more optimal, as by increasing the number of operation theatres. But in this question, both care and cure are in the same line that a higher number of operating theatres should solve the problem regarding increasing the number of surgeries at SkaS. Also, the decision-making and judging vary between physicians regarding patients' decisions. The anesthetists make different decisions regarding emergency patients. Moreover, there is weak communication and harmonization between the physician who executes the registration and the coordinator who is planning. Consequently, there is also obscurity in who is mainly responsible for the process and who should take the initiative to contact the other party during uncertainty.

Moreover, there are visible differences in views for care and cure if the surgery can start too early or not. According to cure, randomness is hard to take into consideration from a system point of view. Slotted times are preferable since it is easy to plan for. According to care, there are no disadvantages to starting before the planned time. The surgery team sees the opportunity to utilize the time and use time after the surgeries to add unplanned surgeries the same day.

Since waste occurs when a surgeon fills in wrong information and statistical data from surgeries. The integrated mutual resources should be in a beneficial manner for all parties as

the hospital. Identified waste is also the existence of suboptimization (Tay et al, 2017). Even though the COVID-19 pandemic has led to an increased collaboration between the specialties and more common planning over different surgical specialties, there are still differences and in some cases tension between the surgery specialties, that are described in 4.1. Some people at some specialties and departments strive to optimize their own activities and resources. The limited numbers of operation theatres are causing fights between the different specialties and in the COVID-19 pandemic, the number of theatres is even lower than usual.

The planning process is a challenge in the fast-changing environment at the hospital and makes the planning process hard to manage perfectly, but it is considered as a key for success. The elective care and emergency care must be coordinated and work together. However, pre-conditions for having a sustainable process system must exist.

In summary, there are both success factors and barriers to manage for the hospital. The Orbit system is a tool and guidance for information sharing. The planning system would have not been able to perform without this framework. Common and standardized surgeries are working appropriately and are easy to register. In addition, the soft values that are related to the human properties such as dedication, openness and willingness for change are transparent across the professions and specialties. The main mentioned barriers are variation amongst employees regarding knowledge, performance and preferences, missing routines and work standardization, lack of or bad communication, late information changes in the planning system, patient variation and the fixed planning system Orbit.

5.3 How to achieve an improved production and capacity planning at SkaS regarding surgical specialties

This following section is to be able to address the third research question, *how could the production and capacity planning be changed or improved within a surgical specialty?* This is done by dividing the suggestions into sub-categories such as openness for change, respect within the organization and the communications aspect. Lastly, the suggested improvements are presented and discussed.

5.3.1 Achieving sustainable improvements

5.3.1.2 Openness for change

Overall, it can be said that change is natural and impossible to avoid (Sveningsson & Sörgärde, 2019). And therefore, it should be made part of SkaS everyday work, since as Bergman et al. (2015) implies, change should be made an inspiring part of the organization.

To be able to achieve a sustainable workplace, employees need to be open for change (Bradbury, 2009). More so, making the system sustainable is, according to Bradbury (2009) and Kira and Lifvergren (2013), dependent on the participation of different stakeholders. To achieve and work towards efficient and well-working planning, many areas must work together and interlink in the process. This, since it is stated by Ferguson et al., (2013) and Plsek (1999),

that when working towards improvements in a healthcare context, it is important that various professions work in teams. One success factor when it comes to collaboration is flexibility, however, this can be difficult to achieve as the healthcare sector is an organization with a bureaucratic structure (Willem & Lucidarme, 2014). O’Leary and Vij (2012) stress the fact that collaborations should be informal and not hierarchically dependent in order to work best, and that the actors should have an equal status. This can be hard to achieve in the hierarchical world of healthcare, making status a must to address. Adding to that, Carlin et al. (1996) and Berwich and Nolan (1998) bring up that feature such as system thinking is a good quality management tool when reaching for improvement in the healthcare sector.

Moreover, when conducting a long-lasting change, the mentioned plan strategy and process strategy should be combined according to Börnfeldt (2018). The change has to come from both the management and the rest of the organization. Hence, the management group should be aware and encourage the employees to suggest improvements and ideas. The improvement project at SkaS is observed to follow this strategy.

The intrinsic motivation is in these cases required and needed (Bergman et al., 2015). Also, as the employees at SkaS are considered to be the people linked to theory Y, creative and responsibility seeking (McGregor, 1960), the combination of intrinsic motivation and earlier mentioned type Y personality traits can be beneficial when conducting change. More so, Sveningsson & Sörgärde (2019) stress the fact that the feeling of meaning is vital. This can also be seen in the project group as many are dedicated, bringing up issues that are important for them and wanting to work for a better work environment, and to achieve a higher number of surgeries, whilst at the same time not compromising patient safety and also the quality of the surgery. Using the frontline workers like this and using their improvement suggestions is, according to Liker (2009), a good way to proceed by engaging the whole organization. This will in turn lead to the reduction of waste on a daily level (Liker, 2009).

In general, it has shown that employees that have been working for a long time at SkaS with much experience are more resistant to change. Many people are considered comfortable and are satisfied as is. One issue, according to Sjöquist (1990), is that organizational change is often assumed for the worse. Therefore, as mentioned by the development director as well, it is important to stress the fact that we are not conducting changes, we are conducting improvements. More so, Sveningsson & Sörgärde (2019), stress the fact that resistance or conflicting interests, both common when conducting change, should be seen as something valuable, since it is an asset that can contribute to the process.

Since working towards a common aim over different professions has shown to be powerful in the industry as well as the healthcare (Plsek, 1997), SkaS main objective is promising, to strive for good care and health to fulfil the patient’s needs. Moreover, the earlier prioritized strategic theme to strive for sustainability is noticeable at the hospital and after observation at the field study, and overall, employees are considered to be open for change and improvements. All parties need to be open for change and understand the mindset to achieve empowerment of sustainability (Bradbury, 2009; Kira & Lifvergren 2013).

5.3.1.3 Mutual mindset, respect within the organization and workshops

As stated, the dedication amongst the employees at SkaS shine through in many actions they take. However, multiple problem areas connected to differences in the three studied worlds of healthcare (Glouberman & Mintzberg, 2001) are detected such as misunderstandings, miscommunication, variations in ways of working and variation in need of information to give some examples. To be able to overcome these differences, a well thought out integration process might work. One area of integration, detected by Glouberman and Mintzberg (2011), is commitment to purpose, which as stated throughout this thesis, is common. By using this force, common improvements could be achieved, but this does not illuminate all the issues. Another area of integration, the urgency aspect (Glouberman & Mintzberg 2001), is also seen, more so than ever due to the COVID-19 pandemic. The last area of integration is the knowledge aspect (Glouberman & Mintzberg, 2001), which as well is seen in the empirical study.

Even though these are known areas of integration, they do not seem to be enough to accomplish an improved environment and the planning. Blaming other professions for the problems rather than oneself is seen as common throughout this thesis and there have been low efforts trying to understand each other's profession and points of view. We believe that there is a need for openness and endless learnings about each other's professions and needs. This is something that Lean Healthcare has accomplished, and as Cory and Hallman (2018) discusses, this way of working can alter cultural- and organizational structures. Cory and Hallman (2018) further explain that Lean Healthcare has led to understanding of how important it is to work together over working levels and departments. The need to collaborate over different professions is urgent at SkaS.

Understanding of each other's professions and needs can be achieved by workshops. This has been done at SkaS, with little presence, at least by the cure profession. It is unclear if this is due to lack of time or any other factor. By some interviewed surgeons, it was stated that they did not know the meaning for these types of workshops and thereby did not attend. When it comes to Orbit, and learning how to use this system, the surgery coordinator stresses the importance to attend classes that are set up to educate the surgeons, however, as mentioned, there has been little or no interest for this amongst surgeons, who are now filling in the surgery registrations and cards faulty. Moreover, as Liker (2009) argues, it is important to respect your network partners. We have seen lack of respect to some extent throughout this project, such as not trying to fully understand each other's perspective and need of information, making this a vital area of improvement.

5.3.1.4 The communication aspect

According to Bergman and Klefsjö (2012), quality and customer focus is vital when reaching for improvements. In this case, the patient is seen as the customer and patient safety is always of the utmost importance. Also, communication is one of the best tools to achieve successful Change Management (Eriksson, 2002). What has been detected at SkaS is miscommunication and lack of communication regarding e.g., prioritizations, responsibilities and new information. To better achieve improvements regarding production and capacity planning, it is thought that

the communication factor must improve since, according to Dudau et al., (2016), miscommunication is the main issue when it comes to collaboration. By improving how various professions communicate, and how planning is communicated in the planning system Orbit, a more even and efficient flow of patients can be the final product.

As mentioned, improvements in the healthcare area have tended to thrive when the various professionals work together with strong communication (Ferguson et al., 1993; Plsek, 1999). The strong forces of dedication, knowledge and urgency are present (Glouberman & Mintzberg, 2001), but communication within the hospital would be a potential improvement area and a good solution for the hospital to continue striving for delivering care of high quality and working in harmony with the sustainability goals. The identified integration barrier between the worlds in healthcare consists of cure, care and control (Glouberman & Mintzberg, 2001) and will remain as a problem if no action is taken. As stated, communication is key in change and the interaction of humans in different professions are vital. The collaboration within healthcare is seen as a tradition (Plsek, 1999), but is not considered as well working in practice.

5.3.2 Suggested improvements for better production and capacity planning

Below, improvement suggestions are presented, which are all thought to be relatively hands-on and possible to manage in the near future. All suggestions target the production and capacity planning process. The suggested improvements are thought to target the common barriers discussed in 5.2.2. Which improvements target which barrier is visually explained in Table 5.2 below.

Table 5.2: Barriers and suggested improvements

| Barriers | Suggested improvements |
|---|--|
| Orbit, as an inflexible planning system | Improve PCP planning software Cross-functional team among the hospitals in VGR |
| Missing routines and work standardizations | Implement Poka-Yoke Internal education Develop a PCP process & measurement tools Restructuring responsibilities |
| Lack of or bad communication | Internal education Develop a PCP process & measurement tools |
| Late information changes in Orbit | Implement well adapted surgery cards to match patient variation |
| Patient variation | Implement well adapted surgery cards to match patient variation |
| Variation amongst employees in areas such as knowledge, performance and preferences | Improve the PCP planning software Internal education Develop a PCP process & measurement tools Cross-functional team among the hospitals in VGR |

5.3.2.1 Improve the production and capacity planning software to decrease errors

Firstly, one positive note with the current software used for planning is that it visualizes data in the form of performed surgeries in time order. The system shows what surgeries are in action and which ones are to come, which is stated by Perla et al., (2019), as something valuable for healthcare professionals. However, the system is very static and has a distinct limited options of surgery cards and the possibility to be more specific regarding diagnosis and the patient's needs. To facilitate the working procedure, the system should be more adaptable and flexible with more options. The system and information should be more integrated, and it should be easier to find the information. The surgeons prefer when it is easy to choose the right diagnosis and surgery card. In the current system, surgeons need to adapt to their own routine and way of working to overcome the fixed system and adapt to the specific patient and case. The routines are not standardized, and this should be improved. According to Lean principles (Liker, 2009), it is of highest importance to do the right thing from the beginning to skip duplication of effort. With this said, the software system Orbit needs improvements since, as stated by Bodilson (2005), it is vital to adjust poorly designed organizational systems and not only the people working in it. From the empirical study, it has been found that there is a high level of need for

the surgeon to have more interaction between the Orbit system and Melior. By having more interaction and facilitating the registration, waste as duplication of effort can be reduced.

Moreover, in terms of adapting the system to the people using it, there is a wish for some type of form where the surgeons could contact the surgery coordinators in real time, other than making a phone call which is done today. By having this feature, surgeons could contact the coordinators, maybe on set out times, to be able to discuss surgery cards in order to choose the most sufficient one.

5.3.2.2 Implement Poka-Yoke

A very hands-on improvement regarding the planning system Orbit worth implementing would be to make more fields mandatory to fill in. This is brought up by the surgery coordinator as well as surgeons filling in the registration and card. It is stated that it would be easier for them to know what kind of information that needs to be filled in, in order to plan capacity well. Some surgeons even stress the fact that more fields were mandatory earlier, and that this now, for no known reason, has been changed so that they do not know which information is vital for the surgery coordinator to receive. These types of miscommunications risk patient safety and must be addressed (Göransson et al., 2015). Göransson et al. (2015), further states the importance of well filled surgery registrations and cards to be able to communicate well between various professions.

Connecting to the literature about Lean Management, Poka-Yoke can be seen as a method to target this problem area (Dudek-Burlikowska & Szewieczek, 2009). One of the Lean principles, Stop and fix the problem (Liker, 2009), is somewhat connected to this area. The Poka-Yoke method was introduced by engineers at Toyota Motor Corporation in 1961 as a method to prevent errors which were originating from mistakes (Dudek-Burlikowska & Szewieczek, 2009). According to Dudek-Burlikowska and Szewieczek (2009), this technique can be used to avoid errors caused by humans at work. Poka-Yoke methods and devices are simple to use and preferable by many. These methods can for example be visual indicators, as a Poka-Yoke tool is any device preventing mistakes that are obvious to the eye (Fisher, 1999). Applying this to SkaS, at the hospital in Skövde in particular, this could mean initiating the mandatory fields once again, making it impossible to make errors regarding a faulty filled in registration or card. This can be done by either marking mandatory fields with a sign, or by highlighting said field in a color that brings attention to the eye. Gathering information from the surgery coordinator, the fields that should be mandatory are: The anamnesis, if the patient is taking blood thinning medication, if there is a current infection and if the patient has an up-to-date ECG. To conclude this section, Poka-Yoke, a method drawn from Lean Management, can ensure less variation in the registration of data.

Moreover, Poka-Yoke might be able to connect to areas that are not IT- or software-specific. To be able to plan production and capacity, one needs to understand the process, and to help understand the process, it can be beneficial to be alerted if something is done wrong. By making a clear path of how production and capacity planning should be brought out, with little or no room for errors, sustainable planning can be achieved.

5.3.2.3 Implement well adapted surgery cards to match patient variation

Another area of improvement, also connected to the surgery registrations is why the registrations are changed last minute, making it difficult to foresee capacity. It was shown in the empirical study that 72% of the registrations were changed the day before, or the same day as the surgery. When looking closer to what was the reason for change, the main problem area were the surgery cards, as 73% of the registrations were changed in regard to the surgery card in itself. Only 18 % of the registrations were changed in order to add information and the remaining 9 % of the changes were connected to the time aspect. By targeting the problem regarding surgery cards, it is thought that many problem areas will dissolve. The problem areas brought forth are as mentioned, that the card does not always provide the sufficient information to match the diagnosis. This makes it impossible for the surgeons to choose an ultimate card to match the method of choice.

5.3.2.4 Develop PCP process & measurement tools

To be able to plan production and capacity fairly, there must be a deeper understanding of both the planning method, and how it is brought out practically. Therefore, on a more long-term note, we believe that the hospital in Skövde is in need of a process-thinking. As of today, there are no clear processes in place regarding how to plan production and capacity in the short-term measure of two weeks. More so, there need to be more areas of responsibility, meaning that there should be clear process owners to see which person is responsible for what. And as stated, combining the two strategies of change, the plan and process strategy, is sought after to achieve change (Börnfelt, 2019), and this is why the process-thinking must come from both personal and management to work at best.

Along making a clear production and capacity planning process with process owners, there is a need to measure if the process is well functioning. Because as Bertholds (2010) states, there is a need to measure change to see if they are made for the better and by this avoiding waste. Finding the difference between the planned production schedule and the actually performed production schedule is of the utmost importance to be able to conduct continuous learnings regarding the production and capacity planning process.

McCann et al., (2015) also states that a change philosophy is often adapted, then fading as time goes by. This is why it is vital to measure the changes to see that the well-functioning changes, made for the better, sustain.

5.3.2.5 Restructuring responsibilities

Whilst on the same note as above, with improving the process of filling in the surgery registration and card, an improvement area with another take presented itself. This improvement regards the responsibility aspect. When interviewing the surgery coordinator, it became clear that faulty filled registrations and cards are always corrected by the coordinator to be able to plan production and capacity. This is something that the coordinators do not mind doing, as long as there is time set aside for this task, which it is not today. By handing over a larger responsibility to the coordinators of filling in the registration and cards (which in

practice, already is done) the mindset of having “the right person at the right place” can be achieved.

In other words, the employees at Skövde hospital should work on the top of their competence, meaning that surgeons should focus on performing surgeries, and administrative personnel should focus on administrative work. As mentioned, this is already the case at SkaS, however, we believe that the surgery coordinators should be recognized as the ones responsible for filling in the registrations and cards with what they are educated and legally allowed to do. In practice, this would mean that the surgeons fill in the cards with sufficient information to provide a safe surgery, and then the coordinators take over the responsibility to fill in information that can be gathered on anamnesis, current infections etc. When suggesting this division of labor, some of the surgeons were positive, with the note that they were not sure how this would work practically. This is however not seen as an issue since this is already the division of labor. The surgeons are only not aware of this as of now, since they are not aware that most of the registrations and cards are fixed by the coordinators anyway. This can be connected to Lean Management as the waste, non-utilized talent or skills of workers has been identified here (Lander et al. 2007). Coordinators are considered to have the skill to contribute to the surgery registration at a higher level and to get more responsibility.

5.3.2.6 Internal education

According to Rice (2015), the entire organization must work in the same direction to be able to accomplish goals and objectives. To achieve a more sustainable planning process and working for SkaS sustainability objectives, they should strive for more continuous education and more structural training for new employees. Accordingly, to accomplish a learning organization and always striving for improvements that are in line with the values of Lean healthcare (Brandão de Souza, 2009; Al-Hyari et al., 2016; Cory & Hallam, 2018).

This is to provide a structured learning process for surgeons as to how to fill in surgery registrations and cards. By educating the surgeons it is believed that the increased knowledge, along with a clear standardized path to fill in these forms will be beneficial for the planning. This, since the forms will be filled in correctly from the beginning, leading to less work for the coordinators regarding faulty cards, meaning more time for them to plan capacity.

5.3.2.7 Cross-functional team among the hospitals in VGR

To interact more with other hospitals in the region are suggested to achieve more collaboration and knowledge sharing regarding the production and capacity planning system. First, the hospitals can evaluate their own organization and after that, consociate and obtain synergetic contributions for all involved parts. This can lead to a reduced dominance for e.g., Sahlgrenska University Hospital to facilitate the minor hospitals to convey proposals. As a consequence of the decentralization in healthcare, all hospitals do not have Orbit as their planning system. But having a common system to encourage cooperation and interaction, would open possibilities to find an optimal and smooth planning system together and should not be ruled out. In the long-term, a common system for hospitals in Sweden could be possible to implement to achieve

earlier mentioned advantages. However, the complexity of the decision making in this system should not be ignored, but the idea should not be excluded.

5.3.3 Gains of improvements

By implementing the mentioned improvement areas in 5.3.1, mutual mindset, respect in the organization and education, improving the communication system and striving for openness for change, SkaS has the potential to develop and work towards their vision. Moreover, the following suggested improvement for the hospital in and 5.3.2, improving the production and capacity planning software, implementing Poka-Yoke, restructuring responsibilities and striving for a more sustainable system for surgery cards are all considered reasonable and possible to accomplish.

By executing improvements and changing mindsets, it would facilitate the ambitions of Clinical, Economic and Social/Human sustainability. By prioritizing sustainability, it will facilitate the challenges in the healthcare system and the vision will be affected in the right direction. It is thus possible to achieve a more sustainable planning system with more predictable routines and a more equal approach. The work environment is expected to have a more predictable planning, fewer rescheduling and fewer errors. This would result in a better-quality performance for the surgeons as well as the coordinators and thus reduce costs of failure. The improvements would also contribute to time saving and thus decrease time efforts of the information flow and use the time to save more lives and provide more care to the society.

5.4 Future research and theoretical contributions

In this chapter, theoretical contributions will be presented and potential future areas of development to evaluate further on the findings of the thesis.

5.4.1 Theoretical contributions

What has been seen throughout this thesis is the lack of theory in some areas and lack of how various common theories can be interlinked. Therefore, this paper may have some different theoretical contributions. Firstly, little to no information was found in variation regarding soft aspects such as communication, collaboration and respect among employees. Theories regarding variation were mostly connected to Lean Management and more technical aspects of production. Adding to that, there might be some contributions from how to achieve change in a healthcare context that can be applied to industries in use of Lean Management with the main importance of taking soft values such as communication and respect into consideration when achieving continuous improvements.

There was also little to no information about how to interlink production and capacity planning with Lean Healthcare and Improvement Science. Adding on production and capacity planning to Lean Healthcare and Improvement Science can lead to a more even and efficient flow. Even in this area it was shown that production and capacity planning might reach more success if soft values are brought forth, making this an addition to Lean Healthcare and Improvements Science, as it was shown that production and capacity planning would benefit by not only

striving for technical changes or improvements. Moreover, the usage of buffets when planning surgeries at Skövde Hospital, is an important principle in advanced production and capacity planning. This can be used as a complement to the planning achieved by Lean Management or Lean Healthcare planning principles.

Adding to the common theory presented that there exist four worlds of healthcare, it could be seen that this was the case even for Skaraborg Hospital group in general, but also Skövde hospital in particular. More so, the problem areas brought up by Glouberman and Mintzberg in 2001 are still present 2021 with little change or improvement as there are still discussions and conflicts between the various professionals of care, cure and control. Also, defining value co-destruction as a waste is not well known related to the different words of healthcare and therefore, this finding can be seen as a theoretical contribution to Mintzberg's and Glouberman 4C. More so, a fourth area of integration between the four worlds was detected as the patient's voice and needs when it comes to communicating between the four worlds. This became visual when the four worlds needed to communicate over production and capacity planning as care, cure and control were united in the thought that the patient's voice comes first and that it is important to set other sub-optimized interests aside to be able to provide safe care within the ordained time.

5.4.2 Future research

Some aspects and findings have been found in this thesis regarding the current system for SkaS production and capacity planning but evaluating more and even deeper into the planning process would be interesting. It would also have been interesting to see how other hospitals perform and manage the experienced problems at SkaS. Therefore, this thesis can hopefully inspire other hospitals to evaluate a similar investigation of the surgery planning, surgery registration and involving all stakeholders to avoid suboptimization nationally. Hence, it would have been interesting to evaluate deeper and investigate in the fourth world community, which implies *the patients* (Glouberman & Mintzberg, 2001). By gathering more knowledge of their actual needs and experiences, valuable improvements could be found regarding hospitals planning processes in Västra Götalands Regionen, but also generally in Sweden.

Also, Bertholds (2010), comments the need for change, and that that change should provide value for patients. This thesis, as mentioned in the limitations, has not taken the patient's perceived value into account and therefore, a suggestion for future research would be to study this area. A take on production and capacity planning connecting to the subjective value of patient experience could contribute to a deeper understanding of the planning, since as Bertholds (2010) mentions, the soft values are vital in a healthcare context, which means that only providing objective measurable data will maybe not provide the whole picture.

6. Conclusion

The production and capacity planning at an operational level at SkaS is performed by different surgical specialties and stakeholders. The surgeons perform the main medical planning, i.e., the surgery registration, and the coordinators schedule and plan the following steps. Variations that interfere with sustainable planning and communication that are insufficient are identified. It has been found that the information in the surgery registration is insufficient and changed too close in time before surgery. The consequences arising from the current production and capacity planning system are causing delayed surgeries, increasing the surgery preparation time, decreasing the quality and leading to unnecessary costs. In addition, the working environment is burdensome and impaired, which results in stress and conflicts when trying to solve and fix the problems internally. Also, late changes in the information flow, insufficient information or missing information are affecting the patients negatively.

SkaS strives to offer patients good care and health and is in need of various improvements. To achieve a more efficient and even flow of patients, and a better production and capacity planning process, the hospital has a potential to improve both the way of working and the software system Orbit. By striving for openness for change, a mutual mindset between professions and more efficient communication, variation will likely be reduced. Suggested improvements target the planning system and the need for well adapted and flexible surgery cards. Internal education and developing the PCP to become a more standardized process with measurable data will help the hospital achieve better prerequisites to be able to achieve a more even and efficient flow. Also, more hands-on improvements such as initiating Poka-Yoke in Orbit and restructuring responsibilities are suggested to provide a more sustainable production and capacity planning.

Skaraborg Hospital Group has set the aim to increase the number of planned surgeries. Accordingly, the design of the planning system and working procedures need to be improved and be more efficient to enable increased capacity. By accomplishing a higher number of surgeries per resource, the flow efficiency can increase. The production and capacity planning system should make it possible to plan short-, medium and long term. Moreover, the emergency flow should be taken into account to be able to plan PCP for the elective flow.

To sum up, since sustainability is a prioritized strategic theme for SkaS, the suggested improvements regarding production and capacity planning are reasonable to strive for. The COVID-19 pandemic has led to cancelations of thousands of surgeries, the care burden is growing large, and the healthcare situation is very complex. SkaS needs a better planning system and process to fulfil patient needs, but also to contribute to the national goal of providing good healthcare on equal terms for all inhabitants and achieving a population with good health in general in the society. Theoretical contributions of this thesis consist of additional information about variations and change in a healthcare context related to Lean Management, stressing the importance of soft values such as communication and collaboration to achieve continuous improvements.

This thesis also indicates that there was also little to no information about how to integrate production and capacity planning with Lean Healthcare and Improvement Science. Therefore, this thesis tries to find and explain the link between production and capacity planning with Lean Healthcare and Improvement Science. Lastly, the thesis is evidence of still existing continuous discussions and conflicts between the four various professions in healthcare, where value co-destruction, as a waste, is not defined and therefore is seen as a theoretical contribution to Mintzberg and Glouberman's 4C model.

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Appendix A

Kind of physician?

- ☐ Intern physician
- ☐ Resident physician
- ☐ General practitioner
- ☐ Chief physician
- ☐ Other: _____

Which surgical specialty do you work at?

- ☐ Surgery
- ☐ Urology
- ☐ Ear, nose, throat & jaw
- ☐ Women's care
- ☐ Orthopedics
- ☐ Other: _____

How many years' experience do you have filling in surgery registration forms?

- ☐ 0–1
- ☐ 2–3
- ☐ >4

I am pleased with Orbit ad the design of the surgery registration form

- ☐ I agree
- ☐ I partly agree
- ☐ I neither agree or disagree
- ☐ I disagree
- ☐ I strongly disagree

When i fill in the surgery registration form, I am uninterrupted and have good pre-requisites

- ☐ I agree
- ☐ I partly agree
- ☐ I neither agree or disagree
- ☐ I disagree
- ☐ I strongly disagree

How much time do you need for filling in the surgery registration form?

Do you ever need to revise the surgery registration?

- ☐ Yes, often
- ☐ Sometimes
- ☐ Never

If so, when do you need to change?

- ☐ The same day
- ☐ The day before
- ☐ The week before
- ☐ Two weeks ahead
- ☐ More than two weeks ahead

Why do you need to revise the registration?

What requirements and expectations do you have regarding the surgery registration and surgery cards?

Do you have any suggestions as to how to improve the surgery registrations?

Appendix B

Treatment number _____

Please circle the answers!

Was the surgery delayed?

YES

NO

Was the surgery delayed due to a faulty surgery registration or surgery card?

YES

NO

Please proceed to the suitable section...

Anesthesia nurse

Did you find the information you needed in the surgery registration and surgery card?

YES

NO

If no, what information was missing? Please choose one or more answers.

The patient was not sampled before the surgery

Choice of anesthesia

How ill/well the patient was

Other missing information _____

Surgery nurse

Did you find the information you needed in the surgery registration and surgery card?

YES

NO

If no, what information was missing? Please choose one or more answers.

How the patient should be placed to be able to perform the surgery

Information about equipment or the need of special instruments

Diagnosis

Information about the surgeon performing the surgery (the surgeon was changed last minute)

Other missing information _____

Assistant nurse

Did you find the information you needed in the surgery registration and surgery card?

YES

NO

If no, what information was missing? Please choose one or more answers.

How the patient should be placed to be able to perform the surgery

Information about equipment or the need of special instruments

Other missing information_____

Other comments:

Appendix C

Interview questions: Surgery registration (SR) and surgery cards (SC) in Orbit

Overall questions

What would you say works well with the current system of SR and SC in Orbit?

What would you say does not work well with the current system of SR and SC in Orbit?

Why would you have to change a SR or SC the same day as the surgery?

Why do you believe the SR and SC are not filled in sufficiently?

What do you believe would make the process of filling in a SR and SC better for you?

Regarding the time aspect

Do you fill in SR and SC for both emergency and planned surgeries?

Which one takes the longest to fill in?

If you had optimal prerequisites, how long do you need to fill in a SR and SC?

The need to change a SR or SC

When you fill in a SR or SC the first time, do you sometimes feel that you will have to alter this SR or SC closer to the surgery?

Have you thought about the consequences that might appear if you change the SR or SC the same day as the surgery?

Different surgeon

How many times have you performed a surgery with a SR and SC that another surgeon has filled in?

Information

What do you need as a surgeon information-wise to be able to fill in a SR and SC to fulfil a safe surgery?

What kind of information is it that you need to add closer to the surgery?

What do you believe is the main reason that SR and SC are not filled in sufficiently?



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