

Healthcare Production Control Maturity Model

*Development of a Model for Assessing the Maturity
of Production Control at Healthcare Departments*

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THESIS PERIOD

Jan 2023 - Jun 2023



Acknowledgements

We are very grateful to Astrada AB who presented us with this interesting topic and trusted us to do our master thesis in collaboration with them. Special thanks to Johan Mann for your patience and guidance throughout the project, and to Torbjörn Karlsson for your eminent healthcare expertise.

We would additionally like to thank Maria Malmström and Pernilla Sandström at Qulturum in Region Jönköpings län. Your knowledge, enthusiasm and devotion to healthcare production control has been an important source of inspiration for us personally. Without your efforts within healthcare production control and your contacts in Region Jönköpings län, our thesis would not have been the same. On that note we would like to thank the participating departments and healthcare workers from Region Jönköpings Län for letting us borrow your time. The same applies to all talented experts that were kind enough to share their insights and beliefs with us in the expert interviews, your insights have been invaluable for the thesis.

Finally, we would like to thank our supervisor at the Division of Engineering Logistics (the Faculty of Engineering at Lund University), Prof. Andreas Norrman. His critical eyes, feedback and guidance have been key for the final presentation of a trustworthy, rigorous report.

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Lund, June 2023

Abstract

Title	Healthcare Production Control Maturity Model: Development of a model for assessing the maturity of healthcare production control at healthcare departments
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Background

Sweden has been struggling with bad access to healthcare. The National Healthcare Guarantee is not fulfilled, and Sweden has low productivity numbers. One suggested solution to deal with this issue is increased healthcare production control. Healthcare production control (HCPC) is the activity to actively trying to match healthcare needs with capacity. Public authorities are advocating increased healthcare production control in the regions and many regions are just starting up region wide efforts.

Problem Definition and Purpose

Region Jönköping Län's central development unit of Qulturum has started rolling out healthcare production control together with the software system Astrada KPS and has so far seen promising results. For their continuous work with healthcare production control, they desire a way to assess the maturity of different departments or organizations. This would allow them to prioritize efforts and guide departments in their HCPC journey. The purpose of this thesis is hence to develop a maturity model for healthcare production control. A maturity model will summarize important knowledge in the field and could be used to share their knowledge with other healthcare regions.

Conceptual Framework and Methodology

The thesis uses methodology connected to maturity model development that has similarities with the constructive approach. A literature review was used to create an initial understanding of HCPC and maturity models. A two-sided conceptual framework was created, capturing both important areas of HCPC and maturity models. Expert interviews were then held based on this conceptual framework and analyzed in relation to the extant literature to form a first draft of a maturity model. Three workshops with stakeholders were held to refine the model and the maturity model then evaluated with two different organizations.

Construction

A maturity model was finalized after the evaluations. The final maturity model is grid based and consists of twelve different process areas that can be categorized into four categories: 'Organization and Culture', 'Structure and Routines', 'Measurement and Control', & 'IT'. In total there are five maturity levels, in order of increasing maturity: 'No HCPC', 'Reactive', 'Active', 'Internally Integrated', & 'Proactive and Holistic'. The final maturity model is complemented with questions and examples, a blank sheet for assessment and administration mechanisms for future assessment.

Keywords

Healthcare, maturity model, production control, resource planning, capacity planning, Swedish healthcare.

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Abbreviations

Abbreviation	Explanation
BPOMM	Business Process Orientation Maturity Model
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integration
DRG	Diagnosis-Related Group
HC	Healthcare
HCPC	Healthcare Production Control
HCPCMM	Healthcare Production Control Maturity Model
MM	Maturity Model
KPS	Kapacitets- och produktionsstyrning (The change initiative in Region Jönköping's Län)
NBHW	National Board of Health and Welfare
OECD	The Organization for Economic Cooperation and Development
PC	Production Control
PEMM	Process and Enterprise Maturity Model
PPMM	Planning Process Maturity Model
RCCP	Rough-cut Capacity Plan
RJL	Region Jönköpings Län
S&OP	Sales and Operations Planning
SALAR	The Swedish Association of Local Authorities and Regions
SCMMM	Supply Chain Management Maturity Model

1 Introduction

In the following chapter, a brief introduction to the thesis will be given. After having given a general background, and background on the collaboration between Astrada and Region Jönköping Län, the problem formulation and the research purpose will be followed. Thereafter, we present three research questions, focus and delimitations, and finalize the introduction with a summarizing structure of the thesis.

1.1 Background

The Swedish healthcare system is performing well (OECD, 2021; Wreile-Jensen, 2017). However, it contrasts the other Nordic countries in terms of bad productivity numbers. Waiting times are getting longer and patients waiting for a first visit are increasing. In fact, the productivity should have been five percent higher to achieve a balance between in- and outflow in 2021 (Gunnarsson, 2022). Commonly reported in the media are the issues with access to healthcare. In March 2022, none of the healthcare regions were able to live up to the maximum waiting time stipulated in the law about national guaranteed access to healthcare (Florén Sandberg et al., 2022). The guaranteed access to healthcare has had little effect and so has the billions of SEK spent to shorten the queues at healthcare regions (Hedbom, 2022). Capacity challenges are seen as part of the reason for this, since the throughput has remained the same while the staffing numbers have increased continuously (Graf & Barkman, 2022; OECD, 2021; Stiernstedt et al., 2016). Sweden has among the most doctors per capita in OECD, but the healthcare visits per capita are comparatively low compared to OECD, especially for visits to doctors (Stiernstedt et al., 2016). In April 2023, Omni reports that 66 000 of the people waiting on surgery has waited longer than the maximum waiting time of the national healthcare guarantee in Sweden. This happens whilst only about a third of the country's hospital numbers reach their pre pandemic productivity numbers for surgeries (Wikström, 2023).

The bad situation has been acknowledged by authorities and governmental bodies. In 2018, the National Board of Health and Welfare¹ (NBHW) published a report where better resource utilization and competence management was described as one of three big system changes in Swedish healthcare. Healthcare production control was further described as an important tool for achieving this (Socialstyrelsen, 2018). The Swedish Association of Local Authorities and Regions² (SALAR) presents the purpose behind healthcare production control as: *“ensuring that all resources are in place at the right time to ensure that patients are given healthcare of a good quality”*. The authors further claim that this should yield results such as increased accessibility and shorter lead times, but also better resource utilization and financial results when resources are matched against need (Palmgren & Eklund, 2014). Healthcare production control has been a focus in recent years.

An increasing relevancy of this can be seen in recent years where it is seen as one Official Report from the Swedish Government published an investigation in 2022, where one of the main conclusions was that regions must intensify the work with healthcare production in order to balance demand with supply (Gunnarsson, 2022). Currently, there are two different governmental (Ministry of Health and Social

¹ Swedish: *Socialstyrelsen*

² Swedish: *Sveriges kommuner och regioner (SKR)*

Affairs) decisions on official missions given to the NBHW relating to healthcare production control and resource utilization (Socialstyrelsen, 2023):

- Mission to support and strengthen the regions' production- and capacity planning and return targets for number of hospital beds.
- Mission to develop a proposal of a national plan for healthcare's competence management.
- Mission to strategically, continuously and in the long-term follow-up and have a dialogue about healthcare's accessibility.

Already in 2016, the Swedish Government Official Reports stated an increased understanding for the need of healthcare production control among the healthcare regions. The initiatives were described as 'fragmented' and 'at a small scale', not sufficient for a strategic- or more proper operational control (Stiernstedt et al., 2016). A drive for change is indeed seen in many regions. The region of Västerbotten initiated their work in 2019 to introduce a uniform planning- and measurement system (Rönnegard, 2019). Tornhagen and Melkko (2019) tracked the progress of Region Norrbotten's efforts to achieve an expedient and efficient healthcare production control. In the Norrbotten case, the audit showed that there was a lack of common guidelines on how the planning process should be carried out. Reports have additionally been released for e.g. Region Jämtland Härjedalen (Hellqvist, 2022), Västra Götalandsregionen (Västra Götalandsregionen Revisionsenheten, 2019), Region Västernorrland (Ahlborg et al., 2022), Region Kronoberg (KPMG, 2018), and Region Blekinge (Hellqvist, 2016), thus indicating an increasing interest among regions. The work with healthcare production control had not come very far according to these audits. The region-wide, broad, implementation advocated by the government's official reports was not there in reality (Stiernstedt et al., 2016).

The healthcare region of Jönköping, also known as Region Jönköpings Län (RJL), is a region that has moved past the investigative stage and come quite far in their region-wide roll out of healthcare production control. In 2017, RJL initiated their own interpretation of a production control system, applied in a healthcare context. They group their efforts under the term 'KPS', which is short for capacity- and production control³. RJL's efforts have been done in collaboration with the software company Astrada that has developed software to aid the tactical and operational planning of healthcare processes. Astrada is the company that has requested this thesis, and together with RJL they are the most important stakeholders.

1.2 Remark on Defining Healthcare Production Control

A small remark should be made regarding the different names used for healthcare production control (HCPC). The two acronyms KPS and PKS short for Capacity- and production control and production- and capacity control respectively are used by RJL and in several audits of other regions that were identified in the background. Capacity corresponds to resources and production is what you do with your resources, the healthcare (HC) you produce. Some regions simply call the phenomena HCPC. SALAR's publication from 2014 also uses the word 'healthcare production control' (Palmgren & Eklund, 2014), and so do some other literature identified in the area (e.g. Rosenbäck, 2017; Vissers et al., 2001). Rosenbäck was interviewed in the thesis and protested the use of capacity- and production control, claiming that there should only be two viable alternatives. Either you call it capacity- and healthcare need⁴ control or it should be called production control (PC). Behind that reasoning is the belief that PC already includes the balancing of capacity and HC needs, or at least should do so in an

³ Swedish: *kapacitets- och produktionsstyrning* or *produktions- och kapacitetsstyrning*

⁴ Swedish: *vårdbehov*

ideal case, and that production and capacity are highly dependent on each other. Alternatively, Swedish Government Official Reports and reports from the NBHW group their efforts in the area under the acronym PKP or POK short for production and capacity planning⁵, this was also recurrently found in some audits.

The definition of ‘healthcare production control’ is chosen for the remainder of the report, abbreviated to HCPC, due to it being the term used in key literature of the report. Although some interviewees might use alternative definitions, it has been translated into HCPC for the purpose of continuity in the report. Astrada-KPS, KPS and RJJ KPS will be used when it is important to differentiate the software program provided by Astrada and RJJ’s efforts in the area respectively.

1.3 The Collaboration Between Astrada and Qulturum-RJJ

Astrada AB, hereafter referred to as Astrada, was founded in Stockholm in 2002. Astrada developed their concept and software - a development that is constantly progressing with new business dimensions and software applications. Today, Astrada serves industries like logistics & transportation, bank & finance, municipalities & regions, and – most importantly for our thesis, HC (Astrada, 2023). One of the products in Astrada’s HC portfolio is the application used for KPS in RJJ, named Astrada-KPS. The software’s main task is to support tactical and operational decision making for the HCPC. Its engine can be used to recommend suitable schedules based on sophisticated mathematical methods and the user interface focuses on visualizing both numerical data and decision recommendations. In addition to this, each unit in the region also has customized software features that are particularly suitable for them.

But for RJJ, KPS encompasses more than mere software support (the same goes for this thesis on that note). It is used for their entire implementation of HCPC, and among many improvements, new schedule routines have been introduced, follow-up happens more frequently, and staffing routines are revised. To make an example, it is explained that regional departments now have the possibility to make changes in staffing to adjust the supply in accordance with the actual care demand. According to RJJ (Kaverén, 2022), KPS intends to, systematically and fact-based, work with planning, controlling, and follow-up based on inhabitant’s needs. Beginning with only a few HC clinics, Astrada-KPS is being implemented in RJJ in a controlled and responsive way. Main responsible for this change management, and the KPS-initiative in general, is however not RJJ as a whole but a knowledge- and improvement center named Qulturum. Today, more and more departments in RJJ are getting involved in KPS thanks to them. Something that clearly characterizes KPS is that it concerns entire clinics, and all clinics within the same specialty across the entire region (with hospitals in Jönköping, Värnamo, and Eksjö) at the same time. There are still a lot of departments for which KPS has not been introduced yet, but implementations are progressing for many clinics and the project is now concerning over 3000 co-workers in the region.

1.4 Problem Formulation

The Qulturum efforts have shown different HC improvements as a result of the KPS-introductions in the last five years. As a result of this, some other regions have turned to them asking for support in how

⁵ Swedish: *produktions- och kapacitetsplanering*

to initiate or improve their HCPC. Some consider introducing HCPC with corresponding software solutions. Qulturum wants to both inspire others and help these in their HCPC-movement.

Qulturum has encountered some resistance when implementing KPS in RJL. What they see is that how smooth the implementation progress varies strongly between departments. They have some ideas on why this might be the case as the maturity in the planning processes vary as well, but do not have a good way to visualize or map this. They want to be able to assess and make structured mappings of departments implementing KPS, to facilitate these departments, but also to assess those that have not yet initiated the transformation. The latter would help them prioritize between departments and get indications on areas where departments themselves can improve before the KPS-implementation begins. Qulturum wants to continue to lead by example and support other HC regions in the movement towards more HCPC. On this note, they see a potential to provide and distribute a final maturity model (MM) regarding HCPC to other interested HC regions. Such a healthcare production control maturity model (HCPCMM) could thus be fruitful for other Swedish HC regions as well.

Based upon this, it can be concluded that requested success criteria by Qulturum-RJL are:

- A model used for assessing the maturity of HCPC on a department in a Swedish region. This model will be named HCPCMM.
- The possibility to make assessments ‘external’ for overlooking ongoing as well as potential implementations. Department could be benchmarked, but not for certifying the maturity in any way, rather to prepare for upcoming changes.
- The possibility to make assessments with the HCPCMM internally for each department by co-workers to raise awareness of the as-is situation.

The view of many regions’ aspirations to employ structured ways of working with HCPC is also confirmed through student theses. Särholm & Larsson (2020) did a case study on how Sahlgrenska University Hospital in Gothenburg could schedule their doctors after demand, since scheduling at that time all was done manually with identified system shortcomings. They suggested that a centralized scheduling unit for the entire hospital would be interesting to study in the future. Besides, the current scheduling software application used there, Medinet, was considered inadequate. There have also been some theses done together with RJL. Sterwin (2018) showed that shorter waiting time for dental surgeries was experienced after the implementation of KPS. This was however before Astrada’s software was fully implemented at the dental department and when the overall KPS-work only had been live for a year. Additionally, Johnsson and Hedtjärn (2021) discovered that KPS has a positive impact on both the access to HC as well as the work environment within surgical unit⁶ in RJL.

Although some earlier research has shown promising results of HCPC in Swedish healthcare no one has mapped what underlying factors are making departments successful and what a mature department could be. In literature, the focus tends to be very niche with e.g., optimization algorithms for specific departments, and few take on a general perspective (2.2 *Defining Healthcare Production Control*). Additionally information in public reports on the area of HCPC is scattered and unstructured. There is plenty of research done relating to maturity models of different kinds (2.3 *Maturity Models of Planning Processes*), but no earlier research has been found that develops a MM for HCPC. That will be the most important scientific contribution of this thesis. The HCPCMM will primarily be used for assessing the maturity of HC departments, but the theoretical content and derivation of suitable HC process areas will inform future research on the topic of HCPC.

⁶ Swedish: *Enhet för kirurgisk vård*

1.5 Research Purpose

The purpose of our thesis is to develop a model used for assessing and raising awareness of the maturity of HCPC within Swedish HC, as well as contributing to the discussion of HCPC maturity. More specifically, this will be done at an operational and tactical level.

1.6 Research Questions

Three research questions will be asked, building upon each other to provide a clear path to follow for delivering according to the purpose stated above. The first question we ask is:

- RQ1: How can HCPC maturity be defined at a HC department level?

We formulated this question with the purpose of better understanding how maturity is expressed within the context of HCPC. Since the model developed assesses ‘maturity’ one must also understand what that means in the studied context.

The second research question, RQ2, capture the concluding thoughts about the model design that was needed:

- RQ2: What model design will be best suited for assessing maturity within Swedish HCPC?

The purpose of this question was to realize how the model should be designed to best fit with the described intentions by Astrada and RJL.

The thesis had a third research question, RQ3, as well. It asked for the very final visual result of the thesis:

- RQ3: What would be a suitable model for evaluating maturity in a HCPC-process?

The purpose with this question was to guide the implementation of HCPC.

1.7 Focus and Delimitations

The intended scope for the HCPCMM was that of individual HC departments⁷ in Sweden, HC organizations are structured differently between different regional councils and hospitals. HC departments are chosen to represent a general organization below the hospital management and regional management centers. Responsible for tactical planning and below. The subjected organization can be a primary HC center, a clinic or a central unit that has responsibility for several clinics. Most HC organizations of this type should be able to use the model, whereas it is deemed most relevant for departments with a significant amount of plannable care, such as outpatient clinics. In addition, it is important to stress that the focus is on production control for healthcare and with that capacity- and resource planning. Focus will not be on e.g. medical planning, materials planning, or financial planning of HC. The Swedish HC system is publicly funded and has special allocation mechanisms, but no consideration will be taken to these.

Further limited adjustments will be done for standardized patient flows⁸, such considerations were only considered where practitioners deemed it necessary. Patient flows in general are anticipated to require medical knowledge that the authors do not possess, and no detail on patient flow specifications will be made. General conclusions about patient flows can however be part of the constructed HCPCMM.

⁷ Word used to represent organization. Swedish: *verksamhet*

⁸ Swedish: *standardiserade vårdflöden*

A general understanding of HCPC is required to correctly interpret its results. Even though the planning processes of individual departments are what is investigated, it is important to understand how e.g., cross-departmental planning is managed. The relevant planning levels for HC departments are interpreted to be at the tactical and operational planning levels, and no considerations to strategic planning activities are taken unless in relation to tactical and operational planning levels. Apart from HCPC, a general understanding must also be established for MMs related to the business process, supply chain management, and the planning process. It must be reviewed how they are designed and constructed to deliver on their purpose. Similarly, it must also be established what defines performance in HC.

1.8 Structure of Thesis

An overview of the thesis is presented in Table 1.1 below, each chapter is presented together with their output.

Table 1.1: Structure of thesis.

Chapter	Output
1. Introduction	Problem formulation, purpose & research questions
2. Literature review	A conceptual framework to inform interview guides and further analysis.
3. Methodology	Research design and interview guides.
4. Expert interviews	Summary of expert interview contribution per interviewee.
5. Expert interview analysis	Mapping of expert interviews to identify important areas to include in the HCPCMM.
6. Workshops	Summary of workshop contribution.
7. Maturity Model Development and Evaluation	The MM design selection and level definition, synthetization of analysis into process areas, final MM after evaluations.
8. Conclusion	Answer to the research questions, theoretical & practical contribution, limitations, and future research, and concluding reflections

2 Literature Review

The literature review is two-sided, as HC planning had to be considered separate to maturity models. The analysis of HC planning starts off with a general description of HC characteristics, followed by a definition of the area of production control. The literature review will then go into specific activities for HC capacity planning and structured based on hierarchical planning levels. Performance of HC was additionally identified as an important area, to find aspects that can be related to maturity when it comes to maturity models. This review took off from the HC characteristics, as well as performance of planning in general.

For the right-hand side, several different maturity models with different scopes were identified. Maturity models for business processes, supply chain management, as well as planning processes were all regarded as relevant contributing to the final design and aspects of our maturity model. All components of the literature review are illustrated in Figure 2.1. The literature review will be finalized in a conceptualization, both with a conceptual framework, a conceptual maturity model, and a visualization of how they are interlinked.

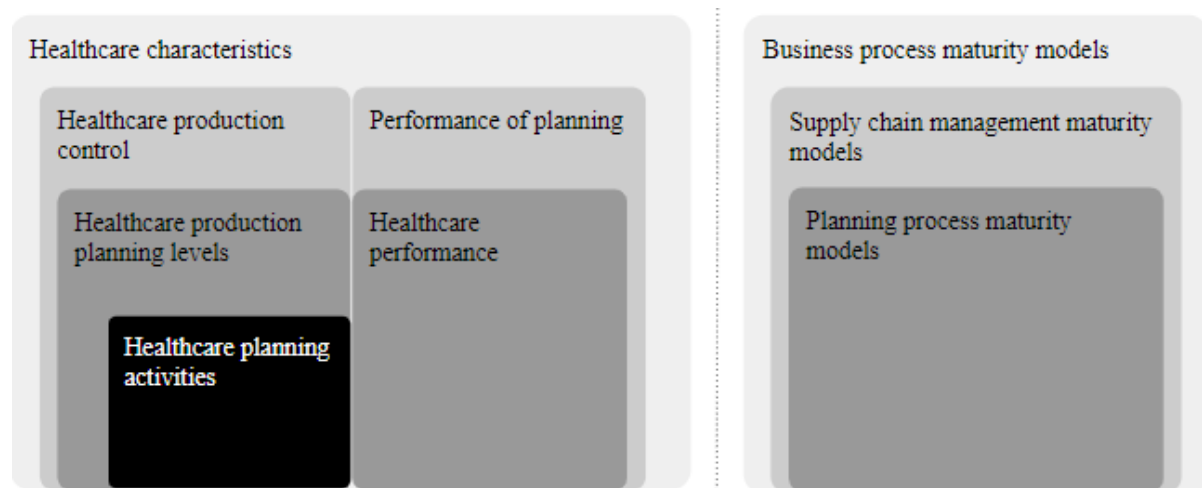


Figure 2.1: Components of two-sided literature review.

2.1 Healthcare Characteristics

To understand HCPC it is important to have a general understanding for how the HC is organized. HC is provided by a range of different organizations and there are many different services offered between them (Hulshof et al., 2012). In Sweden, regions carry the main responsibility for HC, it is their responsibility to e.g., treat and diagnose diseases and injuries through primary- and hospital care. One effect of having regions as principals for HC is that the care system has been dynamically shaped after the conditions in each region. This implies that each region is different in structure from the other. Municipalities are responsible for the care needs of people in specified forms of accommodation and people participating in day activities. HC that usually is performed by doctors is generally not allowed for municipalities (SKR, 2022). Politicians have ultimate responsibility for HC at a regional and national level but rarely interfere with detailed HC control due to the specific requirements of HC knowledge.

Nationally, The Public Health Agency⁹ and the NBHW is responsible for HC questions. The Swedish government and parliament specify what NBHW's mission in the yearly appropriation directive¹⁰. In addition, they get about 200 governmental missions per year that they must handle. NBHW develop guidelines, gather knowledge, compile statistics and follow-up and evaluate (Socialstyrelsen, 2023). National HC control has increasingly focused on increasing accessibility of HC. The HC guarantee has been incorporated in the Health and Medical Services Act¹¹ since 2010 and presents a limit to waiting times for treatment and specialist care (Rosenbäck, 2017). Economic compensation through governmental funding¹² to regions and municipalities is another important control mechanism on a national level that NBHW uses.

HC and hospitals can be considered a special kind of service process where the core process of HC organizations is the flow of patients that are treated (De Vries et al., 1999). The type of HC services is proposed to be grouped into six service groups: ambulatory care services; emergency care services; surgical care services; inpatient care services; home care services; and residential care services (Hulshof et al., 2012). A summary of the classification is provided in Table 2.1, but some clarification might be in place for the reader unfamiliar with HC taxonomy. With this definition, primary care services and outpatient clinics are grouped under ambulatory care services, but so are the “support” departments of endoscopy, radiology and radiotherapy. Inpatient care services include e.g. intensive care units, general nursing wards and neonatal care units (Hulshof et al., 2012). In addition to this there are five levels of care commonly used in Sweden: emergency care, primary care, community care, specialist care, advanced specialist care. Community care¹³ is the kind of care that should be present at all hospitals in a region (Rosenbäck, 2017).

Table 2.1: Taxonomic classification of HC services, summarized from Hulshof et al. (2012)

	Ambulatory care services	Emergency care services	Surgical care services	Inpatient care services	Home care services	Residential care service
Description	Care without offering a room, bed or a board	Evaluation and initial treatment of urgent medical problems	Provide operative procedures (surgeries) for correction, repair, treatment, and diagnosis.	Care by offering a room, a bed and board.	Community health and nursing services, visited at home.	Supervision and assistance with medical and nursing services when required.
Example	Primary care services, outpatient clinics and hospital departments of endoscopy, radiology and radiotherapy	Emergency departments, ambulances, and trauma centers	Operating theater, surgical daycare centers and anesthesia facilities	Intensive care units, general nursing wards, neonatal care units	Medical care at home, housekeeping support, personal hygiene assistance.	Nursing homes, psychiatric hospitals, rehabilitation clinics with overnight stay, homes for the aged and hospices

⁹ Swedish: *Folkhälsomyndigheten*

¹⁰ Swedish: *regleringsbrev*

¹¹ Swedish: *hälso- och sjukvårdslagen*

¹² Swedish: *stadsbidrag*

¹³ Swedish: *närsjukvård*

The market for hospital services, hospital products, hospital processes and resources used for hospital production have special characteristics (De Vries et al., 1999). These are important to understand for planning purposes. Firstly, hospitals have their geographical restrictions and operations are usually centered around the general practitioner (GP). There is no uniform definition of what a hospital product is and nonetheless the amount of hospital products would be many. Hospital processes can both be well defined and ill-defined depending on the complaint. For well-defined processes it is easy to establish a treatment path, but variations might still occur due to different protocols. Ill-defined processes, on the other hand, will be stepwise (e.g., returning to radiology multiple times because the ail cannot be identified) and the outcome will inform and guide the next step. The most important resources for a hospital are staff, beds, operating theaters and diagnostic facilities (De Vries et al., 1999). Some resources, such as diagnostic facilities, X-ray are commonly shared between specialties and clinics (De Vries et al., 1999; Vissers et al., 2001; White et al., 2011). Specialist doctors have multi-functional positions and some suggest that that makes the specialist the leading resource in a PC environment (De Vries et al., 1999).

2.2 Defining Healthcare Production Control

Vissers et al. (2001) defines hospital PC as something that encompasses both patient flow decisions and resource decisions. Other sources (e.g. BearingPoint, 2015; Larsson & Fredriksson, 2019; Rosenbäck, 2017) rather use ‘capacity’ and HC ‘demand’ or ‘need’ to create a similar division between what is mostly patient-related and what comes from your own operations. Patient flow decisions stretch all the way from what patients to address, to decisions regarding patient group service levels, and estimating an expected number of patients per patient group. Similarly, resource decisions cover everything from strategic hospital investment decisions, to target levels of occupancy, and allocation decisions for shared (Vissers et al., 2001). Although Vissers et al. (2001) specifies ‘Hospital’ PC, Rosenbäck (2017) simply calls the same phenomena ‘Healthcare’ PC. The HC organization in Sweden, with regional councils coordinating almost all care efforts across a geographic area, would allow for HCPC to be done at a regional level across all HC rather than restricted to hospital management.

The decomposition and interplay between hierarchical levels plays an important role in PC, Vissers et al. (2001) describe ‘control’ as something that happens horizontally, vertically, and in a feed- forward manner, meaning that feedback should be reported upwards and consequences from changes should be communicated downwards. The horizontal control is exhibited through coordination of demand and supply (Vissers et al., 2001). Rosenbäck (2017) similarly describes a level based HCPC where decisions from the upper level as well as follow-up from lower levels are communicated and become an important part in the balancing of capacity and demand at each hierarchical level. Defining HCPC, “creating a balance between the need for care (inflow of patients) and capacity based on available resources” (BearingPoint, 2015), highlights the role of balancing capacity and demand and clarifies the interconnectedness of terminology such as ‘patient flow’, ‘demand’, ‘HC need’, ‘capacity’, and ‘resources’. The balancing role is represented in Figure 2.2 with the terminology that will be used going forward. More detail on the decisions for different hierarchical levels will be presented in 2.1.2 *Hierarchical Planning Levels for Production Control*.

As the background highlighted, Swedish HC regions tend to use the definition of ‘capacity- and production control’ relating ‘production’ to the HC that should be produced equating it with HC need or demand, and ‘capacity’ with the resources available to solve the need. Based on the definitions above, HCPC would cover both the capacity- and demand side.

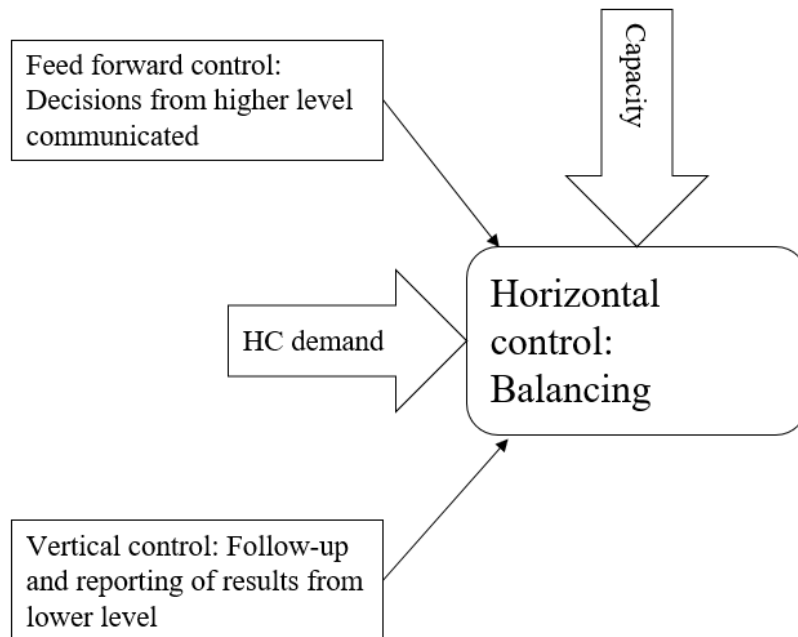


Figure 2.2: HCPC, and the central role of balancing demand and capacity (Rosenbäck, 2017; Vissers et al., 2001).

HC planning and control encompass a lot of different areas and is not restricted to what above is defined as HCPC. Hans et al. (2012) suggests four different managerial areas of HC planning and control: medical planning, resource capacity planning, materials planning & financial planning. Medical planning is the responsibility of clinicians and financial planning is less important in countries with publicly funded HC systems. Among the four presented areas, resource capacity planning and control is the area where most research has been done, and it is the area which covers many HCPC questions related to balancing.

Hulshof et al. (2012) presents an extensive literature review of papers from the fields of operations research and management sciences attacking planning decisions in the resource capacity planning in different manners. Common methods used for this were computer simulation and mathematical programming followed by queueing theory, Markovian processes, and heuristics. Hulshof et al. (2012) shows that a lot of papers are aimed to solve a specific problem in a specific planning level of healthcare. Among their 400 + referenced papers are: *Scheduling patients in an ambulatory surgical center* (Hsu et al., 2003); *A patient assignment algorithm for home care services* (Hertz & Lahrichi, 2009); *How to juggle priorities? An interactive tool to provide quantitative support for strategic patient-mix decisions: an ophthalmology case* (Joustra et al., 2011); *Modelling of Hampshire adult services – gearing up for future demands* (Desai et al., 2008); *Using a continuous time hidden Markov process, with covariates, to model bed occupancy of people aged over 65 years* (Christodoulou & Taylor, 2001). A recent paper identified in the literature review was: *Creating Coherence-Based Nurse Planning in the Perinatology Care System* (Winasti et al., 2022).

Papers of this type can provide insights for HC workers, introducing planning models and the best ways to balance capacity and demand based on research. However, the papers being very specific in nature makes their importance to HCPC maturity in general questionable. Evaluating individual papers'

importance to maturity of HCPC for a generic HC department, would require extensive work and is deemed out of scope.

It can be concluded that there are many ways of optimizing scheduling and forecasting activities out there, but the implementation of these seems to be lagging, which can be an issue of maturity. Only 30 percent of nurse scheduling models were applied in practice (Kellogg & Walczak, 2007). A smaller, Belgian study found that the majority still optimized operation schedules manually (56 percent) or they found the software they used unreliable (26 percent) (Cardoen, Demeulemeester, & Van der Hoeven, 2010). Hulshof et al. (2012) further makes a reservation regarding the need for Information Communication Technology solutions in order to implement the presented OR/MS¹⁴ decision support tools in practice. There are indications that the information systems of HC today are not suited for planning and control, and a lot of information needed is missing (Hans et al., 2012). Optimization is similarly suggested to be a suitable tool only if challenges and priorities can be correctly captured. Otherwise, the use of heuristics (i.e. let different slot lengths, sequencing, or patient characteristics determine the schedule) might be sufficient to implement (Kuiper et al., 2021). However, the manual creation of schedules can be problematic. Scheduling is generally not focused on creating the best use of available resources, rather the focus is to provide care for patients (Hans et al., 2012; Kellogg & Walczak, 2007), and there is a risk of suboptimal schedules (Cardoen et al., 2010).

Applications of certain models further are very niche (Hulshof et al., 2012; Kellogg & Walczak, 2007) and some solutions do not combine the three aspects of appointment scheduling policies, patient flow configurations and allocation of capacity (White et al., 2011). This can contribute to models not successfully capturing the problems faced by HC (Kellogg & Walczak, 2007). Alternatively, they might not rhyme with current ways of working, such as self-scheduling procedures (Kellogg & Walczak, 2007).

2.2.1 Hierarchical Planning Levels for Production Control

The type of planning executed will differ per hierarchical level. Several authors suggest classifying activities into strategic-, tactical-, and operational planning (Hans et al., 2012; Hulshof et al., 2012; Rosenbäck, 2017). Hans et al. (2012) and Hulshof et al. (2012) additionally suggest dividing the operational level into offline operational- and online operational planning to reflect the differentiation needed between emergency coordination- and response and appointment scheduling. Rosenbäck (2017) instead uses the denotation of ‘daily’ HCPC to describe activities that must be solved on a daily basis and includes the political level as the highest level of planning, representing the situation in Swedish HC. Contrasting to Hans et al. (2012) is Vissers et al.'s (2001) definition proposing the hierarchical levels: Strategic planning, Patient Volumes Planning & Control, Resources Planning & Control, Patient Group Planning & Control, and Patient Planning & Control. This relates to the activities taking place at each level, but the primer definition is more common and will be used going forward.

Time horizons for each level are argued to differ (Hans et al., 2012) depending on the application. Vissers et al. (2001) and Rosenbäck (2017) do however approximate intervals for each planning level, as seen in Table 2.2, using their own definitions of the hierarchical planning levels. Although different definitions, the time-horizons correlate well with each other, indicating similar reasoning behind the levels.

¹⁴ Operations Research/Management Science

Table 2.2: Planning horizons for different hierarchical planning levels

Vissers et al. (2001)		Rosenbäck (2017)	
Planning level name	Time horizon	Planning level name	Time horizon
Strategic planning	2-5 years	Political level	Several years
Patient Volumes Planning & Control	1-2 years	Strategic	Not declared
Resources Planning & Control	3 months - 1 year	Tactical	1 year
Patient Group Planning & Control	Weeks - 3 months	Operational level.	8 - 12 weeks
Patient Planning & Control	Days - Weeks	Daily level	Days

2.2.2 Planning Decisions and Activities per Planning Level

The division of activities and decisions across the four hierarchical planning levels are summarized in Table 2.3. It visualizes the differences in the type of decisions and activities for the different hierarchical levels.

The strategic decisions are many and decided centrally on hospital management level (Hans et al., 2012; Hulshof et al., 2012; Vissers et al., 2001). It can encompass anything from deciding the services offered and the catchment area of a specific hospital to investment decisions (Vissers et al., 2001; Hulshof et al., 2012) and decisions regarding the mix of patient groups and cases (Vissers et al., 2001; Hans et al., 2012; Hulshof et al.). Rosenbäck (2017) explains that the balancing between capacity and demand takes place at hospital management on a strategic level or, as is commonly the case in Sweden, at a regional level with responsibility for many hospitals. Rosenbäck (2017) argues that the unit for capacity differs between the strategic and tactical level. At the strategic level the unit is monetary and at lower planning levels the capacity unit is time. The strategic level further acts upon specific directives and goals set by politicians and administers the HC budget.

Decisions on who should do what, including budgets for individual care providers, is then carried on to the tactical planning level (Rosenbäck, 2017). The decisions at the tactical level include forecasting-expected patients per patient group, setting the capacity requirements per patient group (Rosenbäck, 2017; Vissers et al, 2001), as well as taking decisions regarding patient routing (Hulshof et al., 2012) and how shared resources are allocated between specialties and patient groups (Vissers et al, 2001; Rosenbäck, 2017). At this planning level it is additionally suggested to plan admissions and schedule staff-shifts on a general level (Hulshof et al., 2012; Hans et al., 2012; Rosenbäck, 2017). Larsson & Fredriksson (2019) propose you should make a ‘rough-cut capacity plan’ and match it with a production plan based on forecasts of HC demand. The level of detail should either be patient groups (Vissers et al, 2001) or product groups (Rosenbäck, 2017). The differentiation between these two is not significant if they both refer to groups with similar capacity requirements. It is hence generally conducted for specialties or at a departmental level (Vissers et al., 2001).

Table 2.3: Activities, decisions, and planning functions for hierarchical levels of capacity- and production control

	Hans et al. (2012)		Visser et al. (2001)		Rosenbäck (2017)		Hulshof et al. (2012)
	Resource decisions:	Patient flow decisions:	Resource decisions:	Patient flow decisions:	Resource decisions:	Patient flow decisions:	
Strategic	Case mix planning Capacity dimensioning Workforce planning	Investment of resources Shared resources collaboration Outsourcing Required capacity per patient group Target occupancy Levels for leading and non-leading resources	Catchment area Markets & target groups Specialties & product range Patient groups as business units Annual number of patients per group Service level per patient group Production volume agreements with health care insurers	Consolidating tactical forecasts to demand (healthcare need) forecast Match demand to current knowledge base at hospitals Matching patients with level of healthcare Capacity forecasts Balance capacity and demand across hospitals or departments Healthcare product range	Regional coverage Service mix Case mix Panel size Capacity dimensioning Facility layout		
Tactical	Block planning Staffing Admissions planning	Allocation of leading shares resources to specialties & patient groups Batching rules for leading shared resources	Expected number of patients per patient group & specialty Detailed capacity requirements per patient group	Demand forecast for department Time estimations per type of visit Capacity forecasts Balancing of demand and capacity	Patient routing Capacity allocation Temporary capacity change Unused capacity (re)allocation Assess policy Admission control Appointment scheduling Staff-shift scheduling		
Offline Operational	Appointment scheduling Workforce scheduling	Projected number of patients per period (seasonal influence)	Availability of specialist capacity	Scheduling of patients Capacity schedules of workforce and facilities	Patient-to-appointment assignment Patient-to-bed assignment Staff-to-shift assignment		
Online Operational	Monitoring Emergency coordination	Allocation of capacity to individual patient	Scheduling of patients for admission, outpatient visits, diagnostic examinations	Handling of scheduled patient and emergency patients Staff unexpected absence Task distribution	Dynamic patient (re)assignment Staff rescheduling Emergency case scheduling		

The strategic level decides capacity restrictions on the long term. On an operational level the capacity is usually fixed (Hans et al., 2012). However, temporary capacity- and demand adjustments are possible at the tactical level (Hulshof et al., 2012; Larsson & Fredriksson, 2019). Promising examples of this can be found within the perinatology care system where under- and overstaffing was decreased when allowing some flexibility for nurses to move between departments (Winasti et al., 2022).

Tactical planning in HC ideally incorporates the strategic plans, operational restrictions together with available capacity and future demands to create a feasible production plan (Larsson & Fredriksson, 2019). Creating a feasible production plan is seen as capacity planning's ultimate goal (Tenhiälä, 2011; Vollman et al., 2005). The balancing action is clearly captured in Figure 2.3 adapted from Larsson & Fredriksson (2019). The available and required capacity are compared, see 'Activities' and adjustments are made to reach pre-defined targets. Tactical planning further informs the next planning round and the strategic planning level if issues have arisen that could motivate strategic changes. Similarities to Figure 2.2 of PC can be seen. They propose that the components of their model can be used for assessing current tactical planning processes in HC. The presence and quality of each component can be part of the content of a MM. Larsson & Fredriksson (2019) emphasizes contextual differences between departments that influences the tactical planning process. Care demand depends on the care provided and can sometimes be hard to estimate. Psychiatric care is a good example of that. Care for mentally unwell patients demands continuity, but it is difficult to estimate a patient's need for visits.

The confirmation of a balanced production plan can be seen as the most important contribution from the tactical level to the operational. That is the 'Output' of the tactical planning level. At the offline operational level patients are assigned to appointments, beds etc. and staff scheduled to shifts (Hans et al., 2012; Hulshof et al., 2012; Rosenbäck, 2017; Vissers et al., 2001). The output of the operational planning level are capacity schedules and appointment schedules. Additionally, the operative level reports back to the tactical level about deviations from forecast and follows up internally how well things work within the operative level (Rosenbäck, 2017). As seen in Table 2.3, the online operational is proposed to deal with emergent situations, monitoring, planning resulting from patient diagnostics, and other activities (Hans et al., 2012; Hulshof et al., 2012; Rosenbäck, 2017; Vissers et al., 2001), specialists and patients are deemed the decision making partner at this level (Vissers et al., 2001). Some departments will have a lower share of scheduled patient appointments, and more emergency coordination and acute cases. This variation is important to consider for the online and offline operational planning level.

The maturity of tactical planning generally is low within HC and sometimes missing (Cardoen, Demeulemeester, & Van der Hoeven, 2010; Cayirli & Veral, 2003; Hans et al., 2012; Kuiper et al., 2021; A. Larsson & Fredriksson, 2019; White et al., 2011). Instead, HC managers tend to solve problems at the operational level, which, by itself, creates other issues (Cayirli & Veral, 2003; Hans et al., 2012; Kuiper et al., 2021; Rosenbäck, 2017). The links between the different hierarchical levels of operational and strategic is presented as an important part of HCPC, as seen previously in 2.2 *Defining healthcare production control*.

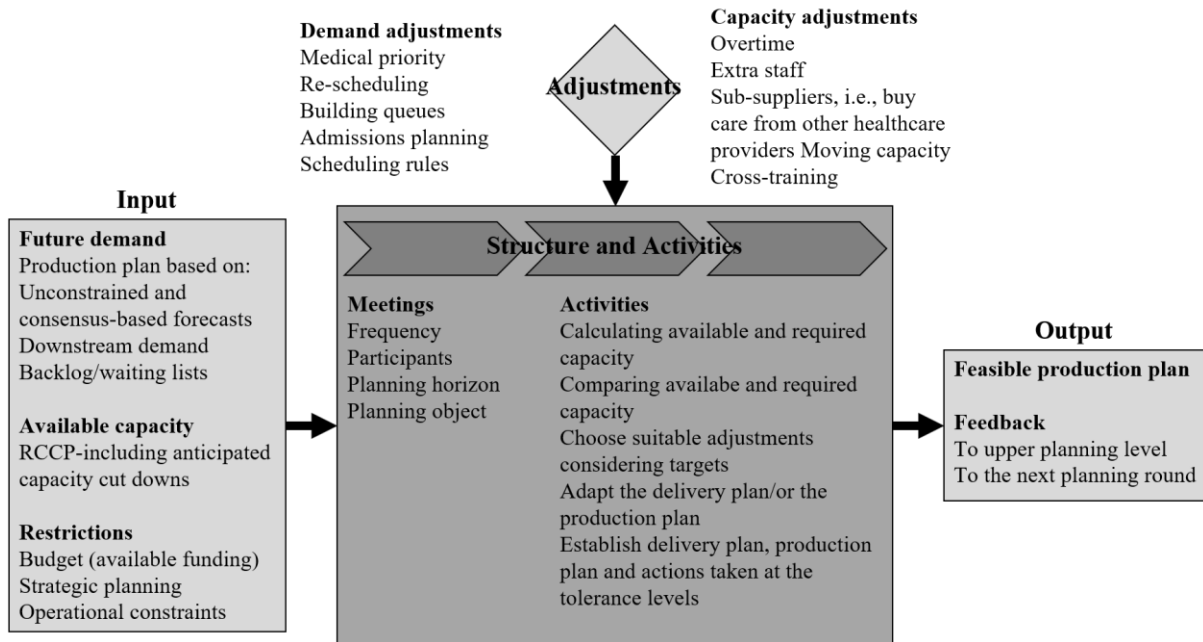


Figure 2.3: Framework for tactical HC planning process and components of such, adapted from Larsson & Fredriksson (2019).

With an immature or absent tactical plan, strategic plans become difficult to translate into actions. Strategic initiatives to increase accessibility might have a hard time translating into the operational level. The operational planning could become very reactive, when control is loss of concepts that would benefit from decisions in advance. For instance, such concepts could be service time variance, demand peaks for when more medical staff must be assigned, and uncertainty for throughput disruptions (like no-shows, multiple appointments, or emergencies) (Cardoen, Demeulemeester, & Beliën, 2010; Cayirli & Veral, 2003; Kuiper et al., 2021). As these events occur, they often delay the operational schedule causing patient waiting time (Kuiper et al., 2021). It is explained how these throughput-related uncertainties normally are treated reactively, and that the important requirement is that this planning is considered early on in the planning process (Cardoen, Demeulemeester, & Beliën, 2010; Cayirli & Veral, 2003; Kuiper et al., 2021). Larsson & Fredriksson’s (2019) framework for tactical planning could hence be used to assess the tactical planning level and could potentially be a good starting point for also assessing HCPC maturity at a department in general. The tactical level downwards is what would be the focus of different departments, or ‘specialties’ (Vissers et al., 2001).

2.3 Maturity Models of Planning Processes

In this part we will review literature to learn more about MMs in general, and those related to the planning process¹⁵ specifically. We propose a collection of process areas that are found useful to incorporate in those MMs that will be relevant for this thesis. After an initial definition of what a MM is in 2.3.1 *Definition of Maturity Model*, design development will be further studied in 2.3.2 *Design Development of Relevant Maturity Models*. This will thereafter be followed by a review of potential maturity and process areas that form the content of a MM.

¹⁵ Planning Process: The process of both assessing organizational goals, as well as creating action plans in order to meet these goals (Mullane, 2015). Some crucial steps in the planning process concern: resource identification, task establishment, task prioritization, assignment and timeline creation, and evaluation (Mullane, 2015).

2.3.1 Definition of Maturity Model

A MM is a framework that describes how developed, implemented or mature a business process is (e.g., Grimson & Pyke, 2007; Hammer, 2007; Lockamy & McCormack, 2004; Vereecke et al., 2018; Wagner et al., 2014). Throughout this review of the literature, many different design approaches have been identified, but a common principle seems to be that they all consist of what Maier et al. (Maier et al., 2012) define as *process areas* and *maturity levels*.

Process areas are the fundamentals that together build up the model's definition of what to consider when assessing organizational maturity (Maier et al., 2012). The types of process areas that create the MM can differ both in number, name, and content. Starting with the number of areas, it is quite connected to the time at which the MM was published - many younger models tend to cover more areas than the older ones (e.g. Lapide, 2005; Wagner et al., 2014). We also note that there has become a standard to aggregate multiple process areas into categories, which makes our comparison of process areas used a bit more intricate (e.g. Grimson & Pyke, 2007; Hammer, 2007; Lockamy & McCormack, 2004; Wagner et al., 2014). The other way process areas differ is in terms of their names and the content described for them - something that instead is rather connected to the model's purpose. Based upon different purposes and levels of details, our literature review has given us examples of MMs for the entire business process, but it has also been possible to narrow our search to specifically those related to supply chain management, or to some relating to the planning process specifically. Based upon this set of MMs (also shown in Figure 2.4), we note that there is a difference in how specific they describe their concepts depending on their purpose. We also note that there are lessons to learn from the entire set of MMs, thus motivating us to encompass relevant findings from this full set of levels to gain adequate knowledge. However, considering the planning MMs only, they seem to have most similarities with our presumptive MM for HCPC, something that motivates a slight focus on these in further review.

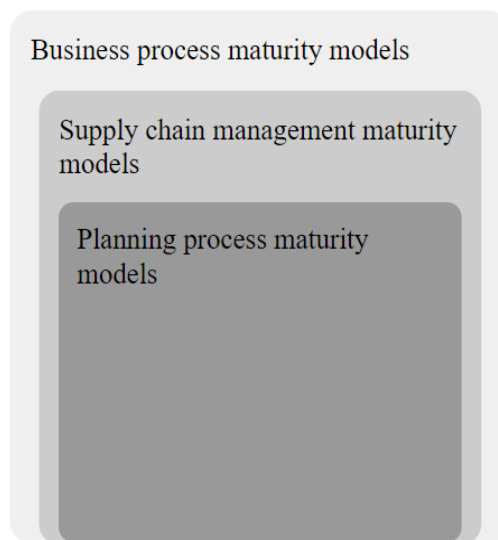


Figure 2.4: Components and the maturity models for planning processes studied in the literature review.

Naturally, a model used for assessing maturity does not only need to declare process areas to consider, but also present different stages of maturity in order to conclude something about the overall maturity. Such 'maturity levels' are usually cumulative stages where the level definition of a higher stage builds upon lower such (Maier et al., 2012). They can be represented in many ways, at least partly influenced by the number of process areas used for the MM. A ladder representation easily visualizes one single

process area and its progression (Figure 2.5), and a spider web representation (Figure 2.6) can be used, with a somewhat larger number of areas, to depict a figure whose size defines how mature the study object is (Lockamy & McCormack, 2004; Raza, 2017; Roland, 2001; Vereecke et al., 2018).

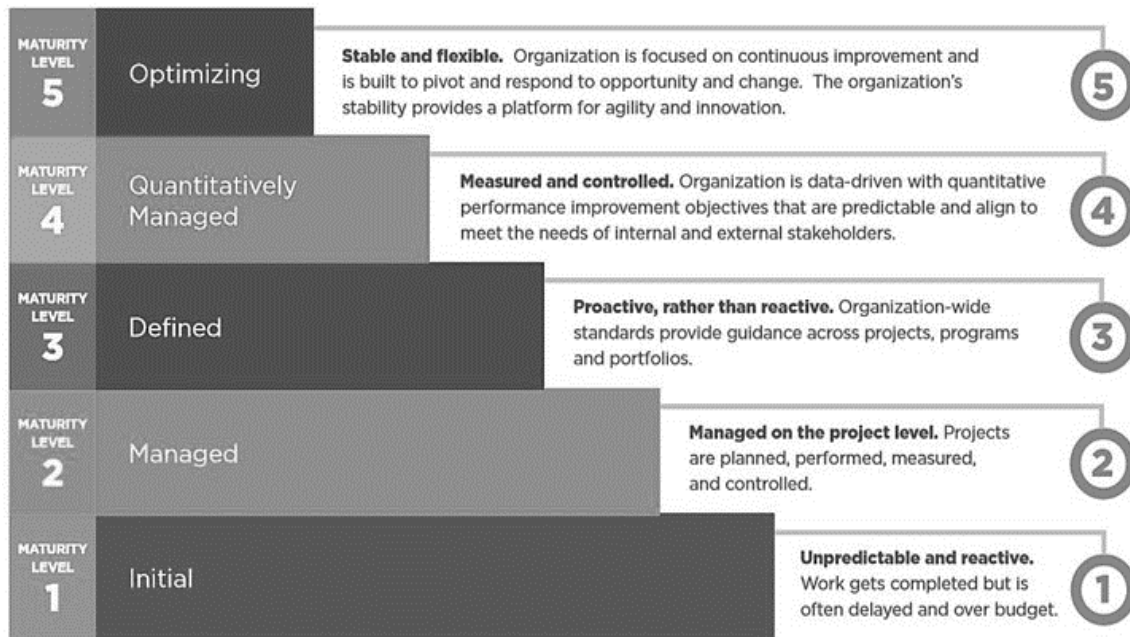


Figure 2.5: Capability Maturity Model Integration (CMMI), a ladder representation of a MM, interpreted by (Raza, 2017).

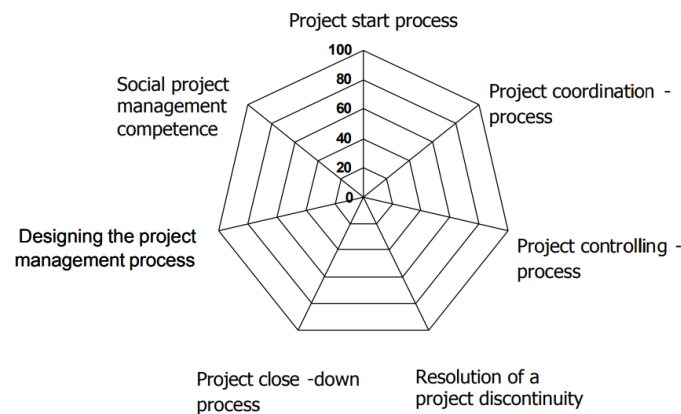


Figure 2.6: The management project manager model, a spider web representation of a MM (Roland, 2001)

Another common way is to make a maturity grid, where text about maturity levels for each process area is described in each cell (Maier et al., 2012). A maturity grid is shown in Figure 2.7. In the following section, 2.2.2, different design possibilities will be further studied.

	Stage 1: No S&OP Process	Stage 2: Reactive	Stage 3: Standard	Stage 4: Advanced	Stage 5: Proactive
Meetings & Collaboration	None	High level	Executive S&OP meetings	Supplier/ customer participation	Event-driven
Organization	None	No formal S&OP teams	No dedicated S&OP roles	Formal S&OP teams	Company-wide S&OP
Measurements	None	How well operations meet sales plan	Stage 2 plus forecast accuracy or lead time	Stage 2 plus new product introduction	Stage 4 plus profitability
Information Technology	Spreadsheets, no consolidation	Spreadsheets, some consolidation	Centralized information with ERP	Standalone S&OP and ERP systems	Integrated S&OP with ERP
S&OP Plan Integration	No formal plan	Sales driven	Some integration, uni-directional constraints	Highly integrated, bi- directional constraints	Seamless plans

Figure 2.7: A MM for a planning process depicted as a grid. This is a simplified version. (Grimson & Pyke, 2007)

2.3.2 Design Development of Relevant Maturity Models

Following the path depicted earlier in Figure 2.4, the presentation of design principles will start by presenting rather all-encompassing MMs that have been identified in the literature review. We will therefore investigate three models for assessing the maturity of the entire business process. This is followed by a review of the Supply Chain Management Maturity Model (SCMMM) before ending up in the discovered Planning Process Maturity Models (PPMMs).

CMMI - Capability Maturity Model Integration

One of the most (and earliest) mentioned MMs is the Capability Maturity Model Integration (CMMI), shown before in Figure 2.5, originating from the software industry and the Capability Maturity Model process, presented and briefly updated by the Software Engineering Institute (2010). They describe that CMMI has the purpose of evaluating the quality of product- and service improvement for software organizations. This can be interpreted as a MM for evaluating only *one* process area - at least visually. As it was developed, five maturity levels were proposed (SEI, 2010). In the *Initial* phase, work tends to be delayed or surpass budget upon its completion. A somewhat higher maturity level is thus *Managed* when projects are controlled with planning, execution and measuring, but tend to be managed reactively. The third level is the *Defined* phase when a rather proactive approach towards planning is supported by an organizational structure. This is followed by *Quantitatively Managed* as statistical tools are utilized to manage the control, and *Optimizing* when a constant improvement work is carried out for the organization. What we learn from the CMMI, and its description of the process area, is how general the formulations can be when a Capability Maturity Model is presented. Maier et al. (2012) also agrees upon this insight, but they explain that there can be a rigorous workload behind this assessment and that it normally must be carried out by an external resource. Consequently, the purpose of conducting a CMMI is seen as providing a certificate, rather than diagnosing or delivering improvement suggestions (Maier et al., 2012). The same picture is also given by Röglinger et al. (2012). In their work, design principles for a variety of MMs are described. They conclude that those MMs used for evaluating the entire business process usually have a basic design or a more *descriptive* purpose, but that they hardly meet the *prescriptive* focus. In other words, models define and describe the processes in question, but

generally do not provide guidance on how to improve them (Röglinger et al., 2012). It will be seen for some other models that this model purpose will shift.

PEMM - Process and Enterprise Maturity Model

As a distinct contrast to CMMI, Hammer (2007) developed the Process and Enterprise Maturity Model (PEMM) to not only focus on software or acquisitions, but instead have a much larger set of process areas covering the business process. A version of PEMM without cell-text is shown in Figure 2.8. He suggests nine different areas for the assessment (related to either process or enterprise); Design, Performers, Owner, Infrastructure, Metrics, Leadership, Culture, Expertise, and Governance. In addition, Hammer (2007) also specifies two to four different sub-areas for each process/enterprise area. For instance, ‘Culture’ is said to consist of teamwork, customer focus, responsibility, and attitude towards change. All these sub-areas (and hence process/enterprise areas) are assessed in a maturity grid over four maturity levels. In each cell (created by the two dimensions of areas and levels, not possible to study in Figure 2.8), it is described what the organization must achieve for that area in order to reach that level. The practical implication of this large MM and how it is designed, is that it is specifically suitable for self-assessing an organization, but also to learn more about it and quicker realize what to improve to increase the maturity further (Hammer, 2007). The right-hand side in Figure 2.8 illustrates how a chart for assessment with PEMM may look like. These implied attributes seem to rhyme quite well, both with a prescriptive focus and with the purpose of our HCPCMM (Röglinger et al., 2012).

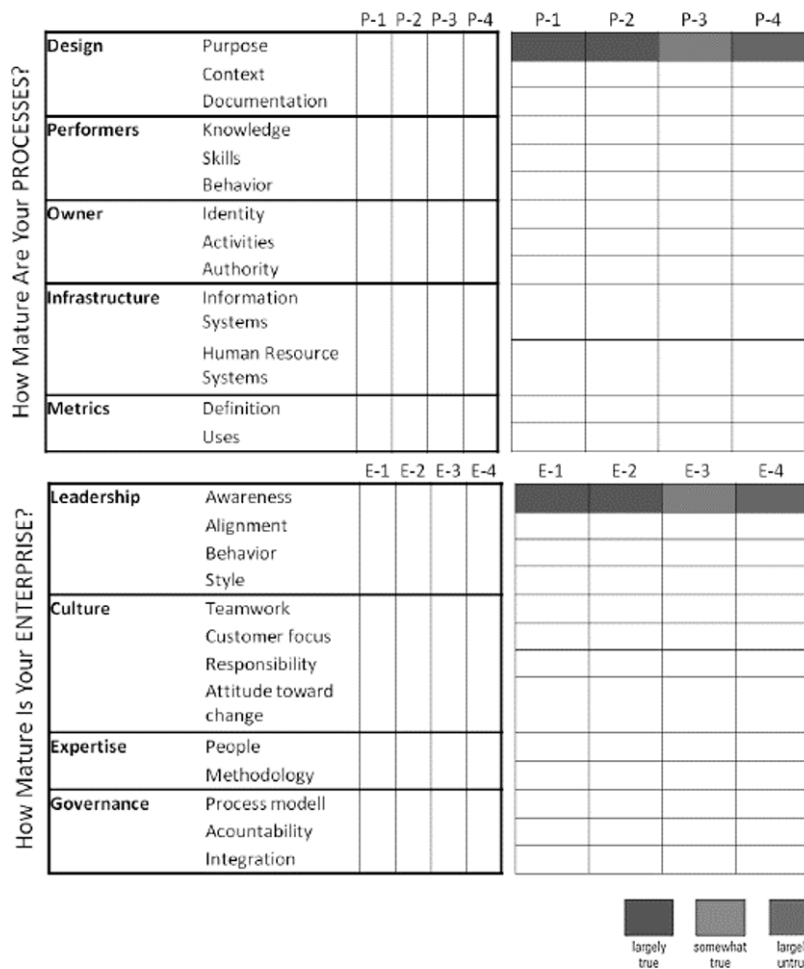


Figure 2.8: An overview of PEMM without cell-text (left-hand side) and a chart for assessment of all the sub-areas.

BPOMM - Business Process Orientation Maturity Model

Based upon CMMI and the two other concepts Business Process Orientation (BPO) and process maturity, Lockamy & McCormack (2004) proposed the BPO Maturity Model (BPOMM). This model is shown in Figure 2.9. In essence, this MM investigates the development potential for an organization in terms of process maturity. The model has clear similarities with the CMMI since it is depicted with five resembling levels of maturity. Another identified similarity between CMMI and the BPOMM is the view of coherence between the levels. That is, an organization will evolve stepwise from the current level to the subsequent ditto. What we learn from this model and its obvious similarities with CMMI, is that it is common to use concepts or ideas from earlier MMs as a new one is developed. The same observation can also be identified for planning process MMs where the model presented by Grimson & Pyke (2007) is inspired by Lapidé (2005) and has inspired others since (Danese et al., 2017; Goh & Eldridge, 2015).

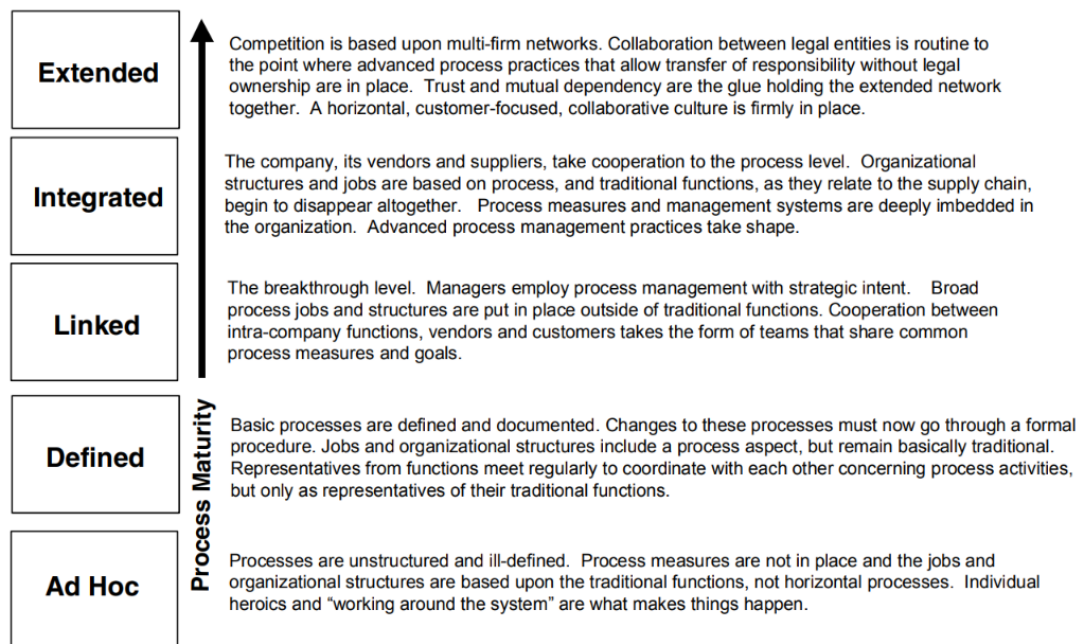


Figure 2.9: BPOMM (Lockamy & McCormack, 2004)

SCMMM - Supply Chain Management Maturity Model

Sometimes models are also further developed by the same authors. This was the case with the BPOMM that was further developed by also incorporating crucial perspectives on supply chain management (SCM¹⁶), and the SCMMM was hence created. It is conceptualized by the Supply Chain Operations Reference (SCOR) Framework and can be shown in Figure 2.10. In the model, it is possible to study how the maturity of SCM becomes increasingly effective for the five levels defined in the BPOMM. In essence, the model exemplifies how the BPOMM can be adapted to a specific business context, but it also gives visual aid to explain how the maturity of a supply chain increases. On the other hand, even this model shares a lack of a prescriptive focus with CMMI (Röglinger et al., 2012).

¹⁶ SCM: Is "The management of the flow of goods and services and includes all processes that transform raw materials into final products." (Fernando, 2022)

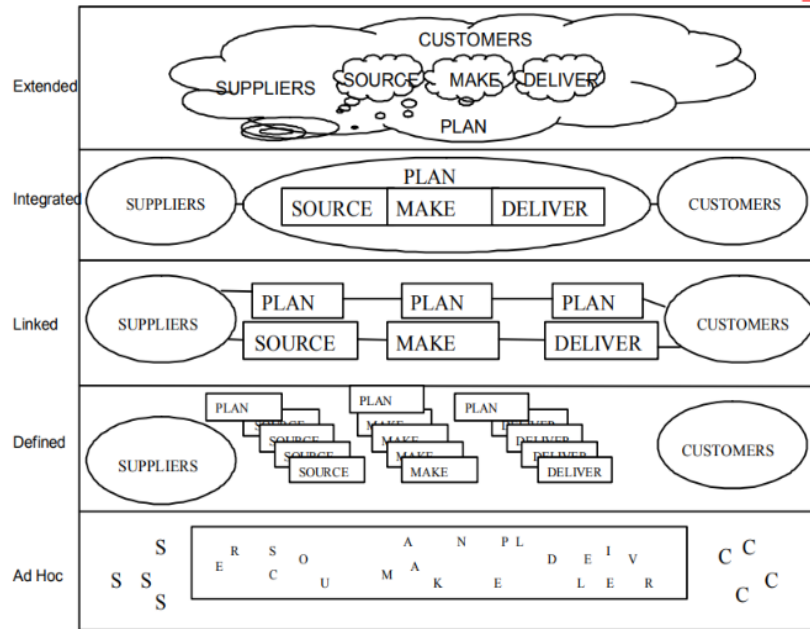


Figure 2.10: SCMMM (Lockamy & McCormack, 2004)

PPMM - Planning Process Maturity Model

Now directing the focus to the more specific planning processes and their MMs, one quick observation is that these models all seem to adapt the maturity grid (Grimson & Pyke, 2007; Lapide, 2005; Wagner et al., 2014). It is also apparent that younger models tend to inherit process areas, formulations, and/or maturity levels from their precursors. The list of identified PPMMs is significantly longer with 13 identified MMs. These will all be reviewed in tables presented, but one should pay extra attention to the following ones:

- Lapide (2005): One of the earliest PPMMs identified. He suggests a MM with four maturity levels and three separate process areas covering his priorities for the Sales & Operations Planning (S&OP¹⁷) process. In his process areas, Lapide (2005) covers both IT and its integration, together with processes (e.g., demand processes), and meeting structures. See Figure 2.11.
- Grimson & Pyke (2007): A frequently quoted model (presented earlier in Figure 2.7). The authors are most likely inspired by Lapide (2005) in their process areas, but it is apparent that their work also contributes to a deepened perspective of S&OP-process areas. They present five maturity levels with names that clearly correspond to their respective content, and define S&OP over five process areas: Meetings & Collaboration, Organization, Measurements, Information Technology, and S&OP Plan Integration. We also note that this paper is one of the first that verifies a MM. The demonstration of its applicability is carried out by exploring the relationship between each of the four first process areas and ‘S&OP plan integration’ for 15 companies. Such a validation is clearly recommended both for developing a MM and in the use of the constructive approach (Kasanen et al., 1993; Maier et al., 2012). One of their findings in this validation round is that IT has an impact on ‘S&OP plan integration’, but only for the higher

¹⁷ S&OP-process: According to Essex (2018), “It is a process for better matching a manufacturer's supply with demand by having the sales department collaborate with operations to create a single production plan. The broader goal is to align daily operations with corporate strategy.” Hence, the S&OP-process has clear similarities with the HCPC, thus motivating further literature review for S&OP.

levels of maturity (Grimson & Pyke, 2007). They therefore conclude that plenty of other processes, but IT must be at place for IT to matter.

- Wagner et al. (2014): Elaborates some concepts from Grimson & Pyke (2007). For instance, they choose to keep some of their names for the maturity levels, like ‘reactive’ and ‘proactive’ thus indicating that they share the picture of such a maturity level development. In addition, they also deepen the content for each process area. Figure 2.12 shows a part of their model.

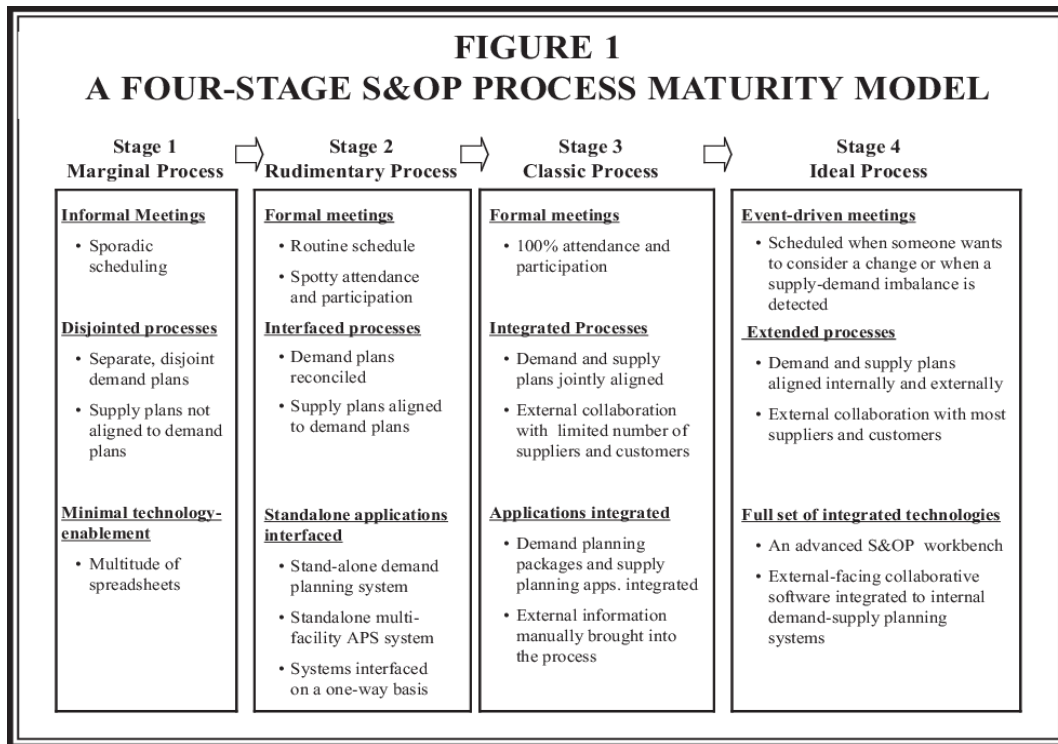


Figure 2.11: A PPMM presented by Lapide (2005)

	Level 0: Undeveloped	Level 1: Rudimentary	Level 2: Reactive	Level 3: Consistent	Level 4: Integrated	Level 5: Proactive
Process Effectiveness	<ul style="list-style-type: none"> No formalized planning process No scheduling of review meetings No consideration of capacities No promotions and price changes planned No risk management in place No product life cycles and new product introductions planned No efforts made to align supply and demand-side plans 	<ul style="list-style-type: none"> Slightly formalized planning process Meetings not routinely scheduled Not all SKUs/product families considered in planning process Issues like promotions, price changes, capacities, risk management, new products, and life cycles planned but not considered in S&OP Little attempts to develop a consensus supply and demand plan jointly and/or to consider information from others Existence of multiple supply and demand plans 	<ul style="list-style-type: none"> Moderately formalized planning processes and typically routinely scheduled meetings Most SKUs/product families considered in planning process Issues like promotions, price changes, capacities, risk management, new products, and life cycles insufficiently planned and considered Demand-side provides a synchronized consensus demand plan so that supply-side organizations can generate a more or less aligned supply plan No alignment with financial plans 	<ul style="list-style-type: none"> Level 2 plus: Very formalized planning processes Routinely scheduled meetings All SKUs/product families considered in planning process Issues like promotions, price changes, capacities, risk management, new products, and life cycles internally sufficiently planned and considered Demand- and supply-side organizations (without finance) jointly generate an aligned set of plans Financial targets/plans primarily drive decisions, instead of being discussed and aligned together 	<ul style="list-style-type: none"> Level 3 plus: Internally completely formalized planning processes Routinely scheduled and event-driven meetings Issues like promotions, price changes, capacities, risk management, new products, and life cycles internally, but not externally sufficiently planned and considered Demand- and supply-side organizations generate together with finance an aligned S&OP plan No interactions with supply chain partners 	<ul style="list-style-type: none"> Level 4 plus: Planning process is formalized throughout the supply chain Event-driven meetings Issues like promotions, price changes, capacities, risk management, new products, and life cycles internally and externally entirely planned and considered All relevant information is internally and externally shared to improve supply chain visibility External supply chain partners participate in alignment process to ensure plan feasibility and cross-company profit maximizing decision making

Figure 2.12: Process effectiveness, one out of four process areas in the PPMM presented by Wagner et al. (2014)

2.3.3 Process Areas of Relevant Maturity Models

In contrast to those MMs that describe the stepwise development in rather broad terms, the literature review has naturally enabled a focus on grid models in general, and those models with a rather detailed levels of granularity specifically (Grimson & Pyke, 2007; Vereecke et al., 2018; Wagner et al., 2014). Reasons for this is first and foremost that maturity grids are very occurring, especially for PPMs, but also that those models have more visual content to review. In addition, their *work orientation* and *intent* resemble our purpose the most:

- **Work orientation:** A maturity grid identifies the characteristics each process and organization should perform well. In contrast to this, the Capability Maturity Models (CMMs) “*Identifies the best practices for specific processes and evaluates the maturity of an organization in terms of how many of these practices it has implemented.*” (Maier et al., 2012).
- **Intent:** It is common that CMMs have a strict standard and are recognized internationally, thus making them suitable for certifying organizations to that standard. The grid, on the other hand, does not have a sophisticated manual (or similar) attached to it. Instead, the assessment can be done simply by looking at the model, which changes the intent from certifying to analyzing an organization (Maier et al. 2012).

This review of process areas will therefore, only briefly, compile information from those MMs with a ladder representation, and instead direct the focus towards other alternatives. In essence, we compile maturity grids, but one MM with a spider web representation is also reviewed (Vereecke et al., 2018).

The targeted MMs in this review have been compiled regarding their process areas defined (see Table 2.4). Out of this compilation, we have identified similarities and patterns between the process areas and thereby derived five categories of potential areas the literature supports. This contributes to the conceptual maturity model and consolidates the findings efficiently. It must be noted that this compilation only is based upon our interpretations of similarities and might hence affect the research quality negatively. But quite often, MMs tend to encircle the same statement, in exact words or pronounced in similar ways. The main challenge is to distinguish those process areas that are defined differently from many others, something that is worth attempting since those contributions still can be fruitful. For instance, Wagner et al. (2014) discuss process effectiveness and -efficiency - two categories that touch upon both S&OP-processes and -balance among others. With this disclaimed, the five areas are:

1. Information Technology (colored grey with white text in Table 2.4)
2. Meetings & Collaboration (colored black in Table 2.4)
3. People & Organization (colored light grey in Table 2.4)
4. Performance Measurement (colored dark grey in Table 2.4)
5. Balance & Integration (colored grey with black text in Table 2.4)

It should also be noted that unsorted process areas do exist - either because a paper has a focus area that deviates somewhat from the purpose with our MM, or if the process area in question covers multiple process areas and are hence impossible to distinguish. These are colored white in Table 2.4. Two examples of the deviations are Neto et al. (2022) where the planning horizon rather is operational, and Cecere et al. (2009) when discussing goals and ownership related to S&OP. As said earlier, Wagner et al. (2014) is an example of when a lot of perspectives are covered in the same process area. The same applies to CMMI, BPOMM, and SCMMM.

Table 2.4: A compilation of the MMs reviewed for identifying process areas. Cells with information in common are color-coded: Meetings & Collaboration (black), Performance Measurement (dark grey), Information Technology (grey, white text), Balance & Integration (grey, black text), People & Organization (light grey), and miscellaneous or dual process areas (white).

Reference or name	Perspective	Aspect 1	Aspect 2	Aspect 3	Aspect 4	Aspect 5	Aspect 6
CMMI	Business Process	Process (software)					
BPO/MM	Business Process	Business Process					
PEMM (Process)	Business Process	Design	Performers	Owner	Infrastructure	Metrics	
PEMM (Enterprise)	Business Process	Leadership	Culture	Expertise	Governance		
SCMMM	SCM	Process (effectiveness)					
Mentzer et al. (1999)	Planning Process	Functional Integration	Approach	Systems	Performance Measurement		
Lapide (2005)	Planning Process	Meetings	Processes	Technology			
Veritana Research (2006)	Planning Process	People	Processes	Technology	Performance Management		
Grimson and Pyke (2007)	Planning Process	Meetings & Collaboration	Organization	Measurements	Information Technology	S&OP Plan Integration	
SAS and Purdue University (2009)	Planning Process	Process Integration	Systems Integration	Performance Integration	Customer Integration		
Cecere et al. (2009)	Planning Process	Balance: S&OP	Goal	Ownership	Metrics		
Viswanathan (2009)	Planning Process	Process	Organization	Knowledge	Technology	Performance	
Wagner et al. (2014)	Planning Process	Process Effectiveness	Process Efficiency	People & Organization	Information Technology		
Goh and Eldridge (2015)	Planning Process	Meetings & Collaboration	Organization	Measurements	Information Technology	S&OP Plan Integration	
Pedroso et al. (2017)	Planning Process	Metrics	Technology	Integrated planning	People & Organization	Organization of the process	
Danese et al. (2017)	Planning Process	People & Organization	Process and Methodologies	Information Technology	Performance Measurement		
Vereecke et al. (2018)	Planning Process	Data Management	The use of forecasting methods	Management of the forecasting system	Performance Management	The forecasting organization	People Management
Neto et al. (2022)	Planning (Demand) Process	Human Resources	Demand Management	Forecasting	New Product Introduction	Supply Chain Management	Tactical planning

Information Technology

One category that can be identified (seen in grey with white text in Table 2.4) is that MMs for production planning tend to evaluate IT. Sometimes, this is instead referred to as 'Technology', 'Systems', 'Systems Integration', or 'Infrastructure', essentially with the same meaning. In the low stages of maturity, it is explained how spreadsheets (Grimson & Pyke, 2007; Lapide, 2005; Wagner et al., 2014) or fragmented IT systems (Hammer, 2007) are used, and that more integrated software systems correspond to higher levels of maturity (Hammer, 2007; Wagner et al., 2014). Furthermore, on these levels, information is consolidated (Grimson & Pyke, 2007), Advanced Planning Systems or optimization features become present (Grimson & Pyke, 2007; Lapide, 2005; Wagner et al., 2014), and the team can use the software as a workbench to facilitate meetings or progress in the planning process together (Grimson & Pyke, 2007; Lapide, 2005; Wagner et al., 2014). In a study made by Ventana Research (2006), it was also established that companies using an adequate software solution outperformed those who did not. This statement was refined by Grimson & Pyke (2007), claiming that a sophisticated software solution did matter, but only if it was supported by a steady business process, like organizational support with suitable measures.

Meetings & Collaboration

It can be observed that process areas like 'Processes', 'Approach', 'Organization of the process', 'Meetings', 'Meetings & Collaboration' share a perspective on processes in general and meetings specifically that must be addressed to ensure a good S&OP-maturity. Out of table 3.4, we therefore define 'Meetings & Collaboration' as the second category (Danese et al., 2017; Grimson & Pyke, 2007; Lapide, 2005; Wagner et al., 2014). It is stressed by both Grimson & Pyke (2007), and Ventana Research (2006) that meetings in general are enablers for planning processes, and there is also a good consensus that higher maturity stages require meeting regularity or, even better, both regular and event driven (Danese et al., 2017; Grimson & Pyke, 2007; Lapide, 2005; Wagner et al., 2014). Wagner et al. (2014) and Viswanathan (2009) also discuss meetings in terms of planning process effectiveness. Measures that are included concern how well meetings are prepared, the attendance rate, and how earlier decided plans are followed up. Apart from meetings, the strategy for the plan itself is also covered in this aspect. Viswanathan (2009) and Ventana Research (2006) both address scenario handling as a way of retrieving a suitable plan by testing multiple solutions and then choosing the best one. Other elements in the planning approach consist of the ability to plan on multiple time horizons, to quickly address raised planning alerts, to evaluate risks related to the planning process, and to optimize a plan according to given information (Viswanathan, 2009; Wagner et al., 2014). Such elements will most likely be essential, even within HC planning. Another key component is the ability to document the process well, something that is stressed by Hammer (2007).

People and Organization

The third category that can be identified is 'People and Organization'. It is defined by considering focuses on 'Organization', 'Human Resources', 'People', 'Leadership', 'Culture', 'People & Organization', and 'Expertise'. Since the organization is structured around people, and since many of the process areas identified all reconcile either people or organization, that seems to be a suitable category. Considering the human resources, Vereecke et al. (2018) point out that both the analytical capability, and a general business expertise regarding product, industry and the organization are important to possess. In addition, relevant experience within the planning process (Vereecke et al., 2018), and maintained education about planning (Danese et al., 2017) are also critical sub-aspects. Hammer (2007) stresses the expertise within the workforce, but also in generalized methods for processes. In addition, Hammer (2007) is one of few to contribute with a specific process area for both leadership and culture. Moving on to organization, this part concerns establishing formal planning

teams, roles, and ownership (Danese et al, 2017; Grimson & Pyke, 2007; Neto et al., 2022) with a cross-functional composition (Ventana Research, 2006; Wagner et al. 2014). The importance of the organizational sub-aspect is said to increase as the maturity level does (Danese et al., 2017). Managers are therefore asked to specifically be present in organizational questions as the maturity increases for other reasons (Danese et al., 2017).

Performance Measurements

The fourth category identified is named ‘Performance Measurements’ and concludes findings related to ‘Performance’, ‘Performance Management’, ‘Performance Measurement’, and ‘Performance Integration’. As described by Hammer (2007), performance metrics are used by managers for instance to track faults, benchmark performance, and to create a dashboard for daily management. Viswanathan (2009) elaborates how this daily management can look like by stressing the need for good reports and proactive monitoring. On a higher level of maturity, Hammer (2007) also adds that metric revision and -improvement regularly takes place. The main reason for evaluating metrics, however, seems to be linked to the accuracy between plan and outcome (Danese et al., 2017; Grimson & Pyke, 2007; Mentzer et al., 1999; Purdue University and SAS, 2009; Vereecke et al., 2018). Vereecke et al. (2018) further suggest that forecasting accuracy should be connected to internal metrics, such as customer service level. Some additional papers, including Vereecke et al. (2018) highlight the importance of a connection to the strategic goal (Hammer, 2007; Ventana Research, 2006).

Balance & Integration

The final fifth identified category is sometimes completely integrated to other process areas, and sometimes separated like many others. It must however be stressed that ‘Balance & Integration’ covers the overall goal with many planning processes and concepts around this are covered in process areas such as ‘S&OP plan integration’, ‘Balance: S&OP’, ‘Integrated planning’, or ‘Customer Integration’. For models related to S&OP, the overall goal is said to be balancing supply and demand (Cecere et al., 2009; Lapide, 2005; Wagner et al., 2014). Cecere et al. (2009) even formulates the entire model around balance as they explain that increased maturity in their model implies increased S&OP-balance. Wagner et al. (2014) means that the supply organization, jointly with the demand-side (and finance as well) has a responsibility for delivering a production plan. If this happens, the process efficiency will also increase since co-planning diminishes the need for re-planning. Naturally, ‘balance’ is not very discussed in PEMM. However, in the process area ‘governance’ it is underlined that organizations should integrate their processes with both suppliers and customers (Hammer, 2007). Integration of the organization’s supply chain is frequently stressed among the PPMs, and it is also explained that there is a connection between highly integrated supply chains and easier balance (Grimson & Pyke, 2007; Wagner et al., 2014). Lapide (2005) stresses the integration of plans both internally and externally for higher maturity levels, so that work is carried out with coherence. This is agreed upon by Wagner et al. (2014) as they connect external integration to improved supply chain visibility. In addition, they also express that: *“External supply chain partners participate in the alignment process to ensure plan feasibility and cross-company profit maximizing decision making”*.

2.3.4 Maturity Levels of Relevant Maturity Models

Maier et al. (2012) suggest that the maturity level names should be distinct, well-defined, and illustrate a logical progression, with the motivation that a *“clear definition eases interpretation of results”*. When the literature was reviewed for such clear definitions, it was observed authors have treated name-setting differently. Table 2.5 synthesizes all the models that have been identified, with the purpose of reviewing

their maturity levels based on: number of levels, level definitions, and level names. The color-coding represents models with resembling maturity levels:

- Connections to CMMI are colored black in Table 2.5.
- Connections to Grimson & Pyke (2007) are colored dark grey in Table 2.5.
- Connections to Lapidé (2005) are colored grey in Table 2.5.
- Miscellaneous maturity levels are colored light grey in Table 2.5.

Table 2.5: Review of maturity levels for the different MMs.

Reference or name	Perspective	Maturity levels							Shorter definition?
		#	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	
CMIMI	Business Process	5	Initial	Managed	Defined	Quantitatively Managed	Optimized		Yes
BPOMM	Business Process	5	Ad Hoc	Defined	Linked	Integrated	Extended		Yes
PEMM	Business Process	4	P-1	P-2	P-3	P-4			No
SCMIMM	SCM	5	Ad Hoc	Defined	Linked	Integrated	Extended		
Mentzer et al. (1999)	Planning Process	4	Stage 1	Stage 2	Stage 3	Stage 4			Elaborated
Lapide (2005)	Planning Process	4	Marginal	Rudimentary	Classic	Ideal			Elaborated
Ventana Research (2006)	Planning Process	4	Tactical	Advanced	Strategic	Innovate			Yes
Grimson and Pyke (2007)	Planning Process	5	No S&OP Process	Reactive	Standard	Advanced	Proactive		Yes, in the fifth process area
SAS and Purdue University (2009)	Planning Process	4	Beginning	Evolving	Improving	Best Practice			No, elaborates on process areas instead
Cecere et al. (2009)	Planning Process	4	Reactive	Anticipate	Collaborate	Orchestrate			No
Viswanathan (2009)	Planning Process	3	Laggards	Average	Best-in-class				No
Wagner et al. (2014)	Planning Process	6	Undeveloped	Rudimentary	Reactive	Consistent	Integrated	Proactive	No, elaborates on process areas instead
Goh and Eldridge (2015)	Planning Process	5	No S&OP Process	Reactive	Standard	Advanced	Proactive		Yes, but interpretations of the adapted MM.
Pedroso et al. (2017)	Planning Process	5	Very Low	Low	Medium	High	Very High		No
Danese et al. (2017)	Planning Process	5	No S&OP Process	Reactive	Standard	Advanced	Proactive		No
Vereecke et al. (2018)	Planning Process	5	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5		No
Neto et al. (2022)	Planning Process	5	Undefined	Reactive	Integrated	Optimized	World Class		No

Number of Maturity Levels

First, it should be noted that four maturity levels do not seem to be enough to cover the full spectrum of maturity. There is a clear increase in the number of stages when the papers from the period 1999-2009 are compared with 2014-2022. One part of the explanation could be that some latter works are influenced by Grimson & Pyke (2007), who pioneered with five levels for PPMs. It can be argued that more content is added to latter models, thus increasing the need for a better refinement. But it is also worth noticing that this additional level, rather intends to cover the low maturity extreme with words as 'No S&OP-process' or 'Undeveloped' (Grimson & Pyke, 2007; Wagner et al., 2014). In earlier models, this was rather a void in the model coverage (Cecere et al., 2009; Lapide, 2005).

Definitions of Maturity Levels

Secondly, the review also establishes that it is rather uncommon to define the levels in the MM, something that would be beneficial if the model was particularly complex in the number of process areas. But instead, the common approach is to discuss *process areas* elaborately and thereby include comments related to specific levels. Instead, the reader must interpret what e.g. 'Proactive' or 'Ideal' actually means. This becomes hard when authors shift their narrative for level name formulation between describing the maturity, and benchmark organizations against each other. Level names like 'proactive', 'extended', or 'undeveloped' all share the property that such an assessment would indicate on the organization's capabilities and are somewhat easier to interpret. But in contrast, level names like 'standard', 'laggards', or 'world class' are comparative between organizations. The implied problem to this is that they consider all assessments as static - 'standard' is where most assessed organizations will be found, and not necessarily between 'reactive' and 'advanced' (Grisson & Pyke, 2007).

Another strategy for level definition is to cover each maturity level in a quite long text, but neither a definition of process areas nor an extensive description can quickly bring a definition to the reader. It can be argued that it is not necessary to have a summary if the MM in question only consists of a couple of process areas, since the overview will be so easily managed. This might explain why e.g. Lapide (2005) does not bring any short explanation of each level, but rather extensive such. It also harmonizes with the fact that the models with only one process area (CMMI, BPOMM, and SCMMM), form their entire MM on these shorter definitions. But there are many extensive models that also fail to define their process areas, and thereby leave it to the reader to make their own interpretations based on clues for each area. For HC, it must be investigated in the empirics whether a MM with a presumptive large amount of process areas will be simplified with level definitions or if it does not matter.

Names of Maturity Levels

Finally, by studying the names used for defining levels of the models, it is apparent that many PPMs either get inspired by or use the model presented by Grimson & Pyke (2007). Both Goh & Eldridge (2015) and Danese et al. (2017) avoid developing a MM themselves, instead they use Grimson & Pyke (2007) as a whole for their papers and, hence, further verifies their work. This clearly motivates an importance for their five levels within the MM-field. In contrast to this, it can also be observed that two models are inspired by CMMI, BPOMM, or SCMMM, but that it is obvious that this is not the overall main source of inspiration for PPMs. Instead, the main source of inspiration seems to be Grimson & Pyke (2007). It can be noted that the level names 'Reactive' and 'Proactive' are selected in many papers after them. Grimson & Pyke (2007) explains that having a proactive planning process e.g. means earlier system warnings, software linked to an ERP-system, or possibilities to optimize the planning. Besides, a proactive maturity rhymes quite well with the aim for improved tactical planning, something we already have problematized regarding HC. Another key word used for higher levels of maturity is 'Integrated'. In the BPOMM, 'Integrated' intends to capture that the company, together with its vendors

and suppliers, “*take cooperation to the process level*” (Lockamy & McCormack, 2004). This could be a suitable word to use when describing the inter-ward collaborations for an HC department.

Another observation is that different names are used to describe the same state of maturity. It must, of course, be stated that there is not a complete agreement on what each stage should contain in terms of content (specifically since they have different numbers of stages and were developed at different years) (Maier et al., 2012), but there is an unproportionable disagreement among the names for the same content. To make an example, ‘Proactive’ is common for some of the highest levels, but other terms for this stage are for instance ‘World Class’, ‘Ideal’, or ‘Innovate’ (Danese et al., 2017; Goh & Eldridge, 2015; Grimson & Pyke, 2007; Lapide, 2005; Neto et al., 2022; Wagner et al., 2014). In essence all of these sources define the content for their most mature step the same way; the S&OP-process should then be aligned both internally and externally, i.e. that the process specifically is well-integrated in the entire supply chain.

We also notice that some MMs use the same name for different stages of maturity, an observation that certainly increases the confusion on how to use the terms correctly. The confusion could have been decimated by clear definitions of the maturity level names, something often missing and leaving it to the reader to interpret. Two examples will illustrate this:

- The use of ‘Reactive’: Danese et al. (2017) and Goh & Eldridge (2015) use the term just as Grimson & Pyke, (2007) does. For them, the reactive state is very early in the maturity and the adequate structures have not been formed yet. However, some initiatives might be present in the organizations. This contrasts Wagner et al. (2014) where structures, formalization and standardizations are moderately set. For instance, roles and responsibilities are decided, but not yet successfully implemented.
- The use of ‘Integrated’: This level name is used of two sources differently. When Wagner et al. (2014) uses the name, it is to describe a very high stage of maturity, when the process is completely formalized internally and no big obstacles remain unsolved (externally, the process can still be improved). Neto et al. (2022), on the other hand, call the corresponding maturity level ‘Optimized’ and let ‘Integrated’ be a lower maturity step, just above ‘Reactive’. For their description of ‘Integrated’, far from everything internally is formalized and clear internal improvements still remain. Noteworthy is also that none of these descriptions harmonize well with a fully integrated organization where the connections are seamless throughout the entire supply chain. This is instead described as ‘Proactive’ in most cases.

2.4 Performance of HCPC

There are many ways to assess performance in general and performance of planning specifically. Jonsson & Ivert (2015) assessed different aspects of performance and found that output should be separated from effects. They also claim that overall plant performance is what normally is investigated, but that shows the need to assess performance of the process itself. De Snoo et al. (2011) found that scheduling performance criteria can be divided into three different categories: they can be either focused on the scheduling product, process or be indirect performance measures. In addition to this there are influencing factors that will affect the previous performance criteria, such as knowledge, skills, complexity, and uncertainty (De Snoo et al., 2011). Hulthén et al. (2016) focus on performance of a specific planning process, the S&OP-process, and divide that into S&OP-process effectiveness- and efficiency. The latter refers to resource utilization and how well the process is organized and managed (ibid.). Process effectiveness relates to achieving customer satisfaction, in the case of the S&OP process

the customer is ultimately the corporation. S&OP-process effectiveness can hence be further categorized into corporate effectiveness and corporate efficiency and measures for this are measured between every step of the S&OP-process (ibid.).

There are clear overlaps between the different structures proposed by Hulthén et al. (2016) and De Snoo et al. (2011). Effectiveness measures for the S&OP-process steps are compared with performance criteria used regarding the scheduling product, whereas efficiency measures of process have distinct overlaps with performance criteria of the planning process. Indirect measures and overall effectiveness measures both refer to the realized organizational performance from the planning process. Influencing factors are almost entirely covered by the efficiency measures of people and organization. The exception is in input data quality that is an influencing factor in de Snoo's model but is seen as an influencing factor by De Snoo et al. (2012). The similarities are illustrated in the halftoned Table 2.6, based on coloring de Snoo's (2012) measures in different colors. The division of Snoo et al. (2011) does not tie each measure to a step in a pre-defined process, but for a clear distinction between efficiency and effectiveness measures in planning operations, Hulthén et al. 's (2016) article provides insights. Nevertheless, the two articles present a multiple of different measures that can be used in planning process performance measurement. S&OP is a tactical planning process and scheduling is the result of operational planning, both levels that are relevant at a tactical level. Some of the measures are especially interesting with the control aspects of balancing and communication between hierarchical levels in mind:

- Plan adherence (demand & supply plans)
- Alignment with strategy- and reward system
- Demand forecast accuracy
- Capacity capability adherence
- Fulfillment of constraints and commitments made to external partners
- Fulfillment of resource utilization constraints

Other measures put forward by De Snoo et al. (2012) and Hulthén et al. (2016) are also expected to be important for HC. The importance of timeliness of schedule release could be directly transferable to HCPC. The influencing factors or organizational & people aspects and indirect/overall effectiveness measures are additionally interesting to consider as they should precede the discussion of what measures usually are selected in MMs, planning research, and HC.

Table 2.6: A comparison of an S&OP performance measurement system categorization and scheduling performance criteria proposed by two different authors.

Hulthén et al. (2016)						
S&OP Effectiveness measures				S&OP Efficiency measures		
Data gathering	Demand planning	Supply Planning	Pre-meeting	Executive meeting (output)	Overall	
Input data quality: -Reliability, timeliness, availability -Standardization -Customization	Forecast accuracy: -Demand forecast accuracy -Ramp up/down accuracy	Resource adherence: -Capacity capability -Inventory adherence -Inbound delivery reliability	Trade-off measures: -Cross-functionality -Alignment with strategy and reward system	Plans adherence: -Supply and demand plans adherence -Financial adherence of plans	Actual vs target: - ROI - Customer requirements (e.g. perfect orders)	Process: -Supply and demand planning routines -Meeting efficiency -Resource efficiency committed to conduct S&OP
						Organization: -Communication of S&OP measures -Monitoring of progress of plans - IT support to gather and analyze relevant performance measures
						People: -Degree of cross-functional participation -Degree of executive participation - Competence/skills
De Shoo et al. (2011)						
Criteria focused on the scheduling product			Criteria focused on the scheduling process		Indirect scheduling performance criteria	
Schedule errors Costs of execution of the schedule Fulfillment of constraints and commitments made to external partners Fulfillment of resource utilization constraints Fulfillments of preferences and wishes of employees using the schedules Schedule robustness/information completeness Information presentation and clarify			Timeliness of initial release Reliability of initial release Flexibility of schedule adaptation Accessibility of schedulers Communication quality Harmonization quality Cost and efficiency of the scheduling process		Realized performance of the scheduled process Complaints and feedback from schedule users	
					Influencing factors Organizational planning structure Scheduler knowledge/skills Information technology Information quality Complexity	

2.4.1 Maturity Models' Connection to Performance

As for now, it has not been established if there are any correlations between MMs and performance. Considering the paper of Grimson & Pyke (2007), their fifth category is used to express the overall impact each of their four first categories have on the S&OP-process. This fifth category, 'S&OP plan integration', captures aspects such as profit optimization, collaborative processes, and seamless integration – aspects that rhyme well with effectiveness measures for S&OP performance (Hulthén et al., 2016). Since their paper establishes positive correlations between each of the four other categories and 'S&OP plan integration', this category essentially becomes an indicator for high maturity and thus high performance. A similar observation can be made by studying the PPMM presented by Cecere et al. (2009). This model is completely constructed around balance, and it therefore underlines that high maturity is reached when the balance between sales and operations is at the best. Once again, this resembles one of the performance measures recommended by Hulthén et al. (2016); 'Supply and demand plans adherence'. In contrast to both these observations, Larsson & Fredriksson (2019) instead use an existing PPMM (Lapide, 2005) to assess tactical planning in HC departments. In this assessment, performance often touched upon thus giving further indications of believed similarities between the terms.

2.4.2 Choice of Performance Measures in Planning Operations

There is a great variation on what goes into a performance construct in research. Some articles focus on a specific dimension and develop their construct within that area (Tenhiälä, 2011), while others measure several performance dimensions, such as Thomé et al. (2014). They measure performance in general across the three dimensions: delivery, flexibility and quality - where each dimension is operationalized with several aspects.

Tenhiälä (2011) argues that delivery performance is the preferred measure for capacity planning. Delivery performance was indeed the most prevalent type of performance measured, and that was the case both for studies relating to S&OP as well as Tenhiälä (2011) who studies capacity planning. Delivery aspects such as delivery timeliness and reliability, delivery speed and lead time, as well as delivery conformance to requested dates were referenced in many studies (Jonsson & Ivert, 2015; Lockamy et al., 2008; Olhager & Selldin, 2007; Tenhiälä, 2011; Thomé et al., 2014; Viswanathan, 2009). This indicates a special relevancy of delivery performance for planning operations. However, these definitions seem to more relate to indirect, effectiveness measures of planning, i.e. the realized performance experienced by customers. However, Vollman et al. (2005) argues that delivery performance is most closely connected to the ultimate outcome of capacity planning, namely creating a feasible production plan. Jonsson & Ivert (2015) directly phrase plan feasibility as one of their performance dimensions for master production scheduling. With their definition, plan feasibility encompasses two performance aspects that relate to plan integration: "production is based on the plan" and "plan used as a frame for operational planning". This is similar to 'plan adherence' as proposed by Hulthén et al. (2016) and adds the connection between HCPC levels.

Among other mentioned performance areas are volume- and product mix flexibility, quality conformance (Olhager and Selldin, 2006; Thomé et al., 2014), and forecast accuracy for S&OP (Viswanathan, 2009). In one study, plant performance was based on manufacturing costs and actual attainment of plant schedule (Bozarth et al., 2009). The latter is surprising, especially since it was the only article touching upon manufacturing costs. Apart from attainment of schedule and forecast

accuracy, these definitions seem less applicable to HC in general, and HCPC process and product. The nature is more that of indirect effectiveness measures.

2.4.3 Performance Measures in Healthcare

Tracking the progress for HC planning processes with performance measures is common, both for research purposes and in the actual care work (Cardoen, Demeulemeester, & Beliën, 2010; Cayirli & Veral, 2003; Rosenbäck, 2017). This literature review has found some essential areas of performance measures used in HC, many of which can be covered by Richardson et al.'s (2001) six aims. They stress that HC must be safe, patient-centered, timely, equitable, efficient, and effective to improve the quality-of-care. This can be achieved with the help of both IT-systems and specific processes related to the internal operations (Jack & Powers, 2009). Patient-centered HC and safety is something that naturally should be considered in all decisions made in HC and with HCPC, but measures for these can be directly disregarded as more indirect effectiveness measures.

Not very surprisingly, extensive waiting times have a harmful impact on HC (Richardson, 2001). Therefore, patient waiting times are measured and monitored thoroughly, and some even consider this an overall performance indicator as they describe HC availability. As described previously, availability is central in Sweden with the use of guaranteed access to HC. It can be measured for the queue only, or also within an initiated process (Cardoen, Demeulemeester, & Van der Hoeven, 2010; Cayirli & Veral, 2003; Kuiper et al., 2021; Rosenbäck, 2017). It is not only average waiting time that is tracked, also maximum times, variance and frequency distribution can be used (Cayirli & Veral, 2003). But despite being frequently measured, Rosenbäck (2017) explains that patient waiting time has not shown any significant improvement in a Swedish context. This does not only jeopardize the quality-of-care, but also implies higher costs (Cayirli & Veral, 2003). In addition to patient waiting time, there is a tendency to capture other time measures as well. Patient flow time gives a slightly different perspective (Cayirli & Veral, 2003). Measures related to both congestion and throughput could be added to this timeliness aim (Kuiper et al., 2021; Cardoen et al., 2010). Specifically highlighted is the risk that lateness is carried through to other processes when patients take longer time than expected (Kuiper et al., 2021; Cardoen et al., 2010). Better access to HC is strongly connected to the timeliness aim and that is what you ideally want to achieve with HCPC, but it can be seen as an indirect effect of HCPC with links to delivery performance.

Effectiveness in HC implies services based on scientific knowledge (Richardson et al., 2001). By this definition, effectiveness would be closely related to quality of HC and could also be considered an indirect effect of HCPC with connection to delivery performance.

Equitable measures consider uniformity of the HC quality (Richardson et al., 2001). Related to planning, such measures can address the leveling of intensity peaks (i.e. that the planning takes intensity peaks into consideration) and patient preferences (Cardoen, Demeulemeester, & Beliën, 2010). Another aspect is the makespan, that is the duration between the arrival of the first patient and the departure of the last one (Cardoen, Demeulemeester, & Beliën, 2010). This might be useful through an equitable HC lens, monitoring potential performance differences between each patient (Cayirli & Veral, 2003). With this background equitability measures would be more related to HCPC, if it relates to creating equal opportunities for people who access HC, relating to a balance between demand and capacity.

Finally, efficiency of HC avoids waste (Richardson et al., 2001). According to Vissers et al. (2001), the objectives for HCPC is to maximize resource utilization, primarily for the costliest resource, using

acceptable standards of service quality. Usually, these resources tend to be bottlenecks, potentially shared between departments or services. This way of planning for efficiency, might enable cost savings and hence a financial surplus that should be used to re-invest in the quality-of-care (Cardoen, Demeulemeester, & Beliën, 2010). However, Cardoen, Demeulemeester, & Beliën (2010) claim that problems regarding financial status are commonly overlooked in well-developed HC nations. For these countries, waste of capacity is a key issue. Jack & Powers (2009) also argue that an organization that effectively can distribute strategies for both demand and resource management, can expect an improved general performance. Their synthetization of efficiency as a HC performance explains that a technical and production focus is found. Moreover, this focus is usually based on statistical measures, and potentially also econometry. Many similarities are also noted between efficiency and financial performance. However, one clear focus distinguishes them from each other. As efficiency has a focus directed internally, instead, financial performance has an external focus covering measures such as profit, financial ratios, or market share (Jack & Powers, 2009). Doctor's idle- and overtime is another efficiency measure (Kuiper et al., 2021). This is related to utilization, something that can be measured for a spectrum of resources (Cardoen et al., 2010). Finally, there is a clear connection between matching demand and capacity well, something that is essential for HCPC.

Additionally, one study of Swedish primary care (Kaltenbrunner et al., 2019) found a connection between lean maturity and quality of care. HCPC can almost be seen as a prerequisite for lean HC implementations (Rosenbäck, 2017), with this reasoning some of the investigated lean maturity parameters can hence be transferable to HCPC. Removing aspects relating to value stream mapping, HC quality and continuous improvement we get the following list:

- Staff engagement and commitment (to Lean)
- First-line managers' engagement and commitment (to Lean)
- Developing and following routines
- Planning work based on patients' needs.
- The implementation and use of automatic quality controls
- Basing the provided care on what patient's desire
- Purchasing and implementing new products
- Access to a change agent at each unit
- Collaborating with partners and suppliers
- Solving problems
- Decision making involving both staff and manager.

The commitment from the manager and staff, and the involvement of these in decision making is a new contribution. So is also the developing and following of routines. Collaboration with partners and suppliers was highlighted before with cross-functionality in mind, but this emphasizes the importance of including this in the conceptual framework.

2.5 Conceptualization of Literature

A conceptual framework and a conceptual MM were developed based on findings from literature of HCPC, MMs as well as performance of HCPC (Figures 2.13-2.15). Starting with the conceptual framework (Figure 2.13), the center section represents what HCPC is. This includes the different hierarchical levels, their connections, and the core activities such as calculating the requested and available capacity and balancing the two (*2.11 Defining Healthcare Production Control*). The activities especially relating to departmental managers or unit managers are highlighted white. From the HCPC

definition are arrows pointing upwards towards indirect effectiveness measures of HC. They indicate what one wants to achieve with HCPC (see 2.4.2 *Choice of Performance Measures in Planning Operations* and 2.4.3 *Performance Measures in Healthcare*).

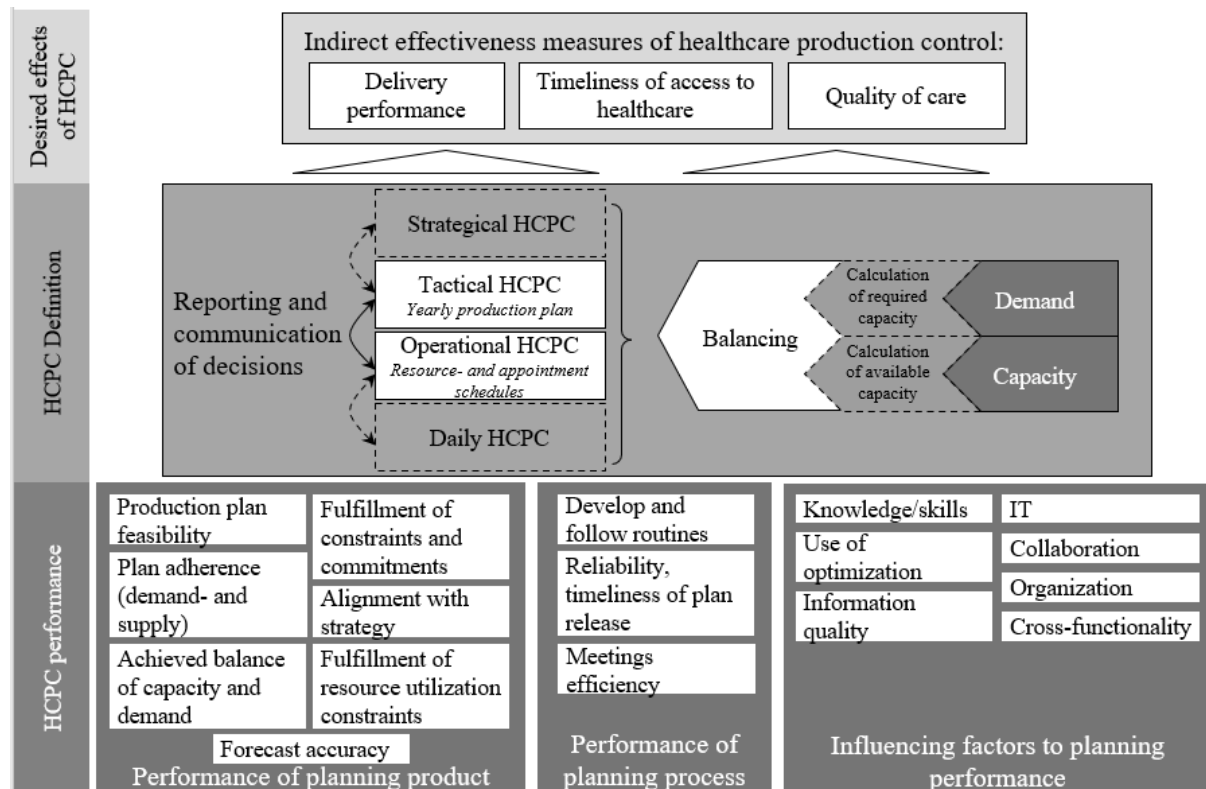


Figure 2.13: A conceptual framework of HCPC derived from the literature review.

Finally, below the HCPC definition are HCPC performance building blocks placed that could affect a successful HCPC or be related to the maturity of such. There are ‘product’-related measures regarding how well the balancing is done and plans later adhered to. Further it notes how well a plan fulfills different constraints regarding resources and commitments. The ‘planning process’ measures relate to how well you adhere to routines, how reliable and timely the plan release is, but also meetings and the efficiency of such. The selection of ‘Planning Product’ and ‘Process’ as well as the measures themselves are identified in 2.4 *Performance of HCPC*. The balancing aspect and meetings and routines is further something that had support in 2.3.3 *Process Areas of Relevant Maturity Models*. The final building block is influencing factors, things that not as clearly connect to the planning process or -product, but can be required for these to succeed and be important for the maturity of HCPC. The factors are identified both from 2.3.3 *Process Areas of Relevant Maturity Models* and from 2.4 *Performance of HCPC*. The findings from our review of MMs are summarized into a conceptual MM as seen in Figure 2.14. The process areas were identified in 2.3.3 *Process Areas of Relevant Maturity Models* and the maturity levels were chosen among many ways to classify the MM levels as seen in 2.3.4 *Maturity Levels of Relevant Maturity Models*. Despite the use of ‘Standard’, which is a relative maturity level name (discussed in 2.3.4), our opinion is that the PPMM presented by Grimson & Pyke (2007) is a suitable choice for the conceptual MM.

		Maturity Levels				
		No HCPC	Reactive	Standard	Advanced	Proactive
Process Areas	People & Organization					
	Meetings & Collaboration					
	Performance Measurement					
	Information Technology					
	Balance & Integration					

Figure 2.14: A conceptual MM, derived from the literature review.

Figure 2.14 will work as a starting ground for developing the HCPCMM, but combining the two conceptual perspectives together is important. They found the basis for the expert interview guides, and HCPC knowledge will inform the final HCPCMM construction in a similar way that the conceptual MM has informed performance measures that could be interesting (Figure 2.15).

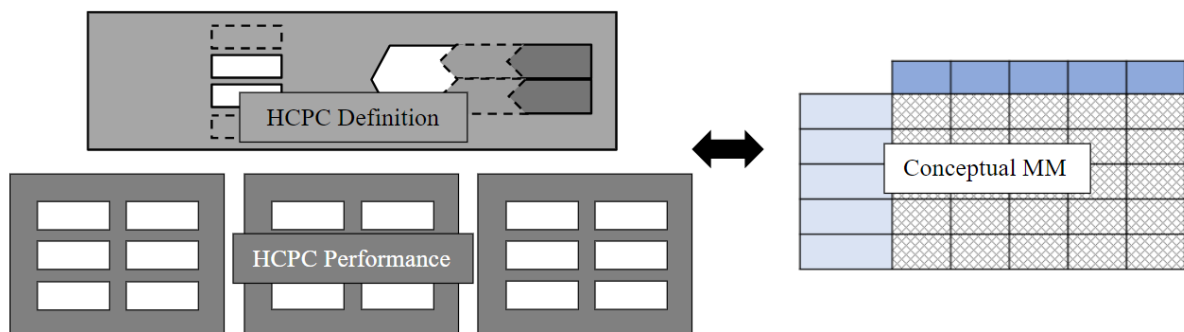


Figure 2.15: Visualisation of how the conceptual framework and the conceptual MM complement each other.

3 Methodology

In the following chapter, the methodology of the thesis will be outlined. First, the overall strategy for approaching the research purpose will be described. This is furthermore operationalized in a research design that will outline its components and describe them in detail. Finally, our strategy for ensuring research quality will be presented.

3.1 Research Strategy

After having executed an initial pre-study of the HCPC, the majority of information on planning in HC was related to optimization of different sub-processes and only limited information was available about the organizational or process-oriented aspects of HCPC. Neither was any maturity model (MM) for HC planning or HCPC identified to this date. Exploratory research is conducted to get a general understanding on a subject and descriptive studies describe concepts where there is some foundational knowledge (Björklund & Paulsson, 2012). Even though we found no research related to HC planning maturity, there is research about the maturity concept from industry. Further, frameworks have been developed for e.g. tactical planning in HC. The study will aim to both extend and adapt current knowledge on HC planning, and transfer knowledge from other contexts to the new context of HC. By doing so we will be able to give guidance on actions for the future. The study is hence both normative and empirical, rather than exploratory or descriptive (Björklund & Paulsson, 2012).

Awareness about HC's special conditions is deemed important for this thesis. But the purpose of it is to construct a MM, not necessarily about finding the ultimate truth about maturity in HCPC. The research will hence be non-positivistic in its character (Björklund & Paulsson, 2012), and will also be influenced by proven strategies for the constructive approach in general and MMs specifically (Kasanen et al., 1993; Lukka, 2003; Maier et al., 2012). Next, the operationalization of this strategy will be reviewed, and this will be followed by systematically considering design elements, one at a time, in *3.3 Research Design Elements*.

3.2 Research design

The constructive research approach (CRA) is a means for putting theory into practice by designing constructions such as models, diagrams, plans and organizations (Kasanen et al., 1993). We find this to be a good choice for fulfilling the purpose of the thesis and our normative ambitions. Kasanen et al. (1993) suggests six steps for the constructive approach:

1. Find a practically relevant problem which also has research potential.
2. Obtain a general and comprehensive understanding of the topic.
3. Innovate, i.e., construct a solution idea.
4. Demonstrate that the solution works.
5. Show the theoretical connections and the research contribution of the collusion concept.
6. Examine the scope of applicability of the solution.

Lukka (2003) develops these steps of the CRA by including the practitioners' involvement already before initiating the second step. A constructive research approach is argued by Piirainen & Gonzalez (2013) to be abductive, i.e. it will move back and forth between theory and facts, instead of moving from theory to establish facts (as is the case with the deductive method (Björklund & Paulsson, 2012)). This allows for practitioner involvement in the constructive process and validation of the

solution. The general steps of the constructive approach and the way they are interlinked is visualized in Figure 3.1.

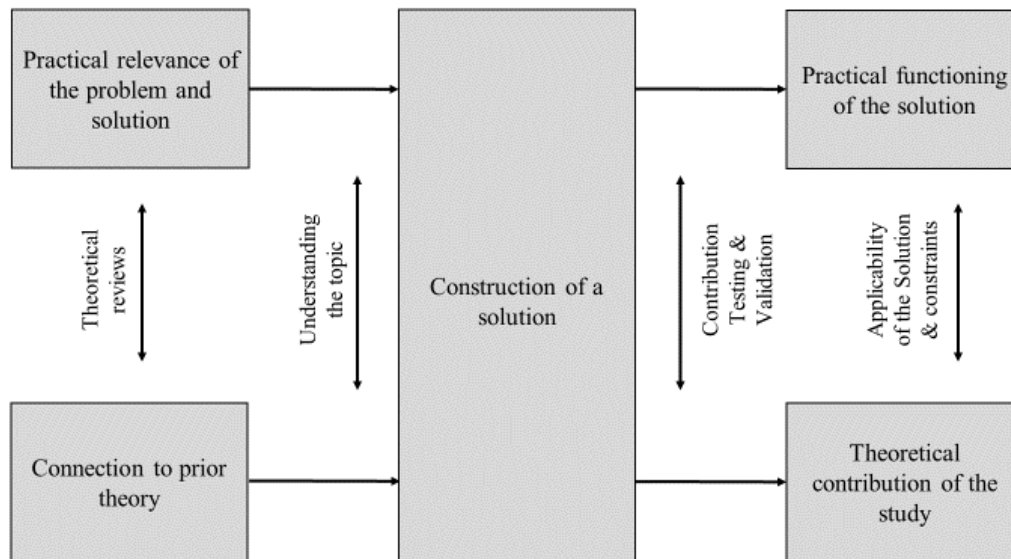


Figure 3.1: Main elements of the constructive approach, illustrating the back and forth between theory and practice. Adapted from Oyegoke (2011) and Lukka (2003).

For the development, or construction, of MMs, authors have developed specific guidelines (e.g. de Bruin et al., 2005; Maier et al., 2012). Arguably, they rhyme with CRA, encouraging practitioner involvement in the development and encompassing suggested steps to test the solution and evaluate the validity as well as the applicability of solutions and breadth of applicability. The CRA is a general methodology and the guidelines for MM development is more specific. They provide examples of exact procedures, especially developed to fit the purpose of the study. Guidelines for developing MMs will hence be used for developing the research design.

3.2.1 Unit of Analysis

Defining a unit of analysis enabled us to address the research purpose, and simultaneously guided towards answers of the research questions (Yin, 2009). The purpose of our thesis is to develop a model used for assessing and raising awareness of the maturity of HCPC within Swedish HC, as well as contributing to the discussion of HCPC maturity. More specifically, this will be done at an operational and tactical level. Therefore, the unit of analysis was defined as *maturity for tactical and operational production control in healthcare*.

3.2.2 Guidelines for Maturity Model development

Guidelines for how to develop a MM differ depending on the type of MM desired. Maier et al. (2012) presents guidelines specifically for maturity grids, which based upon its detailed description and easy overview was chosen as the ideal framework design for this thesis (Figure 3.2). This decision was made, despite de Bruin et al. (de Bruin et al., 2005) providing guidelines for general MMs (Figure 3.3). Becker et al. (2009) further presents guidelines specifically for developing MM for IT management. All three articles provide valuable insights on design consideration, but the framework of Maier et al. (2012) will guide the remaining discussion due to the level of detail and definition of sub-steps in each step. This can be seen through comparison of Figure 3.2 and 3.3.

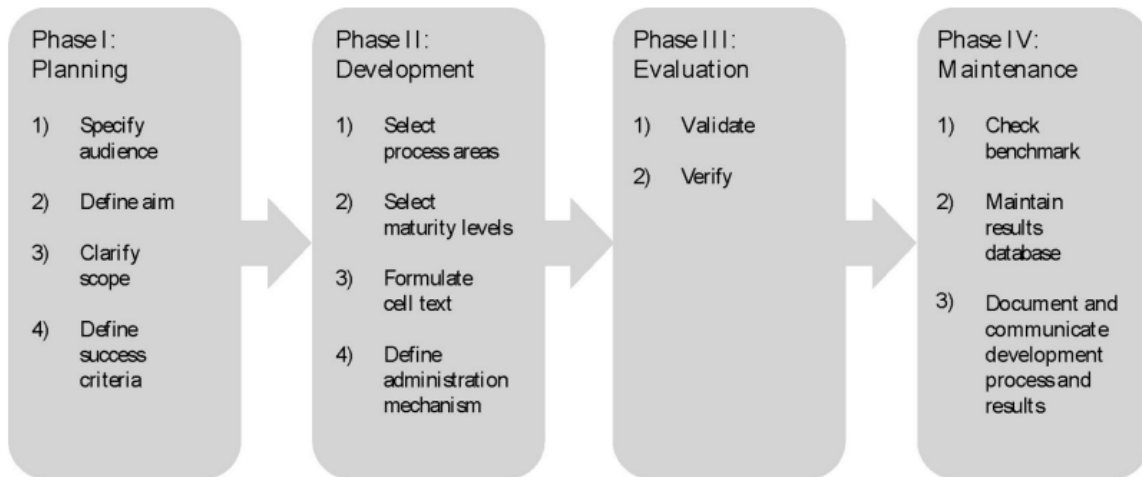


Figure 3.2: The four overarching steps and their respective sub-steps for guiding the development of maturity grids presented by Maier et al. (2012).

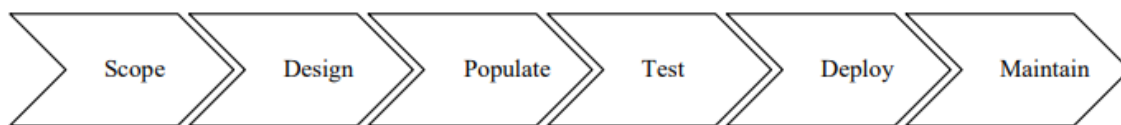


Figure 3.3: The six steps for MM development presented by de Bruin et al (2005).

The first phase of MM development, ‘Planning’, includes specifying the audience, defining aim, and clarifying scope. Decisions include who should use it, who are stakeholders of the MM development, if it should be generic or domain specific, as well as if it should be used for benchmarking organizations or more analytic (e.g. by gaining insights on how to progress) (de Bruin et al., 2005; Maier et al., 2012). Many of these questions were jointly answered by us and RJL (see chapter 1 Introduction). For defining high-level success criteria for a successful MM development, suggested alternatives are *usefulness* and *usability* (Maier et al., 2012) – two terms rhyming quite well with the defined criteria (see chapter 1.4 Problem Formulation). These were later used as a foundation, but expert interviews were used as a means to confirm and operationalize what it would mean in the context of HC.

The second phase, ‘Development’, is the main part of the work since it establishes what content the MM should have. Selection of the so-called process areas (the content of the model) can be based solely on experience in the field (de Bruin et al., 2005; Maier et al., 2012). But, with a lack of prior knowledge or being in a new field, it is suggested to use literature search and if needed complement by other sources of information such as interviewing a panel of experts (Maier et al., 2012) or using a focus group (de Bruin et al., 2005). Expert interviews and literature search were thus used for information gathering of this thesis and was naturally also applicable for the identification of maturity levels (the rating scale) as well as the formulation of cell texts (the intersection of process areas and the rating scale). By looking for good case examples in literature and encouraging expert interviewees to describe best- and worst practices, as recommended by Maier et al. (2012), it was possible to triangulate for suitable levels and cell texts. Maier et al. (2012) also recommends defining the model’s administration mechanism, that is, defining the administrative purpose the MM will fulfill, something that was done in 1.4 Problem Formulation. For this thesis, it is ‘raising awareness’ for the organization rather than to enable ‘benchmarking’. This highlights a focus on the process, rather than the end result as the maturity is evaluated. A conceptual framework developed from literature informed the interview guide for expert interviews. These were then analyzed separately, and a first model design could be presented.

Maier et al (2012) recommends finalizing the maturity grid in group-administered workshops to ensure a high response rate and avoid single-respondent bias. This additionally ensures that the respondents can ask for any clarifications when faced with the MM. The expert interviews were hence complemented by three rounds of focus group workshops, to get feedback from future recipients of the assessment, i.e., practitioners in RJL, and also allow the client Astrada to come with feedback. A preliminary design was presented at the workshops. The development of a MM should be iterative, where first the maturity levels should be conceptualized, and then followed by refinement of the MM (Becker et al., 2009) This is fulfilled by the procedure of first holding expert interviews, and then two workshops with some time apart.

The third phase, ‘evaluation’, implies testing the application of the model, and is important to reach validity and verify the model (Maier et al., 2012; de Bruin, 2005). For the validation, HC departments were chosen to test the MM (at this stage). As it was recommended by both Maier et al. (2012) and de Bruin et al. (2005), none of the evaluating RJL-departments had contributed to the thesis earlier (in an expert interview for instance). Validation further implied that there should be correspondence between what was found and the understanding of participants, but also a correspondence between the model’s breadth and the reality. Apart from the validation, a model verification was also necessary to accomplish. We let the feedback on the MMs applicability from these assessments form the base for what to verify. Maier et al. (2012) suggest that this verification is done against the success criteria. Evaluation can also be seen as an important phase of the development as feedback from the evaluation can be used to further refine the model.

Our final research design elements (Figure 3.4) consist of the general steps suggested by Maier et al. (2012) as a foundation, but with an information step added to better describe the primary information gathering. Neither the deployment phase (de Bruin et al., 2005) nor the maintenance phase (de Bruin et al., 2005; Maier et al., 2012) was included, as the actual deployment is outside the scope of this thesis. Further refinement will naturally take place after the deployment.

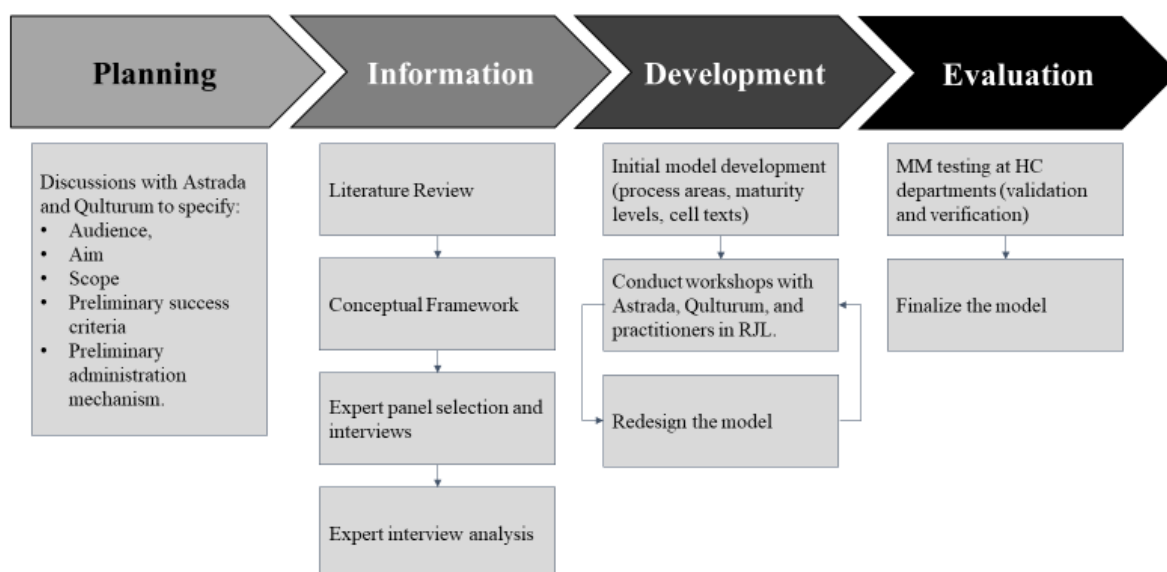


Figure 3.4: The final research design with research design elements

3.3 Research Design Elements

The different research design elements, and the method used for the thesis, will now be presented in chronological order (based upon Figure 3.4), starting with the literature review and the development of the conceptual framework in the information phase.

3.3.1 Literature Review and Conceptual Framework Development

A literature review is a sensible way to create a good understanding of a topic: literature reviews are additionally a way to get a lot of information quickly (Björklund & Paulsson, 2012), but also to build a conceptual framework (Björklund & Paulsson, 2012; Rowley & Slack, 2004). A literature review can e.g., build an understanding of theoretical concepts and help analyzing and interpreting results of a study (Rowley & Slack, 2004). The pre-study showed that there was no developed model or framework on maturity in HC planning processes, but several studies where MMs were developed for planning in particular. This resulted in the literature review being two-sided, where research about planning processes in HC was mainly independent from the research regarding MMs (See Chapter 2 *Literature Review*).

A combination of citation pearl growing, and subject pearl growing were used. These techniques build upon the idea that one item of information, either by subjects or citations (sources), will lead to the discovering of more such (Hansson, 2023). Starting from some initial papers, citation pearl growing was useful for creating an understanding for newcomers to the topic of HC planning and MMs as recommended by Rowley & Slack (2004). The preciseness of the unit of analysis made it difficult to make effective searches, but searches in web-of-science did help identify some of the initial papers for MMs. For this part of the literature review, we did two different searches. The first one used 'Framework', 'Maturity' and 'Supply Chain' as search words, and the second one used 'Planning Process' and 'Maturity Model' instead. For both these searches all its search words had to be included to generate a hit. Together, these searches rendered 252 unique papers and we were able to immediately exclude 162 of them based on that these papers:

- Did not focus on MMs specifically.
- Had a specific focus on MMs out of scope, e.g., 'Circular Economy MM'.
- Had a wide approach to maturity, e.g., by considering it a world phenomenon.

Out of the remaining 90, we specifically studied those six that had occurred in both searches and could establish that three of them had a particular focus on the S&OP-process (Danese et al., 2017; Neto et al., 2022; Thomé et al., 2012). This rhymed well with the intention of our MM for HCPC. One of them was even a research synthesis (Thomé et al., 2012), thus clearly motivating further searches going forward and backward from these three. After having completed these forward and backward searches, the same search principle was adapted to the relevant articles that only occurred in one of the searches. This way, we found a wider range of relevant papers (e.g. Hammer, 2007; Maier et al., 2012) and its searches forward and backward rendered even more crucial literature (e.g. Lockamy & McCormack, 2004). All these sources that were considered relevant were thereafter used in the review.

Moving on to searches related to HC, it was quickly noticed that finding relevant papers for this area was much more complicated due to the landscape of the HC research field. Many papers were published for very specific HC-problems and gaining an understanding for HCPC in general would thus require mapping of more than 300 papers. But since at least a couple of relevant papers could be identified (e.g. Jonsson & Ivert, 2015; Larsson & Fredriksson, 2019), and since Google Scholar was used to further

search the field, it was possible to continue the search. Citation pearl growing was, once again, operationalized through forward- and backward searches (as well as recommendations from the ‘related items’ or ‘similar items’ column when deemed relevant). This way, it was possible to gather relevant papers and thereby get a relevant perspective when reviewing the field.

Both academic and professional literature were considered as information resources. Both literature sources can have a suitable role in forming a research area, but the theoretical basis of the academic literature is stronger due to being peer-reviewed prior to publication (Rowley & Slack, 2004). As recommended by Rowley & Slack (2004) models and concepts were mainly derived from academic literature, and table 3.1 summarizes the most frequently used ones. However, some highly cited maturity frameworks from consultancy groups were also considered.

Table 3.1: A summary of the most used (academic) literature sources, what they mainly propose and where they are used in the literature review.

Source	Content	Used for
Grimson and Pyke (2007)	A planning process MM with evaluation	MM content
Wagner et al. (2014)	A refined planning process MM	MM content
Hammer (2007)	A process and enterprise MM	MM content
Maier et al. (2012)	A strategy for developing a maturity grid	MM construction
De Snoo et al. (2011)	Scheduling performance criteria	Performance of HCPC
Hulthén et al. (2016)	A performance measurement system categorization for the S&OP-process	Performance of HCPC
Rosenbäck (2017)	Ideas for how HCPC should be outlined based on other industries	Performance of HCPC, Defining HCPC, HC Characteristics
Kuiper et al. (2021)	Problems with appointment scheduling in HC	Performance of HCPC, Defining HCPC, HC Characteristics
Cardoen et al. (2010)	A literature review on planning and scheduling of operating rooms	Performance of HCPC, Defining HCPC
Cayirli and Veral (2003)	A literature review of appointment scheduling in outpatient services	Performance of HCPC, Defining HCPC
Hulshof et al. (2012)	Taxonomic classification of HC services	HC Characteristics, Defining HCPC
De Vries et al. (1999)	Some specific characteristics of HC and production within HC	HC Characteristics
Vissers et al. (2001)	A framework for hospital PC in different time horizons.	HC Characteristics, Defining HCPC
White et al. (2011)	Insights to tactical planning related to lean HC	HC Characteristics, Defining HCPC
Larsson & Fredriksson (2019)	A framework for the tactical HC planning process	Defining HCPC
Hans et al. (2012)	A framework for HCPC	Defining HCPC

Finally, the literature review was summarized in a two-sided conceptualization with the intention of highlighting the concepts and connections that was necessary for the thesis. It was two-sided to highlight findings related both to HCPC and MMs, resulting in a conceptual framework (Figure 2.13), a conceptual MM (Figure 2.14), and a visualization of their interplay (Figure 2.15). This was used to prepare interviews and to analyze empirical data. With the conceptual MM having striking similarities to an existing MM (Grimson & Pyke, 2007), this was used to enable a visualization of cell context in the expert interview. This way, no cell text was developed in the conceptual MM.

3.3.2 Expert panel selection and interviews

Expert interviews can be either exploratory, systematizing- or theory-generating (Bogner & Menz, 2009). Systematizing expert interviews can be used to provide researchers with knowledge and facts about topics (Bogner & Menz, 2009). The background of the individual interviewee is expected to change the scope of each individual interview, although the main topics discussed should be the same. Based on the conceptual framework, the conceptual MM, and the research questions, an interview guide was constructed, see Appendix A.6 and A.7. A semi-structured interview approach was chosen to allow for flexibility during the interview (Björklund & Paulsson, 2012) and let each interviewee's respective knowledge shine through. The first three interviews were held on site in Jönköping and the subsequent five were instead held online due to the long distance between each interviewee. However, all interviews were recorded to enable transcription.

Interviewees were selected based on recommendations from RJL, Astrada and when their names and organizations circulated in public sources on HCPC during the initial literature searches. Their relevance was further confirmed during interviews, when they referenced each other and showed great knowledge in the area. In addition, the authors reached out to SALAR and The Swedish Agency for Health and Care Services Analysis¹⁸, where no one were available for an interview. Commonly referred expert Myrna Palmgren was also unable to participate, instead interviewee D who has worked close to Palmgren was interviewed. The result is a selection of people with different roles, having experience of PC in HC around Sweden. Most interviewees held a central more strategic role in their regions, although the first interview was held with an interviewee working more closely with operational HC and the last interview was held with representatives from NBHW. The rationale for interviewing representatives from NBHW is that the board in its reports, related to access to HC, has indicated that HCPC is an important tool that should be implemented in HC to increase accessibility in HC, see also *1.1 Background*. The full list of interviews is presented in Table 3.2. Lettering has been attributed to the interviewees to remove dependence on the people's names and to facilitate reading and understanding of the discussion. Their organizational background is included and will be used when needed. One interviewee wanted to be anonymized. All interviews are reviewed in chapter 4 *Expert Interviews*.

¹⁸ Swedish: Myndigheten för vård- och omsorgsanalys

Table 3.2: Person interviewed and date of interview for the first interview round.

Interview	Name	Position	Dates	Duration
A	Anna Larsson	Business developer at children's health RJL	2023-03-03	60 min
B	Maria Malmström	Logistician at Qulturum-RJL, responsible for the KPS-program	2023-03-03	60 min
C	Pernilla Sandquist	Director of Development Qulturum-RJL	2023-03-03	60 min
D	Malin Sucksdorff	Business analyst at Region Östergötland, optimized HC processes and operations	2023-03-08	90 min
E	N/A	Head of Quality Management and Operational support at a major Swedish region	2023-03-07	90 min
F	Kemal Olin	Doctor from Region Stockholm (RS)	2023-03-08	90 min
G	Ritva Rosenbäck	Researcher, author of course literature in HCPC	2023-03-09	75 min
H	Sevim Barbasso Helmers and Sofia Norberg	Analysts and project managers, The NBHW	2023-03-16	60 min

3.3.3 Expert interview analysis

The literature review provided a background and context for the study, but additionally allowed for building an initial draft of the MM on which the interviews were based. The expert interviews were all recorded in order to ensure a solid problem compilation and empirical analysis. Based upon the recordings, the work with data coding could proceed - initially with the first cycle coding where codes were identified but not yet grouped in any way (Gioia et al., 2013; Miles et al., 2020). It is explained that codes are labels that either describe or provide conclusions to the compiled information during a study (Miles et al., 2020). In our situation, such codes will be used to identify all crucial takeaways from each interview and will consist of either statements or quotes that have a distinct meaning to an interview. Table 3.3 describes all those mechanisms we use to enable coding of the data (Miles et al., 2020). We would like to emphasize that the most used one is called ‘Theming the data’ which is a mechanism for summarizing the content in extended phrases or sentences, and ‘In vivo coding’ which uses quotes from the interviews for coding.

Table 3.3: Selected mechanism with belonging descriptions, used in the thesis for coding the data (Miles et al., 2020).

Mechanism	Description
In vivo coding	Quoted keywords or shorter phrases
Process coding	Identifies conceptual actions as gerunds
Evaluation coding	Assigns judgements to how something is perceived by the interviewee.
Causation coding	Codes affecting each other in a sequence
Theming the data	Somewhat extended phrases or a sentence, summarizing the content

As the coding was completed, the codes for each interviewee were used to reproduce each interview (found in chapter 4 *Expert Interviews*). This way, readers could easily comprehend the opinions, thoughts and experiences behind each interview separately. After this, codes from interviews were analyzed crosswise instead (see chapter 5 *Expert Interview Analysis*). This 'cross-interview analysis' rhymes with a 'cross-case analysis', as by Gioia et al. (2013). Our cross-interview analysis had the intention of seeking both differences and similarities among all codes found in the first cycle coding (Gioia et al., 2013). The codes were grouped according to similarities in their theme, thus creating a more manageable number of terms used to describe the material (Gioia et al., 2013). Miles et al. (2020) also explains that such a hoop to second-order terms and the overall cross-interview analysis is crucial for enhancing the "generalizability or transferability to other contexts". That is, if many experts state similar things, it will be possible to extrapolate statements on a bigger scale. In addition (and seen in our context), if any of the regional experts claim a statement that is supported by a nation-wide expert, the reasoning must be considered even more solid. This way, a cross-interview analysis also has the possibility to deepen the understanding for the subject (Miles et al., 2020). These second-order terms will consequently be followed by aggregated dimensions (Gioia et al., 2013). Most likely, there will be similarities between those aggregated dimensions and the aspects synthesized in the literature review, since the expert interview guide was structured in accordance with the literature review. However, differences may occur since MMs for HCPC potentially are different from MM for PC in general. Finally, this cross-case analysis results in a data structure, capturing codes (first-order themes), second order themes, and aggregated dimensions. This way, the findings can be proven, thus motivating the appearance of the HCPCMM derived. Second -order terms for each aggregate dimension will be shown in 5.1-5-12. The entire coding tree with codes leading up to the process areas can be seen in Appendix A.4, and in addition, Appendix A.5 shows another coding tree leading up to tactical planning.

3.3.4 Initial Model Development

The HCPCMM, as well as its earlier drafts, was developed in accordance with Maier et al. (2012). In this thesis we only describe the final model version in detail (see chapter 7 *Development and Evaluation of Maturity Model*) but will however also communicate the changes made in the stepwise development process (see chapter 6 *Workshops* as well as 7.4 *Maturity Model Evaluation and Finalization* for this). Figure 3.4 establishes development in four steps:

- Selection of process areas (the content of the MM): Plausible process areas was firstly identified in the literature review for MMs. In this phase of the development, earlier recognized process areas were identified and grouped according to content. These different categories, that thus were formed, were included in the conceptual framework. To get a HC perspective on these categories, they were all covered in the interviews. Finally, the aggregate dimensions (originated from the interview codes) were used to gain the general span of the HCPCMM. These dimensions were later transferred into the process areas and clustered into categories based on the discussion in Chapter 7.
- Selection of maturity levels (the rating scale of the MM): Once again, the literature review gave suitable indications on what level names that could be possible to use. We did not formulate suggestions for level names since the number of levels was not possible to specify based on literature solely. Despite this, it was possible to identify some potential names or scales. For the conceptual MM (Figure 2.14), we therefore used one of the reviewed rating scales and could also create a dialogue about levels in the interviews. The way the interviewees formulated their answer to most of the questions gave us indications on what levels that were most suitable to use. In addition, Chapter 5 *Expert Interview Analysis* also verified these names.
- Formulation of cell text (the intersection of process areas and the rating scale): To give the

interviewees an idea of how a MM could look like, the one suggested by Grimson & Pyke (2007) was shown in the interviews. Based upon the specific coding, the defined process areas and maturity levels, this step mostly concerned fitting statements about the organization in the correct cells. The focus was to get each process area ‘free’ from statements relating to other areas, but also to get a realistic representation of the increased maturity based on the empirics. This work was done after all the interviews were completed and reiterated after each workshop, as well as after the evaluation testing.

- Definition of the administration mechanism: As mentioned earlier, the intention with the HCPCMM was to rather focus on raising awareness, but to enable benchmarking of organizations. In essence, this means that suitable coworkers on sight should have the possibility to make assessments themselves together. Therefore, the cell texts were generally customized for someone that might have problems with comprehending PC-terminology. On this note, the HCPCMM was equipped with both examples & interpretations, as well as questions, for each process area to facilitate the internal discussions. But despite customizing the HCPCMM for internal dialogues, it will still be possible for someone outside of the organization to make assessments. This way, Qulturum in RJL can possibly monitor the transition from low to high maturity and prioritize their efforts.

3.3.5 Workshops

After the first-draft MM was developed, three iterations of focus group workshops and model reconstructing were held to improve the model even further (see Chapter 6 *Workshops*). A focus group workshop is a method of collecting data from many interviewees at once by facilitating a group discussion (Gill et al., 2008). Such a method is specifically useful when investigating people's experiences, beliefs, or opinions (Gill et al., 2008; Wilkinson, 1998) which is fitting when a first-draft MM needs feedback. In addition, a focus group also serves the purpose of providing data interactively, and the interaction between participants enables more articulated answers to the questions asked (Wilkinson, 1998).

The first focus group included HC consultants working for the company Astrada. Insights from this workshop led to a second draft of the framework that later was used to gain more insights from a workshop with Qulturum in RJL. A third iteration was held with HC practitioners in RJL thus finalizing the innovation rounds. Figure 3.3 describes the setting for each workshop. The three workshops allowed the focus to vary with the people present. This way, we could keep discussions relatable for all the participants of each workshop and in addition minimize the required time from HC practitioners. Noteworthy is the order of the workshops scheduled. It was considered crucial to start the innovation with Astrada-representatives since they were well-aware of PC in general and within HCPC specifically. This perspective, together with the fact that Astrada KPS is used for multiple clinics in RJL, contributed with a rather holistic perspective. Second was the workshop with Qulturum in RJL. As responsible for the entire KPS-implementation, they too contributed with a holistic perspective. As important stakeholders, these workshops were additionally important for deciding upon a design and the administration mechanisms. Finally, the workshop with practitioners in RJL enabled discussion of specific model content to ensure the model was practically usable, but not so specific that another clinic could not use it. This was a crucial perspective since the two first rounds focused on layout, structure, and what general content should be included.

The intention with each focus group workshop was to contribute with opinions regarding a draft of the MM. When developing workshop plans, it was found that the nominal group technique rhymed quite

well with this intention (Cleary, 2001). In this technique, we learn that the focus group consensus is formed after an initial phase of independent thinking, followed by group presentation and -discussion (Cleary, 2001). Having such a technique also enabled us to control the order of which participant's initial opinions were presented, thus minimizing the risk of one dominant participant influencing the group's consensus. The proposed changes, retrieved as an output from each workshop, were compared against the literature review, and/or the expert interviews, when found necessary. This way, the correct changes could be implemented to the model before the next iteration. In the following subsection, the plan for each of the three workshops will be described, starting with 'Astrada', followed by 'Qulturum, RJL', and finalizing with 'Practitioners, RJL' (later named with numbers in accordance with Table 3.4). A more thorough discussion of both the content and output of workshops is found in chapter 6 *Workshops*.

Table 3.4: Date, duration, and participants with titles for each workshop held. Names will be included/excluded in final report upon confirmation from interviewees, exact role description also to be confirmed with interviewees.

Workshop	With	Date	Duration	Place	Participants	Alias	Participants' Titles
1	Astrada	2023-03-23	180 min	Astrada Office, Stockholm	Johan Mann	P1.1	COO, Astrada
					Torbjörn Karlsson	P1.2	Director, Astrada Healthcare
					Erik Malmgren	P1.3	Consultant and responsible for RJL, Astrada
2	Qulturum	2023-03-30	60 min	Virtual, Zoom	Maria Malmström	P2.1	Logistician Qulturum RJL, responsible for KPS-program
					Pernilla Sandquist	P2.2	Director of Development Qulturum-RJL
3	Practitioners, RJL	2023-04-04	75 min	Virtual, Zoom	Maria Malmström	P3.1	Logistician Qulturum-RJL, responsible for KPS-program
					Kristina Engvall	P3.2	Doctor, doctor's manager, and scheduler, Oncology, RJL.
					Lise-Lott Göransson	P3.3	Nurse and Department Manager, Dermatology, RJL.
					Per Nodbrant	P3.4	Medical physicists and Department Manager, Oncology, RJL.

Workshop 1 with Astrada was the first and longest one. It was held on site in Stockholm together with three company representatives: the COO, the director for Astrada Healthcare, and one consultant responsible for Astrada KPS, see Table 3.4. Before the workshop began a rough plan for the three hours was handed out. The reason for this was because of a stepwise reveal of our draft as the workshop proceeded. This way, we could both control what exact areas that were discussed, and simultaneously avoid an influence of our first-draft model. In the workshop introduction, we specified the audience, aim, and scope for the final MM. Besides, the workshop layout and schedule were explained once again.

Following this was discussions around five different areas, all relevant for Astrada and structured with the nominal group technique described earlier: model design, descriptive or prescriptive cell texts, process areas content and logical progression of the model and finally, a discussion of the formulation of cell text.

Workshop 2 included the two Qulturum employees that had previously been interviewed and was done virtually over zoom, see details in Table 3.4. The main purpose of the workshop was to create an alignment in the design selection and administration mechanism, i.e., how an evaluation should be done was discussed. As important users of the HCPCMM, their confirmation of this was important. Secondly, they were asked about the process areas and content of the cells, guiding the continued development and refinement of the phrasing in certain cells. Since they had been participating in the expert interviews, their feedback on the general content was weighted against the findings from literature and other expert interviews to show unbiased.

Workshop 3 was held with a selection of practitioners from RJL. The selection was unfortunately limited due to difficulties getting hold of HC employees available for a workshop. The final contributors were three, with two coming from the same unit, see Table 3.4. They were asked about maturity levels and the content of the cell texts. This was done primarily to ensure that the model would be understandable to HC professionals.

3.3.6 Maturity Model Evaluation and Finalization

With a draft of the HCPCMM ready after the workshops, the evaluation and the finalization of the model could take place (see 7.4 *Maturity Model Evaluation and Finalization*). This third process area enables coverage of the fourth CRA-step, intending to “*Demonstrate that the solution works*” (Pirainen & Gonzalez, 2013; Kasanen et al, 1993) with the use of *validation* and *verification* (Maier et al. 2012). The first part of the evaluation was to validate the HCPCMM, something that was done both in the workshop with practitioners from RJL, and in the model evaluation interviews. Once again, clinics in RJL were used. Table 3.5 specifies the departments (and managers) assessed in interviews with the HCPCMM to validate it. The reason for choosing those two specifically was because of the easy access to departments in RJL, but also because they had not been used earlier – something Maier et al. (2012) establishes as crucial for the evaluation. It should also be noted that these departments were explained to be at different stages of their KPS-implementation. This is beneficial since it potentially implies model evaluation for multiple maturity levels and thus higher transferability. After this, a *verification* of the success criterias, stated in 1.4 *Problem Formulation*, was also done for the same departments. This completed the evaluation, and both these steps informed us as the model was adjusted a last time.

Table 3.5: Person interviewed and date of interview for the model evaluation. Names will be included/excluded in final report upon confirmation from interviewees, exact role description also to be confirmed with interviewees.

Name	Position	Date	Duration
Lina Johannesson	Unit Manager, midwife. KHV, RJL.	2023-04-28	90 min
Magdalena Fritzon	Department Manager. Primary Care, RJL.	2023-04-28	90 min

3.4 Research Quality

Not only does the HCPCMM need to be evaluated, but also the thesis as a whole. Therefore, the research quality will now be commented as a final part of this chapter.

For a qualitative research that addresses logistics specifically, Halldórsson & Aastrup (2003) suggest using trustworthiness as a general criteria of research quality. In their paper, ‘trustworthiness’ is specified into four relating dimensions which will be used in this thesis, namely:

- Credibility
- Transferability
- Dependability
- Confirmability

The following section will explain these dimensions, and describe in what way trustworthiness can be ensured for each of them. This is also summarized in Table 3.6.

Table 3.6: The four dimensions of trustworthiness and our measures taken to increase it.

Dimensions of trustworthiness	Purpose	Methodological measures to increase the trustworthiness
Credibility	Measures how well the respondents' constructions and the researchers' representations of these constructions coincide.	<ul style="list-style-type: none"> • Multiple Expert Interviews confirming the same statement • Multiple Papers confirming the same statement • The verification of expert interviews against literature. • The evaluation of the HCPCMM with two departments in RJL.
Transferability	Considers the extent to which the thesis has the possibility to make general statements of the world.	<ul style="list-style-type: none"> • The evaluation of the HCPCMM with two departments in RJL. • That these two departments are explained to be at different stages of their KPS-implementation allows testing of (potentially) different maturity levels. • Cross-interview analysis that might imply more general statements
Dependability	Treats the stability of the findings over time	<ul style="list-style-type: none"> • By carefully describing, motivating, and being transparent with choice of research strategy.
Confirmability	Presenting findings free of bias. Researchers must be able to make the data trackable, thus making it transparent were the data origins.	<ul style="list-style-type: none"> • Workshops should collect and clearly motivate why specific changes are made. • Evaluating the model's applicability.

3.4.1 Credibility

Halldórsson & Aastrup (2003) mean that there is no objective reality, but that reality is subjective phenomena. The development of our MM must certainly be described in accordance with this statement. Without doubt, the final result will not only depend on the experts we will interview and the practitioners that have time to participate in workshops, but it will also depend on our interpretations and valuations of the literature and the empirics. All these factors will naturally contribute to a very specific final version that would be different if any variable were changed. However, this will not necessarily make

the model lose all its credibility just because of a change in some way. Credibility can be achieved through respondents affirming the picture drawn by the researcher or taking a stance where there is a need for correction. Triangulation of different methods is proposed as one way of increasing the credibility of a study (Björklund & Paulsson, 2012). In our thesis it was e.g., helpful to use:

- Investigator triangulation: As we used eight different experts for collecting responses to the same questions.
- Data triangulation: As different research articles that studied the same phenomena were collected, e.g., for arriving upon insights regarding levels and process areas for the MM.
- Methodological triangulation: As expert interviews were verified against literature. But also, when the final model was evaluated with the use of two new HC departments.

3.4.2 Transferability

Transferability has to do with the extent the study can generalize the world, but there is a shift towards contextualization (Halldórsson & Aastrup, 2003). Transferability of already established concepts is tested in our thesis, since it uses methodological triangulation to evaluate the final model with the assistance of two departments in RJL. It would have been even better to make evaluations for departments outside of RJL, or between different rounds of model redesign, or for the same department twice, but that will be addressed in 8.4 as a potential for future research instead. But since the evaluation consists of two departments, explained to be at different stages of their KPS-implementation, the study might allow testing of multiple maturity levels. In addition, the context in which the model is supposed to be adapted is more specific than most of the other MMs out there. In this case, knowledge about the restrictions of applicability is important to understand the transferability concept.

3.4.3 Dependability

Dependability is traditionally used to describe stability of findings over time, however with a non-positivistic (naturalistic) approach one acknowledges that reality might shift (Halldórsson & Aastrup, 2003). By carefully describing, motivating, and being transparent with choice of research strategy and method for the thesis we will ensure that people understand the foundations of this study.

3.4.4 Confirmability

The findings should be able to confirm themselves and the bias from the researchers should be so small as possible (Halldórsson & Aastrup, 2003). When the design phase is initiated, the different design suggestions will be discussed during different workshops. Having these opinions collected and (possibly) verifying our model before the next iteration is crucial for the confirmability. In addition, the final evaluations will also have an impact on the confirmability since they test the model's applicability.

4 Expert Interviews

The empirical contribution of the expert interviews will be described below. Firstly, a more thorough background of the interviewees will be presented. Results from the questions of drivers to HCPC will be presented thereafter, to provide a deeper background to why HCPC is relevant for the interviewed individual. This does not inform the development of the maturity model but can further explain where the thoughts of the interviewee origin from. Following this is the interviewees' viewpoints on MM design. Lastly a discussion of concepts affecting maturity will be presented, this discussion is summarized in tables for each interviewee in accordance with the categorization of process areas that is to be used in the remainder of the report (presented in 7.3 Synthesizing the Analysis into Process Areas with Cell-text Formulation). The complete coding trees are found in Appendix A.4. Figure 4.1 provides a summary of the interviewees and their organizational background, with lettering A-H representing the different interviews.

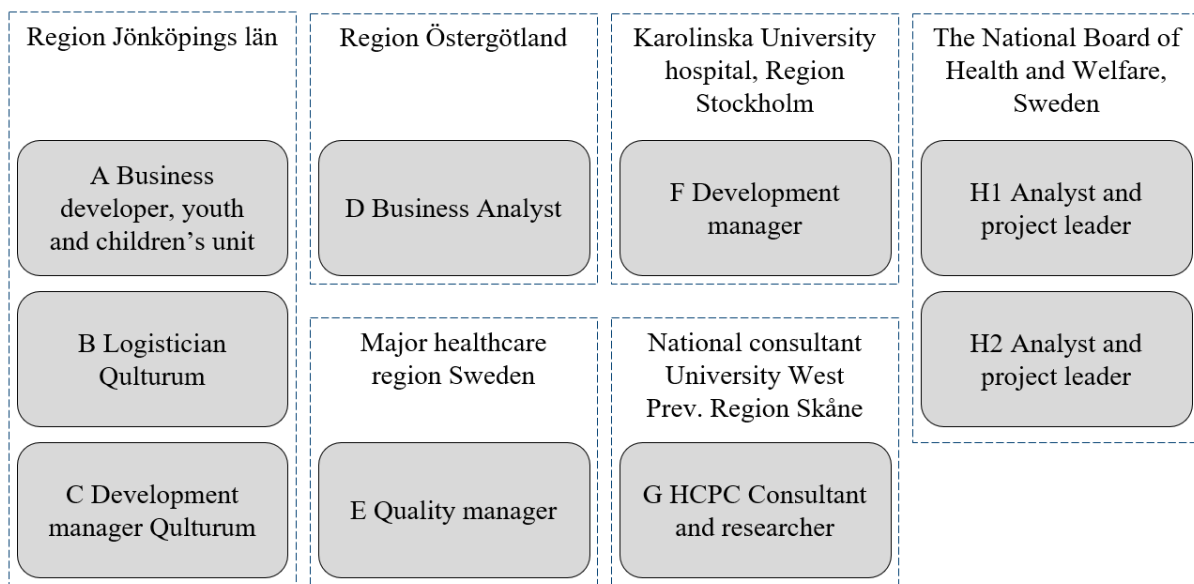


Figure 4.1: An overview of the experts interviewed and their organizational background.

4.1 Interview A - Business Developer RJL

Interviewee A is a business developer at the regional children and youth's unit. The unit is divided into two areas: children and youth medical clinics and children and youth health clinics. The first consists of four different pediatric specialist clinics in the Region and treats children in the ages from 0 to 17 years. The second area consists of three different clinics and focuses on mental illness in children, treating patients between 6 and 17 years. It is a primary care institution before potential referral to children- and youth psychiatry. The interviewee has a support function in the management team of the children and youth medical clinics, collaborating with the unit manager and others.

Interviewee A is originally a physiotherapist and worked with habilitation for several years before pursuing a masters in quality development and leadership. Since then, she has held positions at Qulturum and worked with e.g. process orientated ways of working. Aside from her position as business developer at the children and youths' unit she is also part of the regional project group for KPS

implementation in the central medical care unit¹⁹ of the whole region. In that role she has been part of the implementation at both her own organization and other medical HC clinics and departments.

4.1.1 Drivers to HCPC

One of the main drivers, according to this interviewee, is the insight that continuing the planning of HC as it has been planned before, is not sustainable in the long run. There are simply not enough resources. Many initiatives have been tried out related to HCPC, but the organization needs to adapt to the change and understand what they are aiming for. She asks the question: *“What is it you want to achieve by employing more patient contracts?”*. This is interpreted to express the problems with establishing internal goals when you do not have the means to discuss numbers relating to HC production.

The interviewee describes HCPC to create equality across clinics in her unit, for HC workers as well as patients. Although hard to convince employees sometimes, as there is a lack of internal drive, the equality aspect is easily understandable. Collaboration between clinics is important to create a balanced system load and equality across HC.

4.1.2 Maturity Model Design Reflections

“To understand how things translate to reality, the maturity model has to be pretty concrete” (interview A). The content of MM should however not be too detailed or comprehensive. It should be applicable and easy to interpret. To ensure this, a trade-off between a detail and the model being too abstract needs to be done. Additionally, practical applicability means that the model should work for all different kinds of departments. The number of steps for a MM should additionally be motivated, 5 steps might be too many. The interviewee further requests clarity regarding the criteria for assessment, also called the administration mechanism in MM literature.

4.1.3 Maturity of HCPC

According to interviewee A, *“the big change needed is cultural”*. Without the right culture, there is a lack of internal motivation to change. Many other aspects raised by the interviewee are cultural or organizational: communication and achieving a consensus, knowledge, and trust towards the leadership. The interviewee exemplifies many kinds of knowledge required such as system knowledge, mathematical understanding and knowledge about improvement and change management. System knowledge relates to an understanding of where in the HC system you are, something that is lacking *“you do not see your responsibility for the greater system”* (interview A). A big cultural deficit of today is that people tend to focus only on their own department, and horizontal cooperation can initially irritate clinics. In order for creating collaborative platforms between clinics, which has been important for the interviewee’s work, she’s had to actively work with cultural change and alignment among HC workers.

She clarifies that the knowledge does not have to be present in all employees - it can be replaced with trust towards co-workers’ and the HCPC leader’s abilities. All co-workers should, however, be aware of the importance of improvement projects, and the workplace should be open for changes and improvements. HC workers need to be an important part in driving the change, HCPC cannot only be based on initiatives from the management, it is the people working closest to the patient that best knows what can be improved.

¹⁹ Swedish: *enheten för medicinsk vård*

But the interviewee has thoughts on several different areas. With regards to IT, she argued that the IT-system allows appropriate visualization of HC products. Visualization of a situation allows for correct efforts to be applied, but an IT-system will only be as good as the input data. Today they have different systems that help them with visualizations: *“we have three different systems today and different things can be seen in the system, one system cannot do it alone”* (interview A). Interviewee A hence said that selection of appropriate ‘productification’ is a very important part of HCPC, allowing the creation of a production plan. With ‘productification’ she refers to the selection, and division of HC services into more manageable HC products. The selection of products is good when it is adapted to the organization’s pre-conditions and is allowed to be dynamic over time. The products should be defined based on the type of visit and time required. With the internal resource requirements decided upon, you can calculate the required capacity.

Agreements for internal resource requirements, scheduling, and staffing allow the organization to critically assess and improve processes and components in the organization’s, or department’s, ways of working. It is of importance that there is co-planning before schedules are created: *“The managers for our different clinics meet ahead of each scheduling round. Before everyone put down their own schedules and have different expectations on production levels.”* Agreements additionally allow them to match the HC needs with capacity: *“If you look at a healthcare product, such as referrals, you can see how many first visit appointments per week we should divide per full-time employee”* (interview A). Started working with HCPC revealed how plannable the operations were, the interviewee says that looking at historical data allowed them to identify patterns in demand that they were not aware of before. To know how much HC can be produced, you need to decide how much care a full-time or part-time employee is expected to produce. This way scheduling agreements can be matched with the HC demand. The interviewee gives an example: it can be to set aside time in the schedule for particularly resource-intensive tasks, such as assessing referrals that were not prioritized before. Scheduling agreements contributes to creating equal opportunities and expectations for employees, and to a good working environment. It is however important that the employees understand the decided upon agreements. Apart from scheduling, some routines should also concern when to wish for vacation. On this note, the interviewee explains that her clinic has come up with a principle of applying for vacation four times a year – with a foresight of about six months.

Agreements that are made to secure better ways of working by e.g., coordinating nurse and doctor schedules, or allocating a specific time for certain activities, have no measurable effect if they are not followed. Adherence is something that should be measured and actively worked with. Today many doctors and nurses are still responsible for scheduling their own appointments and the interviewee says that you must actively work with e.g., *“loyalty towards the schedule”* (interview A). Similarly, following-up on the production plan accuracy and how well the demand is covered by the schedule is important. Changes made can additionally change the current agreements around ways of working and lead to improved resource utilization:

“How big of an impact does a prick test have on an asthma investigation? The doctor could not find any research support for that test anymore. We have done those tests for 40 years, but other, much more efficient and specific tests have been launched. Today, we do not do prick test anymore, something that has led to us saving a lot of healthcare resources” (interview A).

When you cannot achieve a balance, or do not achieve your overall goals of accessibility, you have to look at improvement possibilities and adjustments. These adjustments will be needed regularly

according to the interviewee, but one should have a plan for what should be done: “Control signals, or ‘traffic lights’, with dedicated actions give us clear indicators that allows us to be proactive” (interview A). Ideally internal adjustments are made ahead of external ones. The adjustments and actions proposed by the interviewee can be on different levels: “Agreements can be made about what can be down prioritized if needed or what will happen if someone gets sick” (interview A). Once again, the employees need to be aware of the conditions, the interviewee says that the leader should clearly communicate the agreements made and ensure that there is room in the schedule for such adjustments.

Tactical level meetings could address the production ahead for the whole region. An important note is the importance of a broader perspective: “We need to move it up one level in order [eds. from a micro system level] for the management level and support functions to be helpful where it's needed" (interview A). To achieve all the above, it is important to establish routines, not only for meetings but for other aspects as well. Scheduling requires well-established routines and should have good, predictable foresight. A summary of the maturity content covered in interview A is shown in Table 4.1.

Table 4.1: A summary of the maturity content covered in interview A, divided into categories.

Category			
Culture & Organization	Routines and Structure	Measurements and Control	IT
<ul style="list-style-type: none"> • Openness to change is important, although it can cause irritation. • Mathematical knowledge is needed. • Trust towards HCPC leaders • Understanding of HC system, not only focusing on clinic, is an important cultural change. • Cultural alignment between collaborative partners is important. • Agreements need to be communicated clearly by leadership. 	<ul style="list-style-type: none"> • Having a standardized routine for when to wish for vacation is good, especially if the foresight is long. • Products should be defined based on time required and type. • Products should be aligned with the department’s need and allowed to be dynamic. • Production plan is made with HC products. • Decisions on how much HC a full-time employee should produce allows for calculation of available capacity. • Patterns in HC demand can be identified from historical data. • Schedule agreements create equal opportunities. • Changes and improvement work could require agreements to be updated. • A tactical perspective is needed to create better conditions for production. • It is of importance that there is co-planning before schedules are created. 	<ul style="list-style-type: none"> • The people working closest to the patient know best what can be improved. • Adherence to scheduling agreements is important to follow up on. • Adjustments of our own capacity should be prioritized over demand adjustments. • Action plans for when capacity does not match demand are needed. • Improvements should be considered when capacity does not match demand. • Internal resource requirements and ways of working should be followed up on. • Production plan accuracy and adherence need to be followed up on. • Adherence to schedules is something you might need to actively work on. • Adherence to agreement should be followed up on. 	<ul style="list-style-type: none"> • IT solutions are only as good as the input data. • Visualization of production data is an important contribution of IT. • IT should be able to handle HC products. • No sole IT system can handle everything that is needed.

4.2 Interview B - Logistician at Qulturum, RJL

Interviewee B is a logistician and engineer working at Qulturum with a particular focus on KPS. In her daily work she assists existing KPS-clinics across the entire region as they progress with their implementation, but she also prepares and supports the KPS-introduction for new clinics. She has also developed a support working process where meetings are prepared with specified content so that clinics know what to work with until the next meeting. This working process is used to keep track of the implementation for each clinic. The interviewee believes that having Qulturum as an independent resource has been helpful in the implementation of HCPC. Throughout the interview, she gives examples of when PC has been made possible thanks to the fact that geographically separated clinics have had the possibility to communicate and solve problems collaboratively. These prerequisites are explained to be enabled thanks to the organizational structure in RJL with Qulturum.

4.2.1 Drivers to HCPC

According to Interviewee B, there is a nationwide incentive for working with HCPC today. This stretches all the way from the Swedish government to the NBHW, to the SALAR, and to HC regions like RJL. Their respective incentives might differ from (or possibly contradict) each other, but regarding RJL, interviewee B believes that a combination of increased patient accessibility and better working environment contribute significantly. But despite clear incentives within the region, she articulates that change is a result of some co-workers with a distinct driving spirit. In essence, if the leader for the department is committed to (but also believes in) the HCPC-process and can mobilize the team in the same direction, there is a good foundation for change.

4.2.2 Maturity Model Design Reflections

For the interviewee, it is of importance that the designed MM is easy to comprehend. But in addition, she also emphasizes that it must be possible to apply it in a thorough analysis of a department. Therefore, the cell-text must be elaborate, whilst still being accessible. One way this comprehension can be achieved is by clearly addressing those process areas that must be improved to move to the next maturity level. Using questions might be suitable.

4.2.3 Maturity of HCPC

The interview with interviewee B covered a spectrum of topics related to HCPC (see Table 4.2). Scheduling follow up, patient flows, and productization are just three of those discussed during the interview. One of the first insights she wanted to share concerned the misconception regarding the immediate importance of an IT-system for production planning. Qulturum frequently gets requests from other HC regions and seeking a solid IT-system is a top priority for many. In contrast to this, interviewee B argued that an IT-system might be important, but that HCPC encompasses a lot of other aspects as well.

The interviewee believes that forming the organization for HCPC and ensuring a positive culture is key in the beginning of the implementation. There must be an internal trust in the organization, according to her. Besides, the culture suffers from presumptive ultimatums affecting the HCPC work: *"I think that people worries that a doctor will quit his job and move to another region if his schedule is changed. Then we lose that competence."* She underlines that a good leader is the source to all changes like this: *"The leader must be curious and ask for results so that everyone understand the importance of this"*. But the leader also needs to clearly point out a direction and communicate the goals, especially if HCPC-

related complaints arise. Naturally, HCPC will require a lot of time resources from the leader, especially since control must be done continuously. On this note, it would be beneficial to have a HCPC-leader with HC-experience, something that also would reinforce the trustworthiness gained by co-workers. But the leader should not stand alone in this implementation according to the interviewee. She stresses that meetings should be attended by at least the KPS-responsible for the department and the care unit manager²⁰. In addition, controllers or analysts are considered valuable resources for the HCPC work as well.

Table 4.2: A summary of the maturity content covered in interview B, divided into categories.

Category			
Culture & Organization	Routines and Structure	Measurements and Control	IT
<ul style="list-style-type: none"> • Having internal trust in the for each other in the organization is important. • A leader should be responsible for HCPC. • The leader should encourage the organization for HCPC and stand strong if friction arises. • It is beneficial if the leader has HC experience. • A care unit manager should always be a part of HCPC. • Analytics and data controlling are important competences. 	<ul style="list-style-type: none"> • A good tactical plan is generally missing. • Meetings agendas and regularity are important for HCPC. • Meetings must cover different time perspectives. • Meetings with the people you collaborate with are important. • Schedules should be released 12 weeks in advanced and it should be clearly communicated when. • HC product names should always be in line with the organization's processes. • Internal resource requirements should be specified in the HC products. • Co-planning is needed when resources are shared. • Making appointments in other co-worker's calendars is desired. • The production plan should not be too detailed. • The production plan should have as few variations as possible. • One should schedule more capacity than the actual need. • Planning tactically will have effects on the production plan. 	<ul style="list-style-type: none"> • Measurements need to focus on HCPC specifically. • Measurements should focus on imbalances between capacity and demand. • The schedule should not deviate from the plan. • Control is connected to measurements and must be done continuously. • HCPC can improve capacity issues. 	<ul style="list-style-type: none"> • IT should not be seen as the only solution. • Generating schedules automatically is desired. They quality must however be considered before the release. • Optimization requires high maturity. • Visualization is a reason for investing in IT. • Integrated systems require correctly registered data. • Integrated systems must be able to transfer information themselves.

During the interview, it was clear that the interviewee emphasized the importance of having a good tactical plan: "Some have tactical planning, but a minority achieves a good tactical plan". This planning phase has connections to meeting routines for HCPC, and meeting agendas and regularity should thus be seen as a top priority: "What meeting platforms do you have? What workers attend? What are you talking about? How do the meetings work? Are they effective? Do you have a distinct meeting agenda?". At a high maturity level, the people that you collaborate with are important, there should be

²⁰ Swedish: vårdenhetschef

a structure of meetings with them. Sometimes there is a need of national collaboration even. It will also be much easier to cover different planning horizons as well. She explains that the meetings must cover both operational, tactical and strategic perspectives for each department, but also that they must occur with sufficient foresight. For resource scheduling RJL has decided that 12 weeks of forward planning should be a requirement. But also, it should be very clear when a new such is released so that patients can be booked in on the correct conditions. In addition to this, she also explains that HC personnel lack education in working process-based, and it might be relevant to add this competence from other employees.

Regarding HC product selection, it was explained how well-formulated product names grounded in the department can contribute to effective review and follow-up. According to the interviewee, those products are ideally constructed based upon internal resource requirements like time or required competences. Besides, their relevance must be reinforced with time, preferably by analyzing the names via the IT system. For an ideal scenario, she also connected these product names with internal resource requirements later down in the patient process, in terms of resources and appointments. Interviewee B wants to enable co-planning when clinics or departments share resources. In addition, she also means that one ideally "*...should be able to make appointments in each other's calendars*". The reason for having HC products specified this way is however primarily because they are utilized in the production plan to make good estimations. On this note, interviewee B explains that the yearly production plan should not be too detailed in terms of products used.

From the perspective of interviewee B, there are many routines that can be aided by a suitable IT-system. Naturally, both HC products and their internal resource requirements and patient flows can benefit from an integrated IT solution. She sees the potential of generating optimized schedules automatically with a good engine. Regarding the optimization, she stresses that the data quality and the correct constraints must be ensured before anything can be automatized. It is particularly the registration that must be correctly done. Therefore, optimization is related to higher maturity stages. In addition to these potential improvements, she establishes that an IT solution allows the departments to visualize situations they are facing and thereby provide them with qualified decision support. On this note, interviewee B provided us with two graphs from Astrada-KPS representing how production plans at the tactical level can look for departments of high maturity and low maturity in HCPC (compare Figure 4.2 with 4.3). The graphs illustrate how increased HCPC maturity implies that:

- Bars for the appointments yet to be scheduled decreases (queues).
- The production plan is based on an even HC demand.
- The scheduled capacity (hours) lies slightly above the expected demand's required capacity from the production plan. This way, it is possible to hedge for daily variations.
- The department is on track with patient appointment scheduling, and scheduled patient appointments slightly decrease with time.

Such an analysis can be carried out with a suitable IT system and a mature organization should allow for the derivation of such graphs, according to her. On higher maturity levels, the integration of IT-systems also becomes important. On this note, interviewee B says that "*It would be very beneficial if the systems were able to communicate with each other*". She advocates that systems should be able to self-transfer data and aims systems for PC, staff scheduling, HR, the electronic medical record (EMR), and appointment scheduling systems.

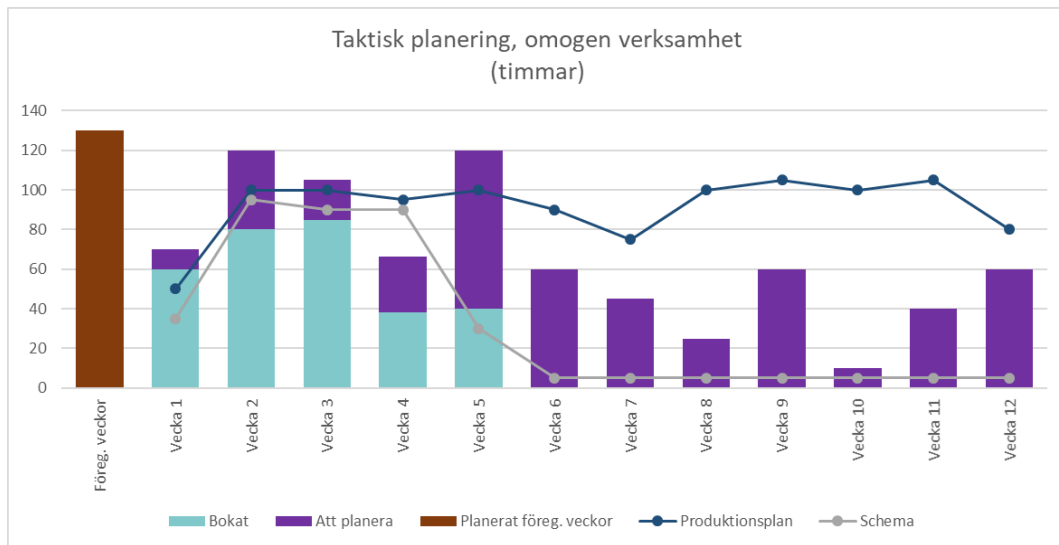


Figure 4.2: An example of how a production plan can look for a department not working with HCPC.

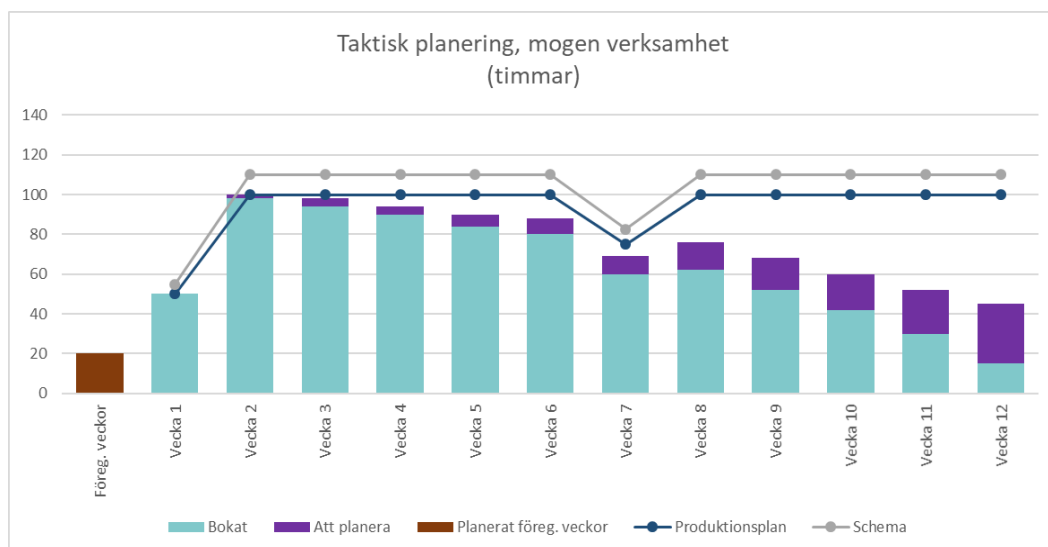


Figure 4.3: An example of how a production plan can look for a department working with HCPC.

Interviewee B also discusses measurements and control. She has the opinion that departments need to focus more on measuring for HCPC specifically: *"Many clinics want better availability. But what does that mean? Better availability for whom? How much better? When do you want to achieve it? You cannot introduce HCPC simply on the notion of 'better availability'"*. Regarding availability, interviewee B has noticed that such a focus from above interfere with the more prioritized focus:

"We've seen examples where the focus from above is on improving the availability for new visits with economic compensation offered, then that becomes the biggest focus. As a result, the queues for re-visits increase significantly. I would wish for a more holistic perspective".

In addition, interviewee B wants the focus directed to the imbalances between capacity and demand. On this note, she addresses both measurements related to balance in the production plan and in the schedule, but also the connection between these: *"The schedule should not deviate from the production plan."* She emphasizes that these deviations or imbalances need to be controlled and states that control

is something that must be done continuously. Especially since HCPC can draw attention to important improvement opportunities regarding capacity requirements:

"One department discussed the actual duration of each patient appointment. They have seen that the co-workers who managed the appointment on time initiated the relevant patient measures immediately, and that they thus had time to take care of deviations during the visits. In contrast, those co-workers who did not manage the appointment on time priority small talk in the beginning and did the patient measures in the end of the appointment time. If they then noticed any issues, they were out of time and needed to reappoint the patient."

4.3 Interview C - Development manager Qulturum, RJL

Interviewee C started off her career as a nurse. With in-service training on project management, she has since taken on management positions. She works as a Director of Development at Qulturum in RJL, a regional Improvement and Development support center that provides resources and competence for HC management. She has been driving the implementation of KPS in RJL together with Interviewee B and hence she has been exposed to many different HC departments both at medical and surgical HC units.

4.3.1 Drivers to HCPC

HCPC, and RJL's efforts within this, is described by the interviewee as part of the process of finding the best possible way of planning. HC accessibility is a problem that RJL is very aware of, that affects the overall perception of HC. She says that a patient's satisfaction with the care provided does not matter if the patient is dissatisfied with the time they've spent waiting. The pandemic has resulted in increased strain on HC accessibility, due to many cancelled surgeries and appointments. The interviewee experiences an increasing political drive to deal with the issues of bad accessibility. She expects there will be governmental funding within the area available soon, which would lead to economic compensation for efforts relating to improved accessibility and perhaps particularly HCPC.

She used the word proactive when describing one of the most important things with HCPC: *"We have to have better foresight and be proactive rather than reactive. A lot of things are missed out on when we are reactive."* (Interview C)

4.3.2 Maturity Model Design Reflections

A good MM should be pedagogical, and one should use it as a good support for internal discussion internally. It should be explicit and provide clarity regarding what needs to be improved.

4.3.3 Maturity of HCPC

In general, the interviewee thinks that the process areas found in extant literature review, such as the Grimson & Pyke (2007) model, are relevant for HC. An important reservation was however made regarding IT. She exemplifies that many Regions reach out to RJL and ask them - "What IT-system are you using?". The interviewee explains that an IT-system cannot single-handedly solve production planning problems. It is only one of many components and could never substitute cultural change. Creating a change among employees is difficult. The willingness to change is usually there all the way from top management down to managers, but below manager level it is usually more difficult to change. For this to happen, the organization needs a good leader, but also that the right competences are secured.

Roles for planning activities need to be carefully divided, and knowledge around data, measurements, scheduling, and planning is also needed. In addition, the interviewee highlights that competences must not only be in place for the strategic level, but for the tactical as well.

The interviewee suggests that meetings, routines, and measurements are important, but many examples given show that it only matters when translated into action. Measurement is important and should be used to ensure that the department is going in the right direction. Follow-up of accumulated costs is an important part in measurement, but it is additionally important to measure both patient satisfaction and work environment indicators. Each measure also needs to have connected actions, interviewee C suggests that proactiveness is achieved when you have a backup plan and dedicated measures connected to specific control signals. Once again, culture plays a role; willingness to act on numbers and change accordingly is stressed. *“You can have a production plan, but it is of no use if it is not implemented in the department”* (interview C).

A lot of the structure needed around PC is relating to the adherence to agreements made and defining data used for PC. Agreements can cover everything from what full-time nurse schedule/doctors schedule looks like to setting down routines for scheduling. Further HCPC products should be defined and to each product there should be appended resource requirements. It is suggested that one should look over the HC products yearly, and the adherence to these is further stressed important: *“Different ways of working and required resources for different activities is one way where we build variation. We must be able to follow up on this”* (interview C). How well the plan covers the need is another dimension that needs to be in place, ensuring the quality of the plan to begin with.

According to interviewee C, a successful HCPC is one where scheduling does not require too much administrative time, as employees should not have to spend too much time on the planning itself. Doctors should ideally not have scheduling duties, that is a waste of time. For this to succeed, the interviewee highlights that one needs to have knowledge about colleagues' competences gathered. It is a type of data that needs to be defined, just like products and their resource requirements. The connection between the two is shown: *“When a cardiology patient is at investigation for heart failure, you need to know the duration of the appointment and what competence to invoke”* (interview C). IT-systems are said to help you identify shortcomings in competence and find a balance between competences and HC needs. More specifically IT can help with visualization of data and facilitate proactiveness, and she also stresses that it is a problem when a holistic view is hard to get. But as hinted before, IT should not be seen as the only solution. The interviewee says that a production plan does not have to be created in a sophisticated IT-system, Excel can suffice for lower maturity levels.

Meetings should take place at least monthly for tactical planning. Separate flows for certain patient groups might require more meetings. For scheduling, 10-12 weeks is a good horizon to aim at. Creating a good forecast of HC needs should also be routine. An ideal forecasting tool can use simulation and follow the patient throughout the HC process, which is why seamless connections between HC departments is an ideal case. Collaboration is needed for planning common resources and tight such requires similarly defined product names. Collaboration and planning should take place at all levels, *“You must make a production plan on the aggregated situation. After that you need to make it on a departmental level and later for each product”* (interview C). The interviewee also stresses that it is through collaboration with other departments that tactical control is executed. The forecast's role in product definition is exemplified through the fact that each product should be forecastable. Another side of production planning, namely forecasting is also described to happen at several levels: *“Forecasting on both tactical and operational level is central”* (interview C). The interviewee claims that making a

production plan based on demand is easy, but this in despite she explains that the tactical planning is generally missing: "At some islands there is tactical planning, but we want it to spread across the region". A summary of the highlighted aspects in this section is found in Table 4.3.

Table 4.3: A summary of the maturity content covered in interview C, divided into categories.

Category			
Culture & Organization	Routines & Structure	Measurements & Control	IT
<ul style="list-style-type: none"> • Cultural change is a core part of implementing HCPC. • Creating a willingness to change based on numbers is a big challenge. • The word 'control' is generally not received well. • A leader or manager responsible for HCPC is important. • Roles for planning activities need to be carefully divided. • Knowledge around data, measurements, scheduling, and planning is needed. • Competences are needed both for the strategic and the tactical level. 	<ul style="list-style-type: none"> • Monthly meetings at tactical planning level. • Patient flows might require special meetings. • 10-12 weeks planning horizon for scheduling. • Scheduling of different professions should be done in synchronization. • All activities or aspects of a working day should be agreed upon in agreements. • Keeping track of the competences is important. • Each HC product should have appended product characteristics and resource requirements. • All data needs to be overseen yearly. • Collaboration is important to reach synchronization between departments. • Collaboration between departments is needed to ensure tactical control. • Tactical planning is generally missing. 	<ul style="list-style-type: none"> • Ensuring progress is made is important. • Connecting measures with actions and acting on measures to change is important. • The work environment, patient satisfaction, and accumulated costs are important things to measure. • Variances should be measured as well as how well demand is covered in plans. 	<ul style="list-style-type: none"> • IT should not be seen as the only solution. • Visualization of data helps proactiveness. • IT can help identify shortcomings in capacity. • Excel sufficient for some tasks at lower maturity levels. • Forecasting with seamless IT connections between HC departments would be ideal. • It is important to get a holistic view upon planning the production.

4.4 Interview D - Business Analyst Region Östergötland

With a study background in management, and accounting, the interviewee has worked in the HC sector in 1995. Since then, she has been working strategically with HC finance and development in different projects and positions, mostly for Region Östergötland (RÖ), but in some periods also for Region Stockholm. In 2006, the work with HCPC was initiated in RÖ, partly thanks to the mathematician Myrna Palmgren. Since then, the interviewee has been involved in projects and initiatives related to HCPC. The region has searched for the optimal system, worked a lot with capacity, and are now specifically approaching HCPC as they intend to improve visualization and keep better track of production plans. At the time of the interview, the interviewee was a business analyst centrally at the regional council of RÖ.

4.4.1 Drivers to HCPC

According to the interviewee, HC departments in RÖ are now asking for more support when it comes to HCPC. She emphasizes that a steadier patient flow enables better organization and structure in the working teams and will thus improve the working environment. The concern around hospital beds is

still seen as a core incentive to keep (or start) working with HCPC, that is the biggest bottleneck the region is experiencing. Another reason is that RÖ are still turning to firefighting in a lot of situations in their daily operation. A motive to work with HCPC is said to be its potential to use resources more efficiently. The interviewee explains that it is not a question of adding more financial funding to HC, but that HC suffers from shortages in human resources.

4.4.2 Maturity Model Design Reflections

The interviewee believes that the challenge with designing a MM for HC is that it must be general enough to be applicable for different departments, but meanwhile specific enough to be relevant as an evaluation tool. Furthermore, she is of the opinion that providing the department with questions is a good way to both facilitate internal dialogues and communicate what should be achieved. Making them realize what their weak spots in HCPC are will be of great importance.

4.4.3 Maturity of HCPC

Interview D took off from the conceptual MM. Going through the topics of the model one at a time, but also recommended a focus on patient flows, adherence to standards, and knowledge- management and control. Initially, meetings and collaborations were discussed, and it was emphasized that a more systematic approach with a shift in responsibility would make the situation better. As for now, scheduling knowledge is inherited and bound to each profession, something that makes planning functions sensitive to disturbances. A more systematic approach would make it a lot better. The overall competence for logistics must increase, with support from the management team. A clear ownership of HCPC should be clearly defined: *"It is important with someone in a planning function, that feels a clear ownership of these questions. This would be a role with similarities to the production manager at a manufacturing firm, a role that has not had a counterpart within healthcare before"* (interview D). There is a fine line management should be convincing, but also involve the employees. At the region now *"there is no one that has made a decision that everyone needs to follow, there is a leadership that listens to the employees"* (interview D). The full spectrum of areas covered by interviewee D, is found in Table 4.4.

The interviewee wants managers in charge of HCPC in RÖ to have decision mandates and authority to control the production. The department head should additionally be supportive of collaboration in these questions. Specific authority must also be given to cross-departmental meeting structures aiming to decide things centrally. Using the meetings to implement change and incorporate HCPC is described as a key activity:

"Production control must be a part of the ordinary control, e.g. through the meeting routines. We are good at discussing the economy, number of employees, and potentially some production statistics. But we need to better address the dialogue concerning production gaps." (interview D)

Another area that was especially discussed in interview D was the importance of data and the issue of poor data quality, something that affects HCPC negatively. According to her, there is an abundance of stored HC data, but it is very hard to apply it to the right contexts. Therefore, tactical decision making becomes both hard and unreliable. The interviewee exemplifies this with the derivation of automated schedules that requires someone to manually assess each produced schedule. It is not the engine itself that is the problem, but the data and the constraints that are omitted in the feed. If the departments had

access to better data, their production plans would be substantially improved. The same goes with schedules, these cannot be based solely on general beliefs about staffing requirements but should be clearly defined. When higher maturity and knowledge is reached AI could be used to create plans. To avoid letting production planning get too complex, it should be based on selected products. A HC service can be defined differently, but *“what the organization uses for control should be part of the product definition”* (interview D). Additionally, with production data comes the problem of transferring data from one system to another. In the current set up, it is not possible to send data manually via the IT systems in use. This is also something that hampers the automatic process of deriving suitable production plans.

For the interviewee, it will be a key focus to establish structure and routines to increase the quality of HCPC, concerning both tools and ways of working. Besides, she also adds that *“The tactical level is the weak link”*. The production plan must be translated to a resource schedule, and both this schedule and scheduling of appointments need stricter rules or operating agreements. This is a good way to identify where issues come from: *“A structured approach to schedules can help us understand where their problem lies, otherwise the solution tends to be that we need to hire more personnel”* (interview D). She gives examples where personal relationships between the scheduler and scheduled staff complicate the fairness and accuracy of the scheduling process. There has not been enough control over personal schedules, *“A doctor can come in and say ‘You will have to cancel my time at the clinic, because I need to prioritize other things. This should not be decided by individuals, rather on a management level’”* (interview D). This is an established cultural tradition that needs to be changed, nurses too are used to wish schedules. Routines and structure must also be created for the IT system that RÖ will use, something that stretches all the way from trusting alerts provided to using the programs as intended.

Table 4.4: A summary of the maturity content covered in interview D, divided into categories.

Category			
Culture & Organization	Routines & Structure	Measurements & Control	IT
<ul style="list-style-type: none"> • Clear ownership of HCPC is important. • Openness for collaboration is important for leadership. • Overall competence in logistics needs to be improved. • Employee involvement is important. • A transition from a situation where employees could dictate their own schedules freely is needed. 	<ul style="list-style-type: none"> • Meetings where gaps in production are discussed are needed. • Meetings at departments and cross-functional meetings should be given decision mandates within HCPC. • Structure and routines, as well as a more systematic approach to scheduling and PC is a key focus. • Production plans should be translated to a resource schedule. • Schedules cannot be based on general beliefs around staffing and historic data. • More rules around scheduling can avoid negative behaviors. • Knowledge about scheduling must be documented and available. • Production planning should be based on selected products and kept updated. • The tactical level must be reinforced. • Cross-departmental meetings are important to hold. 	<ul style="list-style-type: none"> • Scheduling agreements can help identify shortcomings. • Actively working to bridge gaps in demand and capacity • New ways of measuring are needed, such as total patient lead times and work environment. • Structure for following-up and create improvements. 	<ul style="list-style-type: none"> • Transferring data between IT systems is not straight forward. • At higher maturity automatic derivation of production plans is expected and AI can play a role here • Visualization with dashboards helpful for follow-up • The amount of data and the quality of it is hindering efficient HCPC. • Good data would significantly improve departments’ production plans and hence tactical planning. • Trust in the IT system is important. • Using the provided IT systems are important

Visualization in dashboards is a good way of follow-up on processes, and production plans. Software support should be able to simplify and visualize. The link between data, measuring and IT is clear: “*The correct data must be found, it must be packaged, and connected in a way that creates an understanding for the flows*” (interview D). Regarding what one should measure, the interviewee highlights that availability is more of an indirect measure and that new things need to be measured e.g., total patient lead times can be measured instead of waiting times at departments. Work environment is connected to HCPC as structure should clarify expectations on employees in a positive manner. She further highlights that there should be routines for what is done with certain deviations and puts forward the schedule and scheduling agreements as a great control tool. A ‘systematic approach’ is needed here both regarding the “*creation of improvements and acknowledging gaps between demand and capacity, and actively try to reduce imbalances*” (interview D). A summary of the areas highlighted in the interview can be found in Table 4.4.

Table 4.5: Discussion material of HCPC maturity provided by the interviewee during the interview.

Steps for PC process	Selection of things to be in place
1. Creating a good foundation	The management pushes the PC work forward. PC is a crucial prerequisite to improve accessibility, flow efficiency, and working environment for the department. Roles and responsibility areas exist to plan, follow up, and analyze the production.
2. Analyze as-is	Patient flows for the department are mapped and grouped in different logical categories (and categorized in different care services in accordance with agreed syntax) Patient flows for the department is an important fundament for the planning and control. Inflow, production, and relevant KPI:s are visualized and used systematically.
3. Develop production plan	There are dedicated roles for managing and coordinating the work with production plans. There are clear and communicated routines for prioritizing activities and resources (e.g., education, production, research). Scheduling of co-workers is based on the production plan.
4. Work according to plan and follow-up	There are clear routines for unexpected absence and resource control at a daily horizon. The production plan, its follow-up, and measures are a steady topic on the management meetings. The co-workers know the goals for what and how much to produce each day.
5. Make improvements to your organization	The improvement work is executed with structure and a systematic approach. All co-workers have the possibility to contribute to the improvement work. The gap between care demand and HC production is both identified and quantified.

The interviewee provided discussion material that they currently use to discuss the maturity of HCPC. This is used when management levels consider introducing HCPC. Its purpose was to create an

understanding of what an introduction means and how far the organization has come, compared to RÖ overall goals. The material is summarized in Table 4.5 above, and not included in Table 4.4.

4.5 Interview E - Quality Manager major Swedish Healthcare Region

Interviewee E holds a central position at a major Swedish HC region. The interviewee has worked with quality improvement and management of HC at different levels in Sweden: at hospital units, the regional council, governmental level and at SALAR. The interviewee has additionally done research regarding HC organization. A previous strong focus on lean transformation and patient flows motivated looking at variances related to the way things are planned. Now HCPC is an important part of the interviewee's position. The region is working to roll out a central program for HCPC.

4.5.1 Drivers to HCPC

Accessibility has been a problem for a long time, and HCPC in the region has been intensified because of the HC backlog resulting from the pandemic. HCPC aims to create more systematic ways of planning today, it is done very differently around the region. The drivers depend on where you are in the organization. HC workers are driven by a possibly better HC quality for the patient, but it can sometimes feel like it contradicts a good working environment, in that situation, a leader needs to clearly communicate the 'why' to the organization.

The interviewee finds capacity to be the biggest problem and it is not always easy to find the right competence to hire. Within a region it is often the same pool of human resources, one doctor moving from one clinic to another will not be better for the HC system. The system thinking is ideal with e.g. collaborative centers with all managers of similar clinics, but private care providers do make it more difficult to coordinate such efforts. Innovation is needed to solve issues faced. The lack of tactical control activities and the connection between strategic and daily control is another shortcoming of today that makes these things even more difficult. The interviewee believes that capacity can be utilized better, but today those opportunities are hidden. There is a belief that HCPC is important to understand the relationships between your available resources and your output of care. But the problems are many: *"No collaboration and silo-culture, as well as single excel sheets used for analysis is among the problems we see today"* (interview E).

4.5.2 Maturity Model Design Reflections

Regarding the MM, the interviewee believes that the assessed organization should not have to see the framework at a primary assessment. They should rather be asked questions on how their related to different aspects work, and a person outside the organization should do the evaluation.

4.5.3 Maturity of HCPC

The interviewee highlights IT-system as something that would facilitate production control overall in the region. Upon investigation, they have found that the departments with experienced high maturity had updated data and a common vision throughout the organization. Although some departments had made efforts led by a manager or visionary employee, the lack of IT-support made it hard to sustain efforts when that one person left. *"Many are requesting a simple IT system that can maintain the right behavior, because they want to do the right thing (...) They are clinicians and can feel frustrated when*

they're not receiving help." (interview E). The interviewee explains a few problems related to the IT-system in the region that they seek a solution for. Examples are:

- excel sheets that only a few people in the organization have access to or understand.
- There is a lot of data, but not systems efficient for analyzing the data.
- bad data registration leaves a situation where there is no single source of truth across IT-systems.
- Finally, a patchwork of different IT solutions is a problem in itself as it makes communication and collaboration between departments and IT-systems complex.

Instead, the interviewee highlights some of the goals they want to achieve with an IT system.

- They want the simplicity that an IT system can provide.
- They want to set standards for registration across the region.
- IT can help make the appropriate analyses through e.g., visualization.
- IT removes dependence on individuals.
- Finally, the IT-system should cement behaviors connected to HCPC.

With IT comes the importance of input data, and this encompasses many different dimensions. Lack of good data makes it difficult to learn from the past, which is important for HCPC according to the interviewee. When data is good, dashboards are a great way to follow how well your organization performs and what is working and not. This applies to tactical, operational, and daily control. Deviation from plan is a very important measure to follow but the interviewee believes it can require several planning rounds for it to level out after you've started with HCPC. It is a learning process but should be self-regulating if you have continuous follow-up of your deviations, sooner or later you will do something about it. The interviewee claims that this sets a good foundation for controlling of the department, you might start to think about how you can make people work more similarly and efficiently:

"I took part and project a couple of years ago where it differed significantly in the number of surgeries per doctor and day. Some did 3 to 4 surgeries, and some took much longer and only did 2. That is a big difference for a breast cancer patient. Then a standard of four surgeries per day had to be established for these specific operating theatres. They had to train themselves to be faster and some had to do changes in order to address the times needed for the surgery" (interview E)

Selection of products to plan around is not straight forward according to the interviewee. There already exists different descriptive nomenclature such as DRGs²¹ (diagnostics-related groups) and ICD-10-SE²². One must decide what makes sense and simplify so that one has a manageable number of products, and that might take some iterations. Interviewee E argues that for each product that is used to plan, one should ideally be able to connect how long something takes, who should do it, and what rooms and equipment are needed. Measuring process times can be a foundation for defining HC products. The ideal case is that you can calculate an average time for e.g. a surgery and then there is a signal so that the correct tools, room and instruments are in place when it is time for surgery. Well-established time stamps are already there on quite a few surgeries.

²¹ DRGs are used for regional monetary compensation to HC providers.

²² ICD-10-SE is a classification system of diagnosis codes used for development of HC statistics. Many HC providers are obliged to report according to the system.

Ideal production data should also include a way of logging competence matrices, according to the interviewee. It allows you to connect that to the production of health services. In the matrix, it must be established what knowledge, and hence capacity for e.g., certain procedures, you have in your organization today, and might need to develop for the future. Management should make sure that they have the right investment in competence and work with knowledge management and development, to ensure they can handle the daily operations. Today the interviewee believes that a lot of the knowledge around competences is silent, resulting in only certain people being able to make a schedule. Traditionally, responsibility for scheduling has been seen as an important step to progress in your career for doctors, and it can be a sensitive thing to change. Considering the culture in general, the leader needs to clearly communicate the aim with HCPC to the organization.

Forecasting is not necessarily difficult. It was made clear in interview E that HC departments generally are way more plannable than they think. Even emergency care has little variations over time, although it can vary from hour to hour. Establishing the needs can lead to big improvements in matching demand with capacity: *"Schedules adjusted to the clinic's operations and patient arrival was the first thing I changed at an emergency clinic"* (interview E). However, the possibilities for external data integration to further improve forecasts of need should not be underestimated. The interviewee gives two examples: *"Day-to-day there could be forecasts based on weather data so that we know that there will be a rise in incoming hip fractures"* (interview E); demographics can give an idea of what kind of need there will be for different care efforts. This is done on the political or strategic level but the connection to the tactical level is not smooth. The many components of HCPC have strong relations to each other: *"The forecasted need should ideally be connected to our own competence development"* (interview E).

According to the interviewee, *"the maturity in the tactical level is low"* but he also claims that tactical control is a weak point: *"It is a broken system, we have the operative, daily and strategic levels but no way of communicating in between these levels."* He means that one cannot send unsolved problems from the strategic level downwards, because the receiving end (right know) is instead focused on the operational and daily perspective. Co-planning of common resources and a common planning horizon for scheduling with nearby specialties are examples of what needs to happen at a tactical level. Some issues that individual HC departments or clinics face on their tactical level are due to the lack of coordination and commonality across departments. Someone needs to move their gaze: *"The more mature you are, the further forward you need to move your gaze. If your gaze is still on the emergency all day long, the entire management are just looking at the same point. That is a waste."* But he also emphasizes the importance of having a smart leader: *"A departmental manager has to look further. (...) We have to ensure that we have investments in both capacity and skill development so we can handle the daily operations"*.

This leads us to a discussion of meetings. The interviewee argues that daily control is a leverage for tactical control. A facilitator in this is a structure for daily meetings, so called pulse meetings, where key activities are followed up. Well-functioning daily meetings are proposed in Interview E to be a leverage for effective meetings on an operational and tactical level. There should be synchronizing meetings resulting from daily meetings with different sets of managers. In general, there is also a need for patient group meetings and specific meetings for common resources. There must be adherence to common planning horizons, but also well-established links upwards and downwards in organizations, which some IT-systems can facilitate.

Some routines around HCPC are straight forward. The interviewee exemplifies: *"Traditionally we've had shorter scheduling periods. The patient could call a clinic to book an appointment only to get the*

answer: ‘We have not released a schedule for that yet, so we cannot offer you a time’” (interviewee E). Whilst one should be able to book beyond the scheduling horizon, the interviewee suggests that a longer scheduling horizon of around 13 weeks should avoid this. The interviewee ends the discussion with a note on agreements: for a full integration of HCPC there must be agreements in place between departments on expectations and volumes and such agreements need to be preceded by an actual need. A summary of the maturity content covered in interview E is shown in Table 4.6.

Table 4.6: A summary of the maturity content covered in interview D, divided into categories.

Category			
Culture & Organization	Routines & Structure	Measurements & Control	IT
<ul style="list-style-type: none"> •The aim with HCPC should be clearly communicated by the leader. •Change efforts have historically been dependent on individual enthusiasts. •Scheduling responsibilities can be sensitive to change. •Management responsible for long term investments in capacity and competence development •The leader has an important role in tactical planning. 	<ul style="list-style-type: none"> •Meetings are needed at all hierarchical levels. •Links between meetings at different levels are needed. •Meetings for patient groups and common resources are needed. •Schedules should be produced with a horizon of 13 weeks. •Agreements around volumes are needed between departments. •HC products should be selected carefully and be a simplified reflection of reality. •For each defined product there needs to be established resource requirements. •Products can be defined based on process times. •Competence data needs to be clearly established and documented. •Silent knowledge as a basis for scheduling is inefficient. •Departments are plannable and forecasting is easy. •Schedules should be based on patient arrival and the clinic’s operations. •The tactical level needs higher maturity. •The absence of tactical planning creates a gap in the planning structure. •On a tactical level, co-planning must be done. 	<ul style="list-style-type: none"> •Innovation will be needed to improve resource utilization. •Continuous follow-up of deviations should be done. •Deviations from plan is important to measure. •Visualization of deviations in ways of working is important to measure. •Some deviations can be self-regulating. 	<ul style="list-style-type: none"> •Internal resource requirements and competence data should be linked to IT. •Dashboards are efficient for visualizing data at all hierarchical levels. •Data quality and registration must be improved to establish a single source of truth. •IT systems should efficiently analyze the data. •Patchwork of different IT-solutions is an obstacle for collaboration. •IT can remove dependence on individuals and separate excel sheets. •IT requires correct input data.

4.6 Interview F - Development Manager, Karolinska University Hospital

The interviewee is a surgeon working for the Karolinska University Hospital in Region Stockholm. He is no longer clinically active but is instead occupied part-time (50 percent) in the department for HC development. He is responsible for both the implementation of the capacity system Tessa as well as HC- and IT-related questions for the entire hospital. In contrast to other Swedish HC regions, the

corresponding organization in Region Stockholm is quite different. Here, each hospital is considered a standalone entity with internal governance and management. This allows the internal relationship within each hospital to become quite good, but a plausible trade-off is consequently that similar clinics at different hospitals might be more separated from each other. In the region, HC volumes²³ are ordered centrally and are later transferred to budgets and missions for each care centre using so-called DRG-scores (Diagnosis-Related Groups). This system informs how many HC events²⁴ each hospital (and its clinics) should accomplish over a certain period. If the forecast turns out to be misleading or incorrect, the hospital can trade such care events with other hospitals to keep the regional production at the decided level.

4.6.1 Drivers to HCPC

According to the interviewee, the main driver for working with HCPC is administrative purposes. He argues that the management team for Karolinska University Hospital are the most responsible for HCPC. But despite this, each organization is also well-involved. One of the main problems concerns the model for allocating care events in Region Stockholm. These events are not further specified than counting how many care events are ordered for each hospital. From the interviewee's perspective, a much better categorization of these is needed. HC events differ substantially, both in terms of time and money: *"A healthcare event can have a duration of five minutes, but also two hours. Its cost can vary from 100 SEK to 100.000 SEK."*

4.6.2 Maturity Model Design Reflections

According to the interviewee, a well-designed MM for evaluating HCPC is rooted in the possibility to evaluate some crucial abilities. As examples, he claims that abilities concerning management, control, and organization must be assessed, and that it should be required to perform well for all these abilities. The overall assessment must be based on the weakest ability. In addition, he believes that a question-based review with a general and pragmatic focus might be good.

4.6.3 Maturity of HCPC

The interviewee stresses the importance of having a leader that challenges old mindsets and cultures (see Table 4.7 for all statements and suggestions) A manager or leader must create enthusiasm among their employees and be convinced that they together can create a change. He is convinced that one must lead by example and that engaging co-workers to contribute not only is vital for controlling bad measurements, but also to create a substantial change in the organizations culture. On this note, organizational competitions are specifically addressed as something that must be changed to cross-functional cooperation, especially since they obviously are connected to production throughput. He exemplifies how it may sound: *"Before we started with HCPC, people talked about each other in the corridors: 'That urologist cannot have our free production capacity. We are not going to do surgeries this Monday, but do not tell him'"*. The interviewee also means that unofficial resource priorities have caused some organizations to not make optimized schedules. Therefore, transparency in the scheduling process is also recommended for strengthening the culture and production. But for the interviewee, it is not enough to consider the leader and the culture regarding the organization. Competences in the organization must also be reviewed. For him, logistics competences like working with processes in a stochastic environment, forecasting, and scheduling are scarce today. HC managers are usually doctors

²³ Specific word used in Region Stockholm. Swedish: *vårdolymer*

²⁴ Specific word used in Region Stockholm. Swedish: *vårdhändelser*

or nurses and are not educated in logistics. Besides, when for instance, doctors are responsible for scheduling, they do not have the same time to work with more customized tasks. The interviewee therefore states that *"...there is a need to educate engineers in healthcare and hospital logistics."*

Making a production plan normally starts with the forecast. The interviewee is of the opinion that one must have patient processes in mind when the demand is planned. In other words, upstream patients should be included in the forecast. He also believes that the selection of HC products is a key component in suitable production plans. A plan should be based on groups of care services and not all possible patient cases. Therefore, it is important to know how to name the products. He thus gives examples of categorizing them after the activity executed ('surgeries' or 'appointments' for instance). In addition, the interviewee pays attention to the internal resources required to produce that product: *"The dimensioning of products is in fact an estimate of how much capacity should be in place, and what competences are required to fulfill the task. That dimensioning is an important input to the scheduling system"*. He exemplifies 'capacity requirements' with beds, operating theatres, staffing, costs, and rooms and explains that a care flow first can be optimized when it is correctly categorized, preferably with the support of an IT-system.

The next step is to know what HC demand to cover. Therefore, agreements regarding staffing, e.g. *"this department needs to be manned with seven full-time doctors Monday through Friday"*, must be made according to the interviewee. But they must also be made regarding how much time to spend on different work tasks. This way, the department can make sure that enough time is spent on e.g. research or patient appointments. In addition to agreements around scheduling, the interviewee also discusses co-planning as important for securing the right capacity: *"We have to promote a holistic view, take common decisions and collaborate."* He means that there should be an organizational platform for this, but also where department managers can come together and help each other out when there are gaps between capacity and demand. In this situation, it is suitable to have good tools for data visualization. And on this note, excel is not recommended since it becomes too manual. But covering demand is also about balancing on a yearly planning horizon, something that has to be further broken down before matching it with capacity and scheduling. This must be done for all levels of planning, and the organization must support that.

According to the interviewee, there is not so much of a challenge to create a feasible production plan. Instead, the challenge is to control this plan. He believes that it is crucial to act upon deviations, but also to get help from co-workers for doing so. He stresses the need for making adjustments based on data, and that they potentially can be made for all planning levels (tactical, operational and daily). Quite often, these adjustments concern resource schedules, especially when a department underperforms or when the demand indicates so. One measure could then be to borrow capacity from another department. The interviewee also underlines that changes must be included in a new production plan, that they should be considered between planning rounds only, and that there should be a plan for when next year's plan is developed.

A summary of the maturity content covered in interview F is shown in Table 4.7.

Table 4.7: A summary of the maturity content covered in interview F, divided into categories.

Category			
Culture & Organization	Routines & Structure	Measurements & Control	IT
<ul style="list-style-type: none"> •The leader should challenge old mindsets and cultures as well as create enthusiasm for HCPC. •Competition between departments is destructive for HCPC. •The scheduling process needs to be transparent. •The organization must support balancing on all planning levels. 	<ul style="list-style-type: none"> •The upstream demand must be considered as forecasts are made. •HC products should be grouped efficiently. •HC products must contain the right information about internal resource requirements. •It is not possible to optimize if HC products are not specified correctly. •Agreements regarding scheduling must be in place. •Co-planning is needed to secure the right capacity. •There should be a plan for when next year's plan is developed. •There is a need for cross-functional cooperation and a holistic view. 	<ul style="list-style-type: none"> •Controlling a production plan is an important task. •One must act upon deviations. •One must control by making adjustments, especially regarding schedules. •Changes must be included in upcoming plans and only considered between planning rounds. •Adjustments must happen for all planning levels. 	<ul style="list-style-type: none"> •Optimization benefits from an IT-system. •HC products are preferably stored in an IT system. •Visualizing data with more sophisticated solutions than excel is necessary.

4.7 Interview G - PC Consultant and Researcher

Interviewee G has studied chemical engineering and holds an international certification in logistics. She was a production manager for different manufacturing companies before she started working with PC at Skåne University Hospital, in Region Skåne. There she was a unit manager for 'healthcare production control' when she started in 2012. That mission was eventually shut down why interviewee G then wrote a course book in HCPC (Rosenbäck, 2017) and started her own company. The course book has been a central literature source of the thesis, and the dependence of these two sources (empirical and literature) must be understood. As a consultant, interviewee G now holds training and does consulting work within HCPC for several different regions. She is also a recognized expert at the public health agency ²⁵ contributes to NBHW's projects about HCPC and is a doctoral student at Mittuniversitetet. She currently spends most of her time doing research.

4.7.1 Drivers to HCPC

According to interviewee G, the main driver for adapting PC is to create structure and control. Right now, her standpoint is that the HC does not really know costs or what is needed to produce HC. On a regional level, increased efficiency is a driver for PC, whilst for management level at HC departments, a driver is simply the desire to learn more about their operation and 'business'. There is a lack of structure and system thinking in HC today to which HCPC could be a remedy. Today, focus is on HC needs rather than capacity, and that gives issues: plans are based on need and not what care you can produce.

²⁵ Swedish: Folkhälsomyndigheten

4.7.2 Maturity Model Design Reflections

Her expectation is that higher maturity levels correspond increasingly more demands on the HCPC process. There is an opportunity to be more practical and concrete than the conceptual framework presented, e.g. with regards to the production plan, compared to the model presented in the interview.

4.7.3 Maturity of HCPC

The interviewee mainly focused on the control aspects of HCPC and its connection to measurements and follow-up, development of HC products and production plan and finally the scheduling operations. A summary of her thoughts can be seen in Table 4.8. Forecasting was briefly discussed in the light of production plan development. This is something that is not done sufficiently in HC - forecasts need to be followed up upon in the light of the actual outcome. She argues that HC is easier to plan than many expect, and the interviewee further has strong opinions on the HC guarantee that she believes is a bad measurement and nothing you can use for controlling your organization. With the National HC guarantee, higher inflow results in a lower percentage that has waited more than 90 days.

Some remarks are made regarding the general competence in HC. The interviewee means that the highly qualified production personnel that doctors and nurses essentially are, creates a peculiar culture in HC. You have to respect their knowledge in every aspect, but at the same time more logistical knowledge would be beneficial in HC. Concerning culture, the interviewee addresses the idea that department managers are afraid of losing staff due to unwanted schedules. This is explained to be the cause of schedules where co-workers have wished for time slots, something she means is not wanted. On this note, the interviewee says: *"If you instead, consider structures around scheduling, less wishes will be put forward and it will be easier to handle it."*

The interviewee highlights the difference between measures of indirect results and production related measures. The appropriate way to measure and execute the actual control of HCPC is with a selection of production measures, and the primer is something that you can use for reporting on an overall level: *"Many discuss the reporting of waiting times and how they want to improve those numbers. Then I say: Yes, but that is a result measure, let's find something else to measure!"*. According to the interviewee, it is much better to bring control measures from the existence of a production plan. Measuring deviations against plan and how the input parameters for plan deviate from assumption is a good way to keep your production plan under control. Another aspect to consider is its feasibility: *"You have to measure that the production plan holds, that the input is intact and has not changed"*. Besides, *"At the tactical level, we want to ensure that the forecast we did was correct"*. It should also be noted that a production plan is something that should be developed even at a low level of maturity, whilst with higher maturity this feasibility becomes more relevant to follow up upon.

The interviewee also explains that measure is deeply connected to follow-up, but she quickly makes a distinction between PC and improvement work, claiming that many mix them up despite being different things: *"Regions claim that they work with increasing the capacity in their departments, but I do not consider that as production control since it is only an improvement initiative. It is really hard for the regions to understand this difference."* On this note, she explains that: *"If there is an issue with low capacity in a certain operation theatre, the first measure should be to make capacity adjustments with the departments involved."* As a second solution, one might instead return to improvement work: *"Then you can start thinking about how you make other operating theatres with more available capacity equipped for those surgeries"*. Focusing on PC, she clarifies that when a deviation is noticed it naturally

must be investigated and acted upon, but also that it needs to be prevented in the first place. She also explains that co-workers are specifically useful when controlling the different outcomes:

"I've perhaps changed my mind since I started working in healthcare. I would say I trust the HC employees more when they say that something has to be done in a certain way than I trust the strategic management who wants to standardize." (interview G)

Some specific control measures concern the production plan, and more specifically, the update of which when drastic changes in its conditions can be seen. First of all, this is important to also measure: *"On a tactical level, I would say that one measures the follow-up of the production plan. I.e, that the input to the production plan has not been drastically changed."* 'Drastic' practically means that the interviewee does not advocate for small updates all the time. In particular, the software support should not have the possibility to make such small updates automatically. The plan needs to be relatively stable in order to have something to follow up on. To give examples of drastic changes, they might concern improved technology, medical development, national directives, shortcomings in capacity, or changed processes. For all such changes, it is of importance to make updates and ensure that they are well-communicated throughout the organization.

HC products play an important role in production planning and the selection of such should be grounded in the organization's need. The interviewee refers to products as product groups, meaning a group of HC operations with similar resource requirements. Fewer and general product groups are usually preferred over many, and the product groups should consider capacity requirements. In addition, she also explains the product groups might be grouped based on similar routines or competences. But she also claims that a group with miscellaneous products might become relevant: *"In Stockholm, we gathered products that the department did not have any central agreement about within a common group"*. Maintenance of the product portfolio is additionally important, old products should be removed and updates should be done where needed.

The interviewee argues that planning should take place at individual HC departments and clinics, but that a holistic approach is important. Common resources are important to consider. To plan a surgical unit, all other departments dependent on surgery should have been planned first. That way you secure relevant input to the surgical department based on actual need. In short, there needs to be organization and clear routines around the distribution of shared resources. She claims that for simplicity you want to be able to plan each department individually, but then dependencies can be replaced by agreements on delivery specifications. IT systems should be able to account for the whole HC system, but today's systems are not developed with production data in mind and the data does not correspond to reality. In addition to this, a good plan will also be based on rigid and even forecasts. To have a forecast without heavy variations might be a problem for other industries but are dealt with quite easily in HC: *"Healthcare production is very even. It's no mobile phones (...) Healthcare is consistent over time!"*.

Not only does the estimated demand have to be considered, but the available capacity is also a focal point. First up, the capacity must be at place, then one can start making schedules: *"At the tactical level it is important to ensure that you have the sufficient capacity for production, before moving on to scheduling."* There are a few practical improvements that scheduling would benefit from. Scheduling should be based on agreements around the conditions for scheduling. Those can even be a control measure in itself. Responsible for scheduling is a role where a sense for numbers, structure, optimization and PC is beneficial, but on the other hand, the interviewee argues that anyone could schedule if some decisions are made on a tactical level and if competence would be mapped in a matrix. Today the role

is usually filled by practicing HC personnel which could create conflicts of interest as you schedule yourself and your co-workers. Besides, the co-workers have big mandates over their schedule, making scheduling an extra unsatisfactory role to have. Co-planning across different professions such as doctors and nurses should be praxis, at least have the same planning horizon with the limiting resource being scheduled first, so rescheduling does not have to take place. Finally, there is a need to align planning both internally and externally for each organization. The interviewee therefore stresses the need for co-planning and coordination of schedules between professions and resources. Besides, it is said that the leading resource should be scheduled first. As an example, to plan surgeries, all surgical sub-specialties must have done their planning first. Agreements around available common capacity is also something that must be made early in the planning since it makes it easier for individual departments to plan their operations independently. A summary of the maturity content covered in interview G is shown in Table 4.8.

Table 4.8: A summary of the maturity content covered in interview G, divided into categories.

Category			
Culture & Organization	Routines & Structure	Measurements & Control	IT
<ul style="list-style-type: none"> • Specific competences related to scheduling must be ensured. • Managers afraid of losing competence due to bad schedules might be a sign of a destructive culture. • Co-workers should be involved in decision making. 	<ul style="list-style-type: none"> • Product selection should be based on the organization's needs. • Product groups should be quite general and not too many. • Product groups could consider capacity requirements, routines, or competences. • The product portfolio should always be sufficiently updated. • When planning production, a holistic approach is preferred. That is, co-planning of departments that depend on each other. • A production plan should not have many variations built in. • Routines need to be established around shared resources. • Scheduling should be based on agreements. Routines for scheduling lowers the number of wishes. • Tactical decisions and competence matrices make scheduling possible to do for more resources. • Coordination is crucial when capacity is planned. • A production plan should be updated when it is caused by drastic changes. • Tactical planning should take place before scheduling. • The presence of a tactical level makes the operational level easier to work with. 	<ul style="list-style-type: none"> • Forecasts need to be followed up upon. • There is a difference between indirect results measures and production related measures. • Care guarantee is not a measurement to use for control. • Measuring deviations from the plan in a suitable production measure. • There is a difference between PC and improvement work. • One must ensure that agreements are adhered to. • Measure is deeply connected to follow-up. • Deviations from the production plan must be prevented, investigated, and acted upon. • It is important to ensure correct forecasts on the tactical level. • On the tactical level, the follow-up of the production plan must be measured. 	<ul style="list-style-type: none"> • IT systems must take entire HC systems into account. • IT systems must be developed with production data in mind.

4.8 Interview H – Representatives from the Swedish National Board of Health and Welfare

This interview was held with two representatives from NBHW, they will hence be referred to separately in the following text. Sevim Barbasso Helmers will be referred to as H1, and Sofia Norberg will be referred to as H2. When simply Interview H or NBHW is referenced, this is due to both interviewees being behind the thoughts presented, or them talking specifically about the NBHW and its official missions.

Both interviewees are working as analysts and project leaders for two different projects (assigned from the government) aiming at increasing access to HC by supporting regions with different issues. Interviewee H1 works at the department of analysis and handle strategic question by following up one of the central aspects when it comes to access in health care, namely waiting times according to the national Guarantee Act, and having a constant dialogue with the regions about their strategic work with access to health care in which HC availability questions are discussed. Interviewee H2, on the other hand, is project leader at the department of patient safety and readiness. One main purpose of her project is to create methods for HCPC implementation and develop HCPC tools and process support for the regions. The project started because of the need to close gaps between HC needs and capacity within HC, which increased after the Covid-19-pandemic. NBHW has the possibility to use government grants as a control instrument.

4.8.1 Drivers to HCPC

NBHW has, through the mentioned projects, the possibility to study incentives for working with HCPC. Interviewee H1 explains that structured planning is required for all relevant hierarchical levels - from Swedish demographics to resource-, staff- and appointment scheduling. According to her, problems with increased waiting times in HC have become a societal issue and many stakeholders (including inhabitants, HC workers, authorities, and politicians) want to find a good solution to the problem.

Because of its contacts with the HC regions NBHW can report that the Covid-19-pandemic has escalated some main challenges in health care. These are related to lack of critical hospital staff that in turn leads to decreased ability to use hospital beds that can be staffed with the correct competence. The effect of such situation can be prolonged waiting times to surgery, which the regions have indicated in their reports to NBHW, which in turn can lead to decreased patient safety. The situation with the pandemic has directly and indirectly affected the work environment of the hospital staff as well, especially due to less recovery time, for instance in terms of vacation.

Right now, many decision makers have understood that HCPC has an important role in this. From the regions' reports, NBHW has learnt that many HC regions work with HCPC to improve access to health care. This is something that NBHW going forward will support regions with. Many regions are facing difficulties with competence supply and are therefore eager to find ways to use their competences more efficiently and effectively. NBHW additionally has governmental missions focusing on the competence problems of health care and one of these is to develop a national plan for the competence supply of the health care system.

4.8.2 Maturity Model Design Reflections

The question about design reflections for the MM was never brought up with NBHW. The reason for this was their hierarchical distance from clinics or regions working with the evaluation of maturity stages.

4.8.3 Maturity of HCPC

For NBHW well-executed planning is signified by *“the absence of overcrowding, patients treated outside of the desired clinic, or waiting time at emergency departments”* (interview H2). The interviewees have many ideas on how performance of HCPC is best measured. Although regions are reporting accessibility measures, such as waiting times, production levels and hospital beds, to SALAR’s register one must be wary of the measures chosen. It is not easy either, one of the assigned NBHW projects are among other things working to define *“what information would give a comprehensive picture of the available capacity for hospital beds”* (interview H2). A focus on shortening the average time of treatment might lead to undesired consequences. Today quicker discharge from hospital to free up hospital beds can result in patients returning to HC soon after. Similarly, a desire of shorter waiting times according to the national Guarantee Act might imply that less complex patients are prioritized to show good productivity levels. But the criteria for a good HCPC *“should contribute to a balance between inflow of patients and outflow (healthcare services provided)”* (interview H1). Balance can be seen as an important discussion point and if a balance is achieved so will all the indicators of well-executed planning mentioned above.

Additionally, they stress the connection to a good work environment as something that needs to be measured and considered. Especially in the light of the pandemic and people not getting enough time to recover, but also relating to HC workers experience of that they had time to do what was planned. It that way work environment is tightly connected to good HCPC. Measuring the production is something that best happens close to HC departments and daily operations, at a national perspective the interviewees mean that you will have to look at more general indicators. The national Guarantee Act has been something that regions have to relate to but today the interviewees say that it does not have any consequences and is perceived *“as a goal rather than an obligation”* (interview H1). There is a need to create truly effective incentives nationally. NBHW is working to support HC regions alternative definition of accessibility goals and continuous follow-up of HC accessibility measures and providing guidance in appropriate measures.

There is additionally a need to be smart when developing and defining the data to be used for following up the production or tracking the available capacity. *“Reporting of data needs to be close to operations and it should not be a heavy administrative task”* (interview H1). Unfortunately, HC personnel must report in many different systems and registers today: *“you have the medical records software that you must keep track of. Some patients should be reported to certain quality registers and there are tons of other different systems that you should report to”* (interview H2). Interviewee 2 hence highlights a wish to be able to use the data you already have or translate it seamlessly to usable data. In practice it naturally is laid up in different ways across regions. Interviewee H2 says that HC in Sweden have *“way too many different systems today”* and there is generally a *“bad semantic and technical interoperability between the systems”*. Bad semantic interoperability is when there are different codes for the same thing and bad technical interoperability is when IT systems cannot communicate with each other. Seamless connections between different software are hence central and important for utilizing the data in a good way. Automation would be facilitated, and simulations can create an understanding for how different

variables affect future scenarios. Regions want help with developing accurate forecasts of HC demand. Interviewee H2 sums up the opportunity of IT and data: "There is a lot of data in the HC, but we could get better at using it for optimizing processes and flows".

HCPC involves decisions around everything from which professions should do which tasks, to how doctor's competence is best used and the surgical capacity optimized. Everything relates to how the available resources are utilized and developing ways of working. It is clarified from the interviewees that processes do not only relate to the patient's process but also the HC provider's processes. It is important to take a holistic approach and identify where the bottlenecks are and where unnecessary repetition of information and tasks happen. Ways of working regards to collaboration as well, you must establish "how we are collaborating with each other, between departments, within the region, between regions and nationally." (interview H1). Traditionally, there has been a pride for specialties to e.g. have their own IT systems. HCPC is described by interviewee H2 as a facilitator that visualizes improvement opportunities and bottlenecks. For visualizing the bottlenecks, appropriate and correct data is central. The hierarchical nature of HCPC is additionally highlighted: "HCPC needs to handle all different hierarchical levels down to the actual scheduling. From the greater picture of Sweden's healthcare needs down to 'Who should do what on Tuesday at three o'clock?'" (interview H2).

A summary of the maturity content covered in interview H is shown in Table 4.9.

Table 4.9: A summary of the maturity content covered in interview H, divided into categories.

Category			
Culture & Organization	Routines & Structure	Measurements & Control	IT
<ul style="list-style-type: none"> • A backlog of HC procedures is creating an understanding for the need to change 	<ul style="list-style-type: none"> • Decisions on how the available resources are utilized are decisions made within HCPC. • Establishing ways of working and slimming internal processes is important. • Platforms and structure for collaboration is important to define. • Collaboration can happen at a department, between departments, within the regions as well as between regions and nationally. 	<ul style="list-style-type: none"> • A balance between need and capacity is the aim of HCPC. • Direct effects of well-executed planning are not overcrowding, no patients treated outside of the desired clinic and no waiting time at emergency departments. • Focus on shortening average time in hospital and the national Guarantee Act can have unfavorable effects. • Work environment is connected to HCPC. • NBHW can support regions in developing appropriate measurements. • HCPC can visualize bottlenecks and improvement opportunities. 	<ul style="list-style-type: none"> • Data is central for HCPC. • Defining production data should not be a heavy administrative task, requiring separate registration. • Semantic and technical interoperability of IT systems is needed. • Seamless integration of IT systems is needed. • Use of data for automation, optimization and simulations could increase. • Tradition of wanting to use own IT systems needs to be counteracted

5 Expert Interview Analysis

In this section the empirical contribution from expert interviews is analyzed, considering the theory identified in the literature review. The findings from the expert interviews (i.e., the codes) are grouped into second order themes which, in turn, are grouped into aggregated dimensions that informed the identification of content for the maturity model. The exact phrasing of aggregated dimensions has been refined after the workshops. The final phrasing of aggregated dimension, that is used in the continued analysis, will be used to facilitate for the reader. The analysis of this section will motivate why the content should be included in one or multiple process areas, and what information would be required to complement the picture presented in the interviews. The development of the process areas and cell-texts based upon these aggregate dimensions will take part in section 7.3.1-7.3.4. In Table 5.1, all identified aggregated dimensions are displayed. These will also form the subsections of this chapter. For each of these subsections, a coding tree with the aggregate dimension and the belonging second order themes will be displayed. The entire coding tree (with all the codes) is instead shown in Appendix A.4.

Table 5.1: Aggregate dimensions and what subsections they are analyzed in.

Aggregate dimension found	Analyzed in subsection
Leadership for HCPC	5.1
Competences for HCPC	5.2
Culture	5.3
Product Definition and Internal Resource Requirements	5.4
Calculation of Healthcare Demand	5.5
Structure for Capacity Utilization	5.6
Timeliness of Planning Activities	5.7
Meetings and Collaboration	5.8
Measurements	5.9
Follow-up and Control	5.10
Software Support for Analysis	5.11
Systems Integration	5.12

5.1 Leadership for HCPC

Leadership in HCPC is important; a dimension that summarizes insights from interviews (Figure 5.1). It is evident that someone in the organization must have ownership of HCPC (interview A, B, & F). It is suggested that one person can have more than one role, but also that a distinct manager is needed (interview B & C). Hammer (2007) agrees and sets ‘Ownership’ as one process area in the PEMM. It is essential that one person devotes both time and focus to the process, but Hammer (2007) never specifies the process owner to be the top manager. Despite this, it is apparent that Hammer (2007)

believes that the process owner should take a leading role in the project in question. Such an engagement is also discussed by Kaltenbrunner et al. (2019) related to lean HC production, stressing that commitment is needed from the management and that decision making should involve the entire organization.

Interviews also pointed out that a leader must be able to both communicate the goals and purposes behind HCPC and show his/her devotion and conviction regarding it (interview B, D, E, & F). Having such an influential leadership is preferred over a commanding and controlling ditto (Hammer, 2007; Interview D), most likely because the workload needed will be much lower with good leadership. This connects to the final insight; important for leadership in HCPC is to lead improvement- & change initiatives and play an active role in creating a culture with a willingness to change and improve processes (interview A, B & F). Leadership carrying the culture is discussed as an important part for a positive workplace culture in HC (Stiernstedt et al., 2016). It is apparent that the HCPC leader should have responsibility that the appropriate actions to problems are taken. In the model presented by Region Östergötland, it is clear that a central unit can support in the introduction but the responsibility for planning in each clinic should be established early (Stiernstedt et al., 2016).

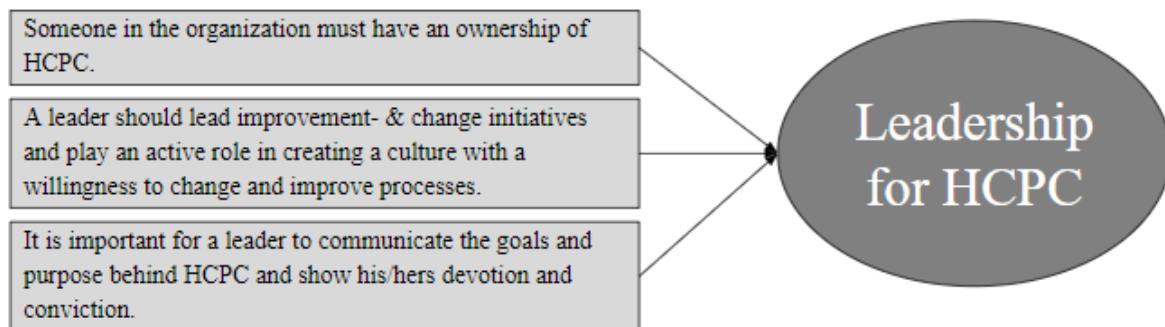


Figure 5.1: The aggregated dimension 'Leadership for HCPC' together with its second order themes.

5.2 Organizational Competences for HCPC

'Competences for HCPC' was another dimension found important (Figure 5.2). Many interviewees stressed that the logistics competence in general, and the planning competence specifically, must be secured for the department (interview C, D, E, & F). Wagner et al. (2014) agree, saying that an organization needs sufficient knowledge in S&OP, and Vereecke et al. (2018) stresses both possession and reinforcement of demand-related competences. But as there are not only logistics-related competences that must be secured, but also analytical skills must be at place in the organization, it is suggested that a controller can be of great help (interview B & C; Vereecke et al.; 2018). In addition, interviewee C stressed the inclusion of people with knowledge in HR and business development. A multitude of different competencies are important for HCPC, and many of them have to do with creating a change and analyze to make improvements, and not all has to be resources within the department.

In addition to securing competence, it is important to consider what is best for the department's when assigning roles. For example, having a doctor responsible for scheduling could be a waste of valuable resources (interview C and F), and that PC tends to become tasks for the scheduler without indications of suitable competences (interview F). Vissers et al. (2001), explain that the overall HCPC-goal for a hospital is to optimize the resource utilization whilst keeping service quality at an acceptable level. The solution to this is explained to be a focus in PC on the bottleneck resource - usually a scarce one used

for multifunctional purposes (Vissers et al., 2001). This rhymes well with improving the utilization of doctor's time as stressed by interviewee C and F.

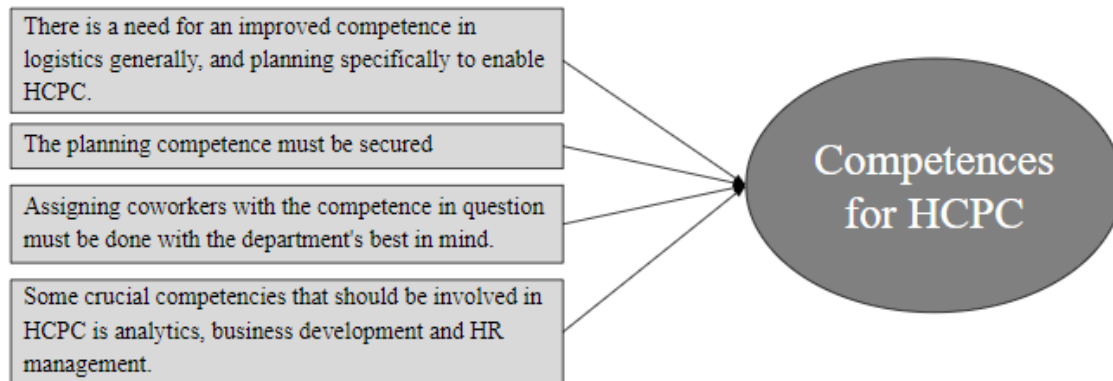


Figure 5.2: The aggregated dimension 'Competences for HCPC' together with its second order themes.

5.3 Culture

Culture in the organization was found to be strongly related to HCPC (see Figure 5.3). We did not find any support for this in the PPMs, but Hammer (2007) clearly stressed its importance for enterprise maturity. It is not necessarily an easy task to implement HCPC in a department. Interviews A, C, and E explain that implementing HCPC specifically will be complicated by cultural resistance. The term 'control' is something that creates irritation (interview C). Hesitance towards both big and small changes will additionally challenge the implementation (interviews A & C), additionally the willingness to change based on numbers is something that has to be there (interview C). The cultural dimension should not come as any surprise since they are well-discussed in e.g. change management literature regarding critical success factors (Alnadi & McLaughlin, 2021; Doom et al., 2010). In addition, 'attitude towards change' is also identified by Hammer (2007) as something that improves maturity. Positive work place culture in HC is proposed to facilitate the innovation and the identification of innovation opportunities, constantly seeking knowledge and inspiration from outside (Stiernstedt et al., 2016).

Collaboration between clinics and departments (e.g. between different departments sharing resources, or clinics that provide the same services) is not always smooth, and relationships can sometimes be hostile (interview A & F). Hans et al. (2012) additionally highlights managerial problems that come from HC departments being managed autonomously: lack of planning coherence and conflicting planning interests are acknowledged issues. The silo-mentality stemming from a strong specialization in HC has resulted in HC being hard to control (Stiernstedt et al., 2016). A healthy and strong feeling of community in a team, department, unit, clinic, or other constellation is often connected to success in HC organizations (Stiernstedt et al., 2016), and teamwork and co-workers' contribution is explained to improve the culture (Hammer, 2007; Interview A). However, a mature feeling of community is important, meaning that actors that you need to collaborate with should not be excluded. A common identity is best if it can include all actors that a professional must collaborate with (Stiernstedt et al., 2016). This perspective is additionally identified in the interviews: seeing your responsibility in the greater HC system is described as an important cultural change (interview A). This latter effect is in line with PEMM's highest maturity level under 'Responsibility': "Employees feel a sense of mission in serving customers and achieving ever-better performance.". Hammer (2007) clearly exemplifies how culture can be included in a MM.

Some cultural challenges are very specific to HC. For instance, it was suggested that there is no incentive for working efficiently in public HC today (interview F), or that “*a doctor will quit his job and move to another region if his schedule is changed*” (interview B). The previous are challenges to implementing HCPC, but the interviewees also explained that a lot of negative behaviors around e.g. scheduling can be avoided by implementing HCPC (interviews A, B, C, F, and G).

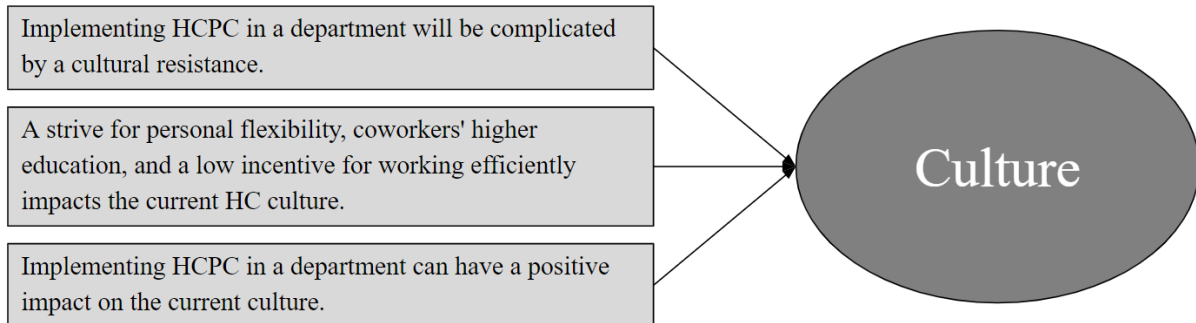


Figure 5.3: The aggregated dimension 'Culture' together with its second order themes.

5.4 Product Definition and Internal Resource Requirements

The importance of defining HC products is highlighted as an important tool for getting the most out of HCPC (see Figure 5.4). It can serve as a foundation for the development of a production plan and be used for control (interview A, B, D). Defining HC products and resource requirements is clearly an important step for structuring HCPC operations. The HC products should be carefully selected, which also means that there should not be too many different HC products to monitor. The product definition should be connected to internal resource requirements, i.e. its requirement of different resources such as staff, beds, rooms etc. This is done to calculate required capacity for products, a necessity for balancing between capacity and demand as pointed out in the conceptual framework and by e.g. Larsson & Fredriksson (2019). Hulshof et al. (2012) claim that the attribution of resource requirements is one of the first steps of tactical HC planning, describing it as creating a ‘blueprint for the operational planning’. It becomes clear that without this, it will be difficult to use the many different optimization algorithms and planning models available for resource capacity planning, an issue that was identified in the literature review. Well-defined products that capture challenges of HC and ways-of-working are important as highlighted by e.g. (Kellogg & Walczak, 2007; Kuiper et al., 2021) and, Hans et al. (2012). The literature shows the importance of accurate resource requirements, data quality in general is highlighted in interviews, see also 5.12 *Systems Integration*.

Furthermore, the analysis shows support for the fact that products and their resource requirements should be revised and maintained regularly (interview C, D, F, and G). Once again it is connected to keeping the data up to date: if control is made with poor information quality, the wrong decision will most likely be taken (De Snoo et al., 2011). This relates both to changes in the offered product mix (C, D, and G), but also to changes that have been made regarding the capacity dimensioning for each product (C and F).

Common resource requirements can serve as a foundation for product definition, but the exact way of defining a product can differ between departments and be based on different things (interview A, B, D,

E, G). If products should be used for calculating the required capacity, it makes sense that products are defined based on common resource requirements. Some choose to call the different products for patient groups (e.g. Hulshof et al., 2012; Vissers et al., 2001), and Rosenbäck (2017) choose to call them product groups. HCPC products can differ between departments (interview E) and be either process based (interview D) or based on e.g. whether or not you have a central agreement around that specific HC service (interview G). This makes it clear that the term ‘patient group’ might be misleading and that ‘product groups’ probably is more appropriate. However, as the grouping of HC services likely will be referred to with its aggregate name in an HCPC context, without any consideration of the HC services that are included in the group, the name ‘product’ is arguably sufficient. One interviewee even said:” Whether you want to call it product names or something else, is perhaps not so important” (interview C).

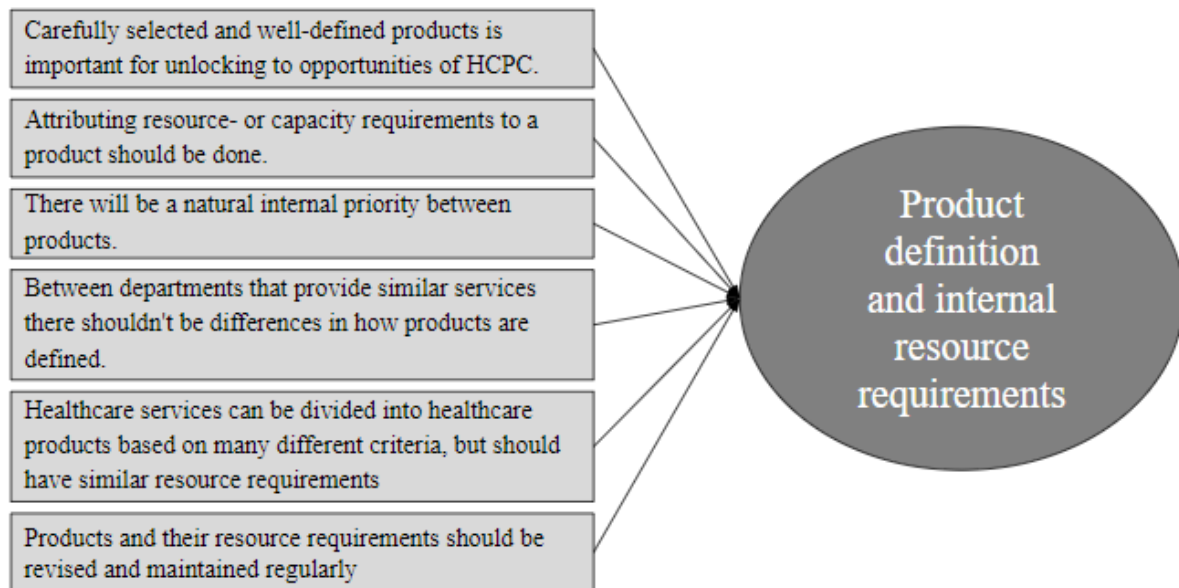


Figure 5.4: The aggregated dimension ‘Product Definition and Internal Resource Requirements’ together with its second order themes.

5.5. Calculation of Healthcare Demand

Regarding the HC demand, people believe that estimations of HC demand are not sufficiently based in forecasts and could be more properly done (interview B, C, D, G), see Figure 5.5. This is proposed to be both on a tactical level, for development of a production plan and operational level with regards to schedules. An interesting remark was made that you cannot base a plan on historic production data, if the historic production was not carefully planned, a forecast should be even (interview G). This is a natural connection to the next second order theme in Figure 5.5, that of HC demand to be even and generally plannable over time (interview A, B, C, E, G), with that comes the notion that development of a production plan should be simple (interview C).

The patient processes are included in the last second order theme, as something important to consider when calculating demand. Patient processes can be both within a department and between departments. This is very much in line with Larsson & Fredriksson’s (2019) three aspects for what future demand estimations should be based on: Unconstrained and consensus-based forecasts, downstream demand and backlog/waiting lists. The latter could not be confirmed from the interviews, but the inclusion of backlog/waiting lists in planning does make sense. Adding to Larsson & Fredriksson’s (2019) view is

the schedule being based on forecasts too. This highlights how balancing between capacity and demand should be a goal with resource scheduling, not only for production plans. Balancing is important at all levels, as can be seen in the conceptual framework. The demand calculation is what Vissers et al. (2001) refers to as an ‘Decision regarding patient flow’ at a tactical planning horizon, however relating to ‘Expected number of patients per patient group & Specialty’ and the operational decision is that of ‘Projected number of patients per period’, indicating that they too believe in a further breakdown of demand on a scheduling level.

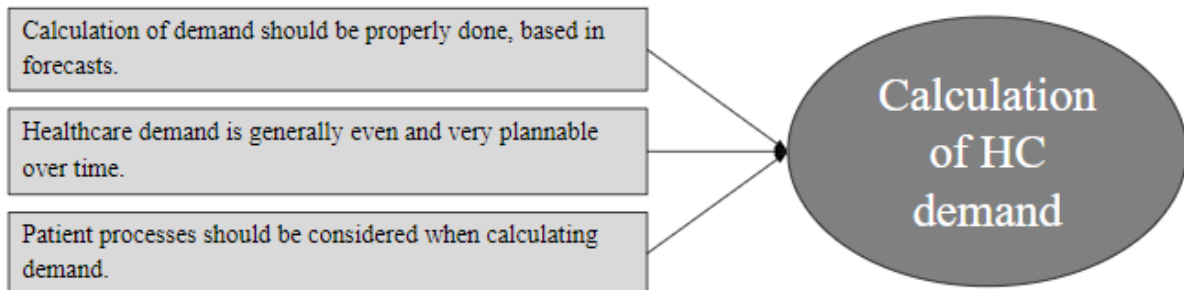


Figure 5.5: The aggregated dimension ‘Calculation of HC Demand’ together with its second order themes.

5.6 Structure for Capacity Utilization

The aggregated dimension of structure for capacity utilization were identified in interviews and is made up of four themes (see Figure 5.6). The first theme regards competences in particular: mapping of competences is important for calculating available capacity, guide appointment scheduling and long-term competence development (interview C, E, G). This is something that it seems not all HC departments do today, an already strained capacity situation can hence become more severe when competence suddenly is lost. A mature thing would be to have this mapped for long-term competence development.

The other three second order themes are relating to scheduling agreements, and more specifically three positive effects with the presence of such:

- Scheduling agreements allow anyone to make a schedule and counteracts many unfavorable behaviors related to the scheduling process
- Scheduling agreements should be established and is important for calculating capacity
- Transparency around scheduling agreements creates an experienced fairness and clarity

This is done reflecting on less good scheduling routines, such as scheduling being based on silent knowledge of competences and a scheduler having conflicting personal interests. Making scheduling agreements and competence mappings easily available is a good way of counteracting such. It is interesting how interviews highlight the mere existence of scheduling agreements, whereas literature presents a possibility of scheduling optimization algorithms (e.g. Hulshof et al., 2012). It highlights what is currently low maturity in capacity control, but agreements around scheduling is clearly a way to create more adherence to production plans and ensure balance of capacity and demand, as the second bullet point points out. Sections 5.10-5.11 additionally discuss opportunities to work more optimized schedules. Even with automatic scheduling, ‘transparency’ of what the schedule is based on and ‘counteracting of unfavorable behaviors’ would likely still be important for employees.

Included in the scheduling agreement are decisions on manning and staffing levels (interview F). Vissers et al. (2001) points out that resource decisions should be made at a tactical level regarding allocation of resources to ‘patient groups’ and decisions regarding resources at an operational level should specify the accessibility of specialist capacity. This is a good clarification of what scheduling agreements can constitute at different levels. At a tactical level, the agreements around staffing should be sufficient to create a rough-cut-capacity-plan that can be matched with a production plan (A. Larsson & Fredriksson, 2019), this was not highlighted from the interviews. The discussion around specialist capacity as proposed by Vissers et al. (2001) is however slightly limiting as e.g. nurses can be a critical resource. One interviewee said that an extra nurse for surgeries would be difficult to set a price on, since they are in dire need of that resource right now (interview E). The importance of decisions around capacity allocation should be clear after this section. Whether or not it is made by a computer or a human scheduler, is left for later analysis.

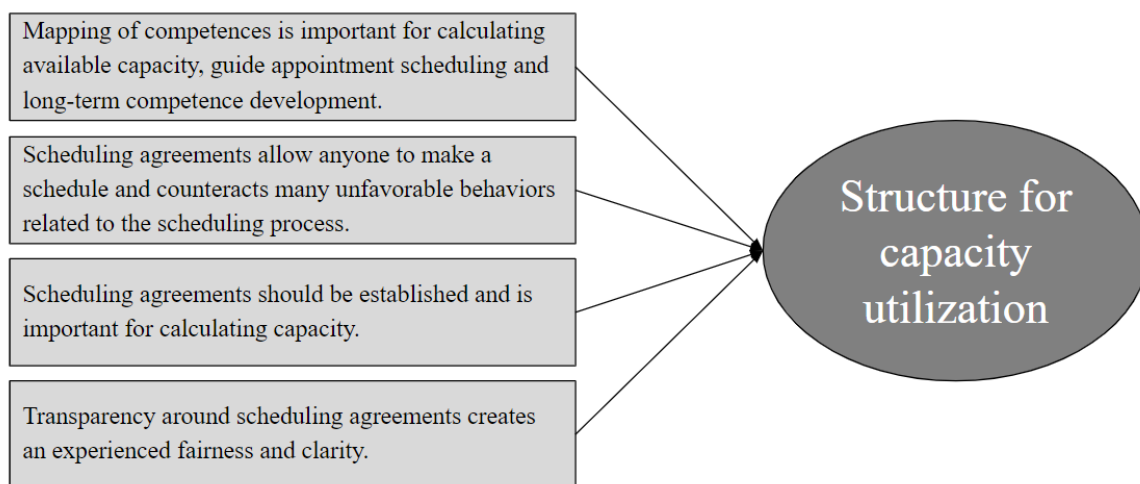


Figure 5.6: The aggregated dimension ‘Structure for Capacity Utilization’ together with its second order themes.

5.7 Timeliness of Planning Activities

Timeliness of schedule release was introduced as an important measure of a planning process in the conceptual framework. The identified aggregated dimension regarding timeliness of planning activities confirms the importance of this (see Figure 5.7). Having a resource schedule produced about 3 months in advance is something that interviewees from two different HC regions proposed (interview B & E). It was brought up in the light of traditionally shorter scheduling periods that has not been satisfactory (interview E). Further, there should be an overall plan for when things are done throughout the year (interview A, B, C, D & F). RJL is working towards an alignment around scheduling routines. Schedules should be released 12 weeks in advance, ideally with rolling updates meaning that there should always be 12 weeks scheduled (interview B). Some departments have strict routines set for when employees should wish for payed time off and vacation (e.g., interview A), this should not contradict a 12-week scheduling horizon.

Interestingly, not many talked extensively about timeliness of production plan development other than it should be done ‘yearly’ (e.g., interview F). The reasons for this could be many. The tactical planning level generally being immature might be connected to inexperience in proper production plan development routines. Alternatively, it can do with HC demand being even, see 5.5 Calculation of

healthcare demand, indicating that revisions of an old production plan might not be needed frequently. Further, if production plans are developed centrally, broken down from a strategic level, as is the case at Karolinska (interview F), the importance of timeliness of production plan development lies not with an individual department. Production plan development is however proposed to happen yearly with rolling updates by Rosenbäck (2017), whilst Vissers et al. (2001) indicate that the corresponding level should have a planning horizon between 3 months and a year, clearly connecting the cross-functionality to that level. It is however clear from that many interpret the tactical level to be happening before the resource schedule development, indicating a time-horizon of more than that of 3 months indicated in scheduling.

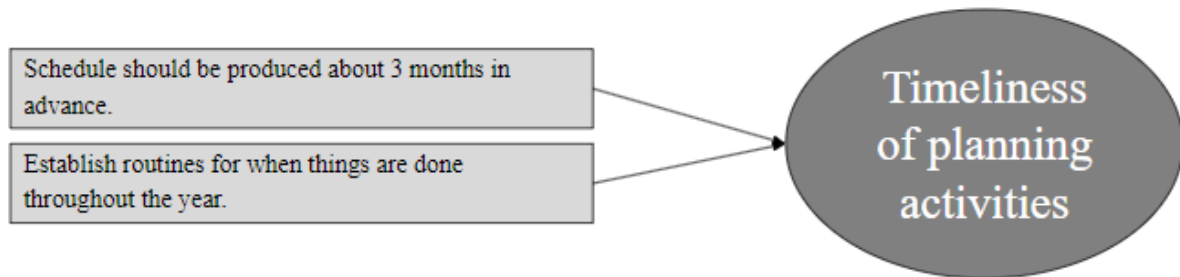


Figure 5.7: The aggregated dimension ‘Timeliness of Planning Activities’ together with its second order themes.

5.8 Meetings and Collaboration

Meetings and collaboration were identified as important from the interviews, see Figure 5.8. This is a dimension sharing a name with one of the process areas from the conceptual MM presented in Chapter 2. Meetings are an especially important routine and structure to be in place (Larsson & Fredriksson, 2019). They highlight meetings frequency, participants, planning horizon, planning object to be important of the meetings. The exact planning horizon was discussed in the previous section. In this aggregated dimension the need for common planning horizons between departments are highlighted (interview B, E & G), and the meetings should take place slightly before a new schedule or plan is rolled out (interview B). Coordinated planning between professions and resources should additionally be done (interview C, F & G), including a set order for scheduling or co-planning. Allocation of leading resources is additionally proposed by Vissers et al. (2001) to happen first, as they limit the planning of other activities.

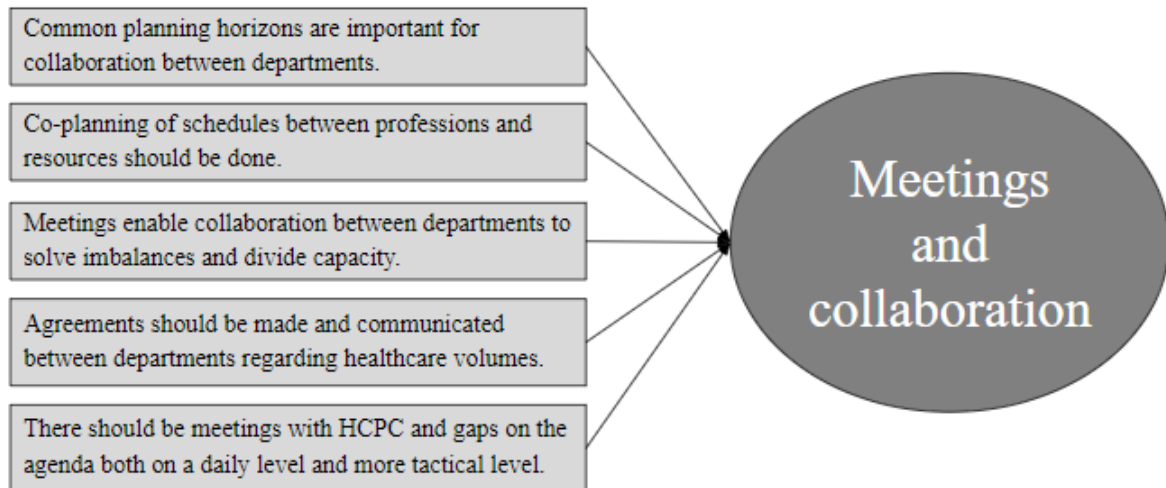


Figure 5.8: The aggregated dimension ‘Meetings and Collaboration’ together with its second order themes.

Meetings are further proposed to be a place ‘that enables collaboration between departments to solve imbalances and divide capacity’ (e.g., interview C, E, & F), see Figure 5.8. This is proposed by Vissers et al. (2001) to happen at a horizon of 1 year - 3 months, but interviews indicate that cross-functional meetings with this purpose not only should be with the production plan in mind, but also ahead of scheduling. In a collaboration between departments, it is further important that ‘Agreements should be made and communicated between departments regarding healthcare volumes. Communication is proposed to be especially important if it results in moving of demand and increased service volumes.

The mere presence of meetings touching upon HCPC and gaps is hence clear, the link between tactical, operational, and daily level are specifically highlighted in a final second-order theme: ‘There should be meetings with HCPC and gaps on the agenda both on a daily level and more tactical level’ (interview C, D, E). The links between different planning levels are also highlighted in the conceptual framework as a core part of HCPC definition, the communication of decisions and reporting of results. For example: feedback from previous planning rounds is important for next rounds (Larsson & Fredriksson, 2019). This second order theme stresses the importance of HCPC to be part of the agenda on meetings, as one interviewee put it: *“There are usually meetings on a tactical level where HCPC is not discussed (...) it can be good to bring in HCPC as an agenda point in existing meetings”* (interview G)

5.9 Performance Measurement

The literature review included a discussion of measurements both in the perspective of a process area in the conceptual MM and as a discussion of different kinds of measures. Figure 5.9 shows the coding tree for the aggregate dimension ‘Performance Measurement’. Two of the second order themes relate to the fact that there should be a focus on HCPC specific measures, rather than accessibility measures, just like the discussion in the literature review on effectiveness vs. efficiency measures (Hulthén et al., 2016) or indirect measures vs. measures related to the planning product or planning process (De Snoo et al., 2011). These two second order themes are:

- Measures related to HC accessibility are considered as result measures (interview D, G, H)
- The focus on result measures must be redirected to a focus on HCPC measures. (interview B, G & H).

The HCPC measures that you should measure can be specified in the next two second order themes: ‘You have to measure capacity and demand imbalances, and how actual outcomes differ from expected outcomes’ (interview A, B, C, E, F, G). This confirms that forecast accuracy and balance/feasibility are important measures, just as highlighted in the conceptual frameworks. High resource utilization is not directly mentioned but could perhaps be seen as connected to a good balance. Complementing this is the theme specifying that adherence to agreements around scheduling and capacity requirements should be measured and followed-up upon (interview A, D, E). This includes adherence to agreements made regarding both resource utilization of HC products and capacity utilization in scheduling agreements, should be measured. This connects ways of working to time-related goals and is important to ensure that the data used is of good quality. Measurements is hence connected to many other aggregated dimensions identified, connecting to data quality and the definition of HCPC data.

Interestingly, interviews found that an employee's working situation is important to measure (interview A, C, D, & H). This is an influencing factor that was not captured in the conceptual framework. The connection is made between a bad working environment and worse adherence to routines (interview A). Additionally, the equitability aims for patients in HC (Richardson, 2001) is translated into a measure of employees’ experienced working environment by creating equal opportunities and expectations across a region (interview A). HCPC’s opportunity to have a positive influence on the working situation is something that makes it an important measure (interview D & H). One can also interpret the consideration of employee’s working situation as a way to highlight that HCPC should not create a chaotic situation nor lead to employee’s simply having to work more. Cultural resistance would likely be aggregated in case of worsened working situations and the positive effects are important to put forward.

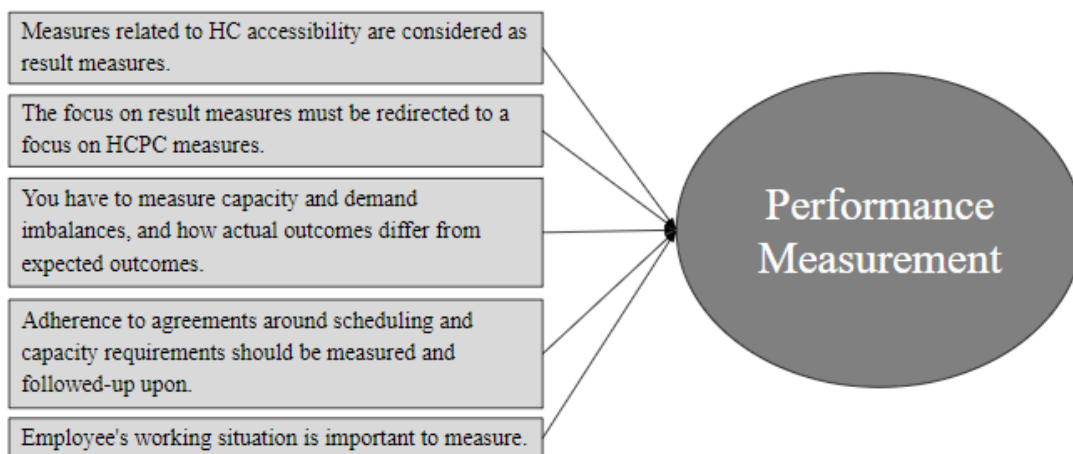


Figure 5.9: The aggregated dimension ‘Performance Measurement’ together with its second order themes.

5.10 Follow-up and Control

Following-up on measures and using them for control was an important part of HCPC identified from the interviews (see Figure 5.10). The importance for this lies in the definition of HCPC. As seen in the conceptual framework, control is proposed to happen both horizontally, in terms of balancing, and vertically, between planning levels (Rosenbäck, 2017; Vissers et al., 2001). The pure act that not only do you need to measure, but you also need to use it for control was identified as a second order theme (interview B, C, F, and G). It was further proposed that this interconnected process must be carried out continuously (interview B, C, F, and G). The importance of this is highlighted in the CMMI as SEI

(2010) where one of the highest levels are ‘Quantitively Managed’ explained as measuring and control being central.

HCPC can also draw attention to important improvement opportunities regarding capacity requirements (interview A, B, C, D, E, and G). It is stressed by interviewee G that there is a difference between improvement work and HCPC, and that it is unfortunate that some misunderstand this. The improvement work in itself must not be a part of HCPC, there is however no denying that starting to take a more quantitative approach to HC planning, which HCPC implies, can reveal previously undiscovered improvement opportunities. It will then be important to act upon these, especially with Swedish HC not performing as desired, see *1.1 Background*.

As stated above and in *2.5 Conceptualization of Literature*, the core of HCPC is to act upon deviations and imbalances (interview E, F, and G). This was highlighted in literature relating to MM too, taking place in both the conceptual MM and as a planning product performance measure. Connected to this are many other second-order themes relating to the toolset you have in place for balancing:

- Adjustments are necessary to create a balance between capacity and demand (interview A, F and G). This is also verified by Larsson & Fredriksson (2019), see figure 3.2.
- Using schedules as a control tool is a good way to balance capacity and demand (interview B, C, D, E, and F). As expressed by interviewee D: *“There is no way to connect actual needs with capacity without structure in scheduling”*.
- There should be agreements regarding specific actions and tools for balancing, in case of imbalances (interview A, C, and D). This creates proactiveness and preparedness for crises.

Improvements and the bullet points above all relate to working actively with the defined data, as discussed in 5.4-5.6, updating it and making tweaks where needed. Apart from control towards balance, one should consider the alignment between the production plan and schedules of staff and appointments (interview A, B, C, and D). For instance, interviewee B tells us that a sign of high maturity is that the amount of scheduled resources exceeds the capacity required in the production plan. This way one can hedge for unexpected situations, related to an increased care demand or a sudden loss in capacity. This connects to the vertical control of HCPC, as seen in conceptual framework, but is also highlighted in performance literature with regards to alignment to strategy (Hulthén et al., 2016). Throughout the control procedure, it is also of importance to involve co-workers in the changes and improvements (interview A, E, F, and G). They should act on measures (interview F), but also be consulted about big changes (interview A and G).

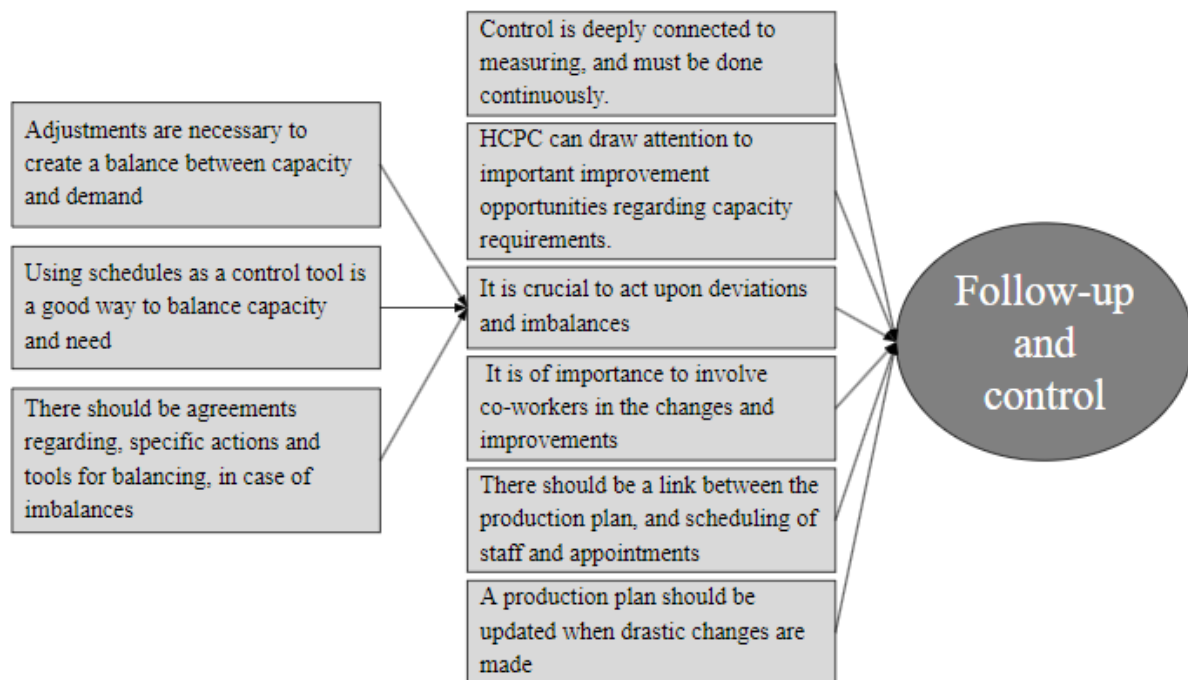


Figure 5.10: The aggregated dimension 'Follow-up and Control' together with its second order themes.

If drastic changes happen, the production plan should be updated (interview C, F, and G). The production plan is strongly connected to HC need: HC cannot limit the demand like a producing company can - when someone needs care, there should be capacity available to meet that need (interview C). With demand being even, so should the production plan. However, the feasibility of production plan (Larsson & Fredriksson, 2019) being important at tactical planning support that changes should be done when needed. *“If three people during a month quit, then we have to make a change to the production plan, or else it will not be feasible!”*, interviewee G exemplifies, whilst still stating that one should be careful with automatic updates as something relatively stable to follow-up against is still needed. The adjustments needed in this example are demand adjustments, as proposed by Larsson & Fredriksson (2019) these are: medical priority, re-scheduling, building queues, admissions planning (i.e., re-routing patients), and scheduling rules. Although contradictory when it comes to HC, there are possibilities to (temporarily) adjust demand and maintain production plan feasibility. In Sweden this is purposely done during summer in Sweden where production is lower, and queues are built (interview E). Similarly, if forecasted demand would be way higher than expected, capacity adjustments might be needed. However, updates to production plan should additionally be done in between planning rounds when new plan are created. Once again interviewee G exemplifies: *“Improved technology, medical development, national directives, changed processes, that is what can cause a change, all these should be incorporated”*. These will lead to changes in products' internal resource requirement, calculation of HC demand, or the structure of capacity utilization, indirectly affecting both production plan and schedule.

5.11 Software Support for Analysis

'Software Support and Analysis' was found important, see Figure 5.11. Software support is an important facilitator both when aiming for improved structure and data-handling (interview D, E, F). Naturally, it can be hard to uphold good routines, and as Interview E said: *“We believe that an IT system can help us to maintain the correct behaviors”*. Software support enabling good visualization of data is one

motive for software inclusion in organizations (interview A, C, and D). The visualization of production plans and patient flows (interview D), as well as visualization to get a holistic view (interview C) is proposed. Visualization could include some simplification, somewhat connected to visualizations is simulations. Those are explained to widen the understanding for how different variables affect future scenarios (interview C, D, and H), and could play a role since regions want tools for forecasting demand according to interview H. Wagner et al. (2014) explains that simulation support becomes relevant for the higher maturity levels. Good simulations and visualization require that the software support is able to handle data regarding products and their internal capacity requirements (interview B, E, and F). Perhaps this is seen as given in many other industries. ‘Products’ are usually taken for granted in the literature sources about MMs (e.g., Wagner et al., 2014; Grimson & Pyke, 2007). One reason for this could be that MMs consider physical products with well-defined materials- and resource requirements and organization’s whose IT systems are designed to focus on the flow of these products. HC is a service industry, and the central IT system is usually a medical records system.

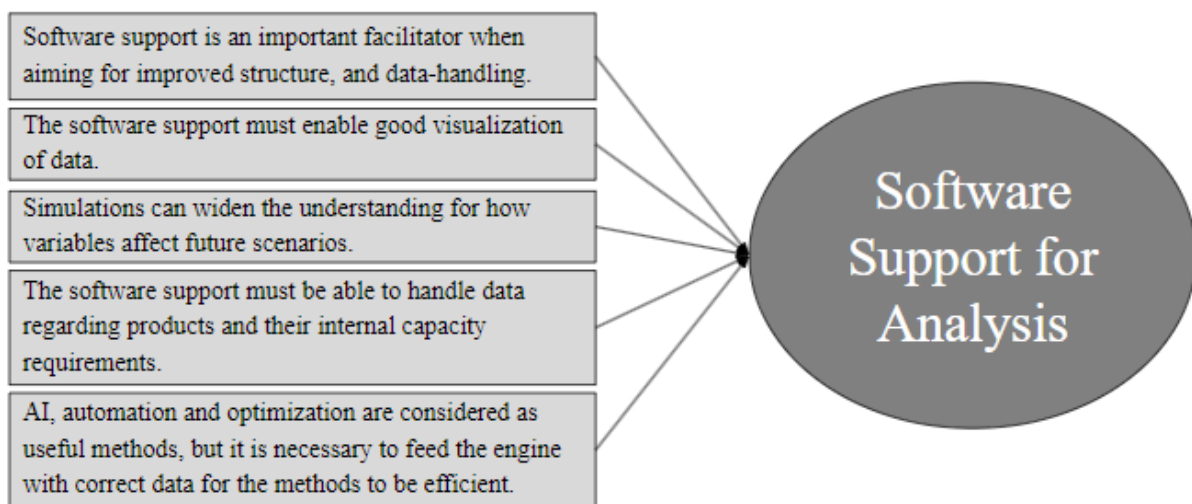


Figure 5.11: The aggregated dimension ‘Software Support for Analysis’ together with its second order themes.

With software support being able to handle products, it is possible to further analyze capabilities of software. There is a general belief that AI, automation, and optimization have the potential to become useful methods, but right now there exists a skepticism due to the data quality believed to not be good enough (interview B, D, G, H). This perspective on automatically generated solutions is shared with e.g., Kellogg & Walczak (2007), studying this for schedule optimization. The methods exist, but the implementations lag behind. Of course, the purpose of having an automatically generated schedule fades if someone manually has to study the schedules in detail before publishing (interview B). In addition, the volatile operational production is another phenomenon that creates uncertainty for e.g., optimization (interview G). Hans et al. (2012) take the explanation one step further, claiming that information systems for HC are not suited for planning and control.

5.12 Systems Integration

The previous aggregated dimension is a natural transition to the last aggregated dimension ‘System integration’ (see Figure 5.12). In order for HCPC to become properly integrated in a department or between departments, the need for effective technical systems increases. The interviews emphasize that the technical interoperability between systems used for planning activities and data for such activities are important (interview A, B, E, and H). What the interviewees request are things like the ability to

combine datasets, that different systems can communicate with each other, and (even better) that they are seamlessly connected (interview B and H). These requests rhyme well with earlier presented literature on the subject, especially claiming that systems connection and cooperation with suppliers and customers is of importance when maximizing the production outcomes (Grimson & Pyke, 2007; Hammer, 2007; Lapide, 2005; Wagner et al., 2014). It is also explained by Wagner et al. (2014) that interfaces linked to an ERP system is something worth aiming for. As discussed previously, the systems of HC today are not focused on such operations. A holistic view of HC is needed, but today's patchwork of IT-solutions is an issue (interview C, E, G & H). There is a widespread understanding that isolated systems need to communicate with each other (interview B and H), but there can be cultural obstacles here too, with a tradition around customized IT solutions for specialties (interview H).

Another perspective that is worth considering in order to get a good system integration is data quality. Data registration should be easy, and the data quality must be secured (interview B, D, E, and H). Information and data quality are factors that influence performance of planning (De Snoo et al., 2011; Hulthén et al., 2016). This is in line with the issue pointed out in previous section and extant literature, about the lack of practical usage of optimization and automation: there is low trust in data accuracy. Data registration is explained as something that should not be a heavy administrative task (e.g. interview H), since this already is the case today (interview E & G). Ensuring this and quality of data at the same time, can be identified as an important trade-off that has to be made, but some propose using existing data. HCPC requires the definition of some new data, as proposed by 5.4-5.6, and keeping it up-to date as highlighted in 5.10 *Follow-up and Control*, will be very important.

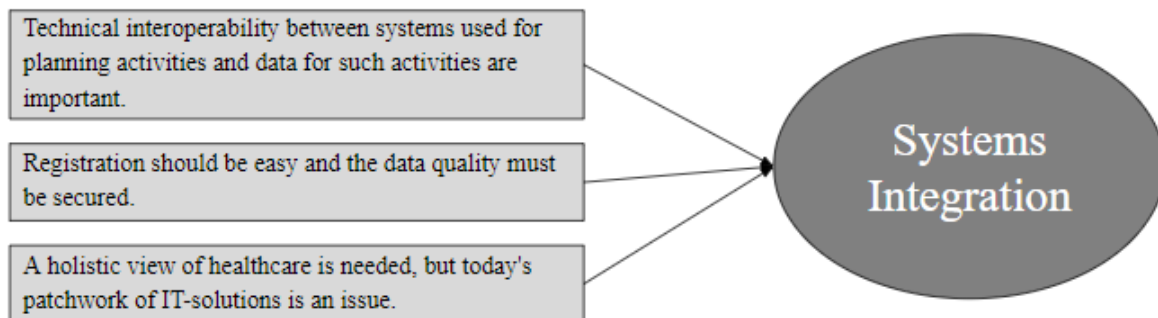


Figure 5.12: The aggregated dimension 'Systems Integration' together with its second order themes.

6 Workshops

The output from the expert interviews was a first version of the HCPCMM, something that was used as a discussion material when the workshops were held. Between each workshop, the HCPCMM was revised so that all suggested changes were analyzed and potentially implemented to the next version. The three workshops also had slightly different focuses, based on the focus groups and phase of the model development. To understand the output from the workshops, it is important to understand what the discussion of each workshop focused on. A summary of this is found in Table 6.1. More details on the focus area, the material presented, and the output of each workshop is presented under each respective subsection.

Table 6.1. The different focus areas for the three workshops, and the material presented during each workshop.

	Workshop 1 (Astrada)	Workshop 2 (Qulturum)	Workshop 3 (Practitioners RJL)
Focus area	Design selection Preliminary process areas and their content	Final evaluation Process areas, content	Process areas, content
Material presented before and during workshop	<p>Before: Plan for workshop</p> <p>During: Alternative model design</p> <p>MM-discussion from expert interviews.</p> <p>The set of process areas and their categorization.</p> <p>Conceptual grid MM with extremes for each process area.</p>	<p>Before: Plan for workshop</p> <p>Full MM with revisions incorporated from first workshop</p> <p>During: Alternative ways for evaluation</p> <p>The set of process areas and their categorization.</p> <p>Selected process areas of MM with developed content</p>	<p>Before: Background to project and plan for workshop</p> <p>Full MM with revisions incorporated from previous workshops</p> <p>During: Overall description of the maturity levels.</p> <p>The set of process areas and their categorization.</p> <p>Selected process areas of MM with developed content.</p>
Additional iterations after workshop	Were sent a copy of the MM version used in Workshop 2 and gave feedback orally	None, although they were given the chance to leave more feedback	None, although they were given the chance to leave more feedback

6.1 Workshop 1- Astrada

Workshop 1 was held with representatives from Astrada. The overall purpose of the session was to confirm a presumptive design for the MM and to get their perspectives on suggested process areas and cell-texts. Table 6.2 illustrate the changes made because of the workshop. The reader must however know that it was up to the authors to choose what and how the draft should be changed after evaluating the suggestions. This will also be seen in Table 6.2. One day before the workshop was scheduled to take place, a plan was sent to the focus group so that they could go through the workshop schedule. No other information was sent in advance, since we wanted to initially answer our questions without having seen our propositions. Throughout the workshop, we gradually presented the suggested HCPCMM.

Table 6.2: Changes made as a result of Workshop 1.

Area of discussion	Initially proposed	Opinions forwarded	Outcome	Comment
Model design	Use a grid model	Use a grid model	A grid model was used	Alignment
Model design	Use a grid model	Make an overview model as a complement	No complementary model was created	The HCPCMM already made an overview assessment
Cell-text formulation	Statements over questions	Statements in the cell texts and additional cell for facilitating questions	Statements in the cell texts and additional cell for facilitating questions	The suggestion was in line with the administration mechanism as well as many expert interviews
Process area overview	'Interoperability' as name for a process area	Hard to understand	A change to 'Systems Integration'	The authors agreed to the feedback
Process area overview	'Data Maintenance' as a process area under 'Measures and Follow-up'	Suggested move to 'IT and Data'	The content was incorporated to 'Systems Integration'	
Process area overview	Examples in the cell text	Suggested to put them in a separate column	Examples and Interpretations were put in a separate column	Made many cell-texts more concise
Overview, Maturity Level Name	'Standard' as the name for the intermediate maturity level.	Questions on what described standard.	'Active' as the name for the intermediate maturity level.	Only internal discussions affected the change.
'Organization & Culture'	Not clearly specified that the departmental manager has a HCPC responsibility	Suggested to clarify this	It was clarified	
'IT-support and data'	Different process areas for different IT-support mechanisms	Suggested to group them	A process area named 'Software Support for Analysis'	
'Meetings and routines'	Two different process areas: 'Routines & Systematics' and 'Developing a Production Plan'	Questions indicating that it might be hard to understand the areas in this category	A fusion of the two process areas to 'Developing Planning Products'	This will be changed further in upcoming drafts.
'Measures and Follow-up'	The process area 'Control' under the category 'Measures and Follow-up'	Suggested to move 'control' to 'Meetings & Routines'	The suggestion to move 'Control' was disregarded, but the process area was rephrased to 'Result and Agreements Follow-up'.	

6.1.1 Discussion 1 - MM Design

Despite having many indications for selecting a grid model, we initially presented alternatives for how the HCPCMM could be designed. We let the focus group discuss between a stepwise model (e.g., evaluated with a Likert-scale) and a grid-model with a descriptive scale. To further increase the transparency, the handouts from RJL and RÖ (see Figure 4.2 and 4.3 for RJL and Table 4.5 for RÖ) were shown. They contributed with perspectives on how discussion and possibly evaluation regarding HCPC maturity works today in the regions, something we wanted the focus group to keep in mind as

the discussion took off. Based on the discussion, the focus group came to the same conclusion as we had - that a grid model was suitable for this purpose. In addition, they also suggested a smaller model where only the maturity levels were described. This way, it could be possible to both study the evaluation in detail and get an overall summary. This suggestion did not result in any additional model, since it would be included as the maturity levels were defined (see 7.2.3 *Defining Logical Progression of HCPC Maturity*) and the overall assessment was made (rules for this were decided after the recommendations from Workshop 2).

Furthermore, we also discussed whether the content in the cells should be formulated as questions or statements. The conclusion was that statements best described each model cell since the text most likely could be more easily formulated. But in addition, questions were suggested to support each process area to facilitate internal discussions. This recommendation rhymes well with many suggestions from the expert interviews, as well as the administration mechanism defined in 1.4 *Problem Formulation*, and was therefore implemented. Just like Qulturum considers the usage of the HCPCMM, this workshop agreed that self-assessment should be complemented (or supported) by assessments conducted by, for instance, regional development resources.

6.1.2 Discussion 2 - Process Area Overview

The second area of discussion was prepared based on the idea that the focus group would agree to use a grid model for HCPCMM. Initially, we presented our proposed set of process areas and how we categorized them. A discussion then followed about whether it was possible to understand the topic of each process area, and if something would be better placed in another category. We got the feedback that the term ‘interoperability’ used in one process area would be hard to understand without written content, so this was later changed to ‘systems integration’. In addition, question also arise regarding the category ‘Measures and Follow-up’:” *Is control in regard to data? KPI:s? What do you mean with ‘data maintenance’? Does it not belong to ‘IT-support and Data’ instead of ‘Measures and Follow-up’?*” (P1.1).

This category was kept in the final version, but the content regarding data quality was found more suitable to include under ‘systems integration’. In addition to the process areas described, some questions also arise regarding the use of ‘Standard’ as a maturity level name. After internal discussions afterwards, we realized that naming the intermediate level ‘Active’ would be more beneficial. This way, the name would instead describe the ongoing process.

6.1.3 Discussion 3 - Process Areas Systematically Reviewed

This general overview of process areas was then followed by systematical review of each process area. Noteworthy is that the model suggested in this workshop only had cell-texts specified for the extreme maturity levels. This was to put focus on the boundaries of the maturity levels, and not to how internal maturity transformations would be deployed. For the category called ‘Organization & Culture’, a change in the description of responsible co-workers for the process was suggested. The focus group’s opinion was that the department manager always was responsible for HCPC, something that was confirmed by expert interviews but not clearly stated by the authors in this draft. The focus group also suggested that a column with interpretations and examples could be added to each process area. This suggestion was agreed to by the authors who believed that many cell-texts would be re-written more concise this way. Moving on with ‘IT-support and data’, it was suggested that a new process area named ‘Software Support for Analysis’ would group ‘Visualization and Simulation’ with ‘Optimization’. In

addition, ‘Visualization and Simulation’ would also include ‘Automatic Accessibility to Data’. This suggested change was considered an improvement of the HCPCMM and was thus implemented. For the third category, ‘Meetings and routines’, the focus group liked that ‘Meetings’ was declutched as an individual process area. But as some questions arise regarding the other process areas in this category, the authors understood that it would be necessary to clarify them even further. To the next draft, we therefore incorporated ‘Routines & Systematics’ with ‘Developing a Production Plan’ and changed the name to ‘Developing Planning Products’ (i.e., the three main outputs of the HCPC; the staff schedule, appointment schedule and production plan), knowing that further iterations might be necessary. Finally, ‘Measures and Follow-up’ was discussed. The process area ‘Control’ was suggested to be redistributed to ‘Meetings & Routines’, in a way that the process area ‘Agreements’ could be more included in that entire category. The authors however believed that it was of importance to keep ‘Control’ separated from the other routines and decided to instead enrich ‘Measures and Follow-up’ with statements about controlling the agreements. ‘Control’ was therefore rephrased to ‘Result and Agreements Follow-up’.

6.2 Workshop 2 - Qulturum

Upon the workshop with Qulturum, the HCPCMM had been developed with cell-texts for all maturity levels (In 7.3.1-7.3.4, it will be described how they were formulated for the final version based on 7.2 *Maturity Levels and Level Progression*). This was the first time that the content of the final model could be reviewed in detail, and that was an important part of the workshop’s focus. In particular the areas of agreements, development of production plan, staff and appointment scheduling as well as product development were the focus for review. These were areas where P2.1 and P2.2 had demonstrated a lot of knowledge during the expert interviews and where a common language was important to establish. As a grid model was selected, also principles behind a final assessment were discussed. It was of Qulturum’s interest that departments should be given a set final rating. The two main discussion areas were hence certain process areas’ content and the final evaluation of the model. Table 6.3 illustrate the changes made as a result of Workshop 2.

Table 6.3: Changes made as a result of Workshop 2.

Area of discussion	Initially proposed	Opinions forwarded	Outcome
Rules for assessment	N/A	Use the color green if a cell is completely achieved.	The color green was used for indicating complete achievement.
Rules for assessment	N/A	Use the color yellow if a cell is partly achieved.	The color yellow was used for indicating partial achievement.
Rules for assessment	A1: A level is fulfilled when a majority of the process areas are fulfilled. A2: All process areas must be fulfilled for reaching that level	No organization is better than their lowest score.	A2
‘Meetings and routines’	A process area named ‘The Development of Planning Products’	Planning products is hard to understand	the area was separated to ‘Routines for the Production Plan’ and ‘Routines for Scheduling’
Product Development’	Placed as a process area under ‘IT & Data’	Replace it to ‘Development of the Production Plan’	The suggestion was disregarded.
‘Measures and Follow-up’	A process area named ‘Result and Agreements Follow-up’.	Put more emphasis on ‘Control’	The process area was rephrased to ‘Follow-up and Control’

6.2.1 Discussion 1 – Deciding Rules for the Assessment with the HCPCMM

Regarding the final assessment they requested a way of visualizing the MM’s grading without all text. P2.1 suggested having a version with only colors for each level and process area and P2.2 suggested that the color of yellow could be used when a cell in the grid is partly fulfilled, and green when you fulfill the cell’s content. The color distribution at a certain level of maturity would then indicate what you should prioritize next. The focus group was presented with two different alternatives for final evaluation. One was based on total fulfillment of all cells of a level in order to reach that level of maturity, while in the other alternative you only have to check off a certain percentage to reach ‘level 3’. Figure 6.1 visualizes the differences between the two alternatives, and one should note that the second alternative additionally allows for weighting of different process areas. Upon reflection on their own organization the focus group agreed that you are not any better than your lowest score and that all cells of a level should be ‘green’ in order for you to reach that level. In their discussion a cell is only green when the content of a cell is fully fulfilled. Regarding putting weights on process areas, P2.2 said:

“If all areas are not equally important, the less important ones should not be part of the model” (P2.2)

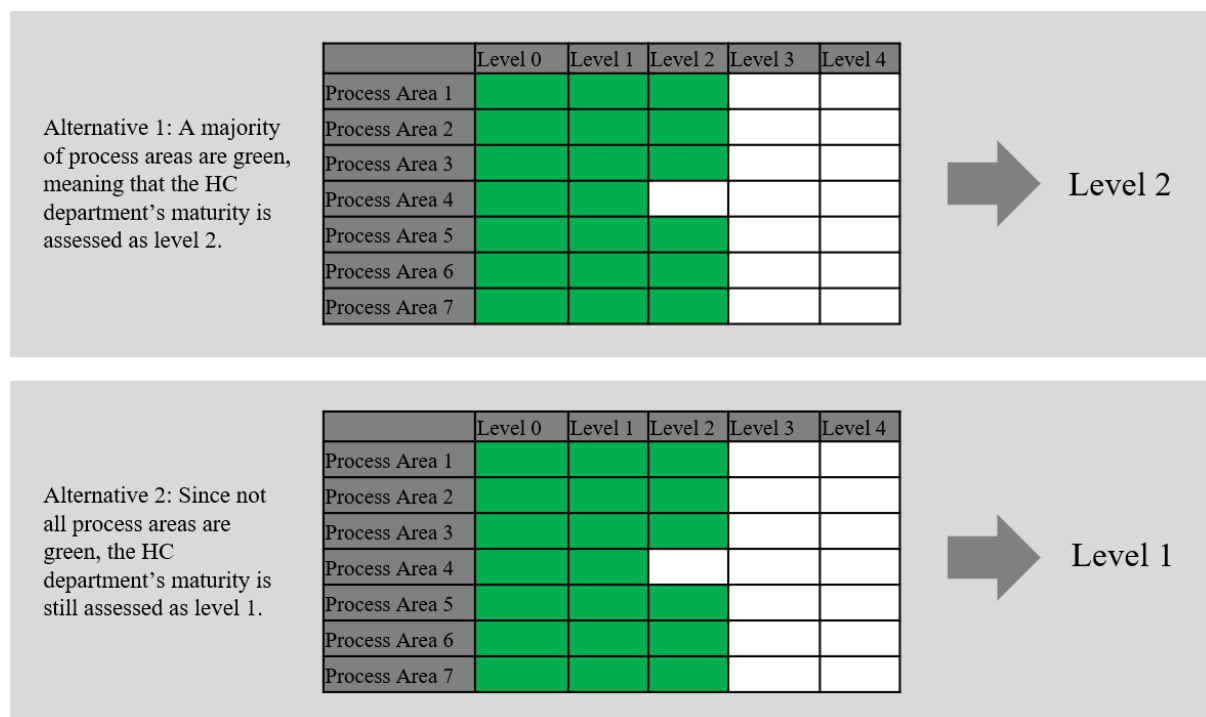


Figure 6.1: Two alternatives for how the final HCPCMM should be used to give a final maturity level evaluation.

6.2.2 Discussion 2 - Specific Process Areas

The three main outputs of the HCPC process, i.e., the staff schedule, appointment schedule and production plan, were at this stage called ‘planning products’, a wording that was met with some hesitancy from P2.1 and P2.2. A solution that would separate the different output processes to separate process areas was presented, with the suggestion that staff schedule and appointment schedule should be kept together due to their strong connections to each other. Sometimes clinics struggle to see the difference between the two. The authors emphasized that appointment scheduling is on a daily control level and not at the tactical/higher operational level, and P2.2 and P2.1 agreed. They say that the schedule should be put down 12 weeks ahead in time. In particular they highlighted that a higher level

of maturity regarding scheduling corresponds to understanding how scheduling translates to your total capacity and how co-planning between departments is important in order to achieve proactiveness. Considering proactiveness in general, we learn that: *“We cannot have ‘full proactiveness’ before the whole region is coordinated in the efforts around production planning”* (P2.2).

Product development was not easy to place in the MM. They recommended it be placed underneath the development of the production plan. The breakdown of a product's resource requirements, which is strongly connected to the product development and selection, does however have strong ties to ‘IT & Data’. ‘Resource requirements’ was a preferred word choice for describing how a HC product is broken down into its components personnel, time, equipment, rooms (compare e.g., bill-of-material). P2.1 clarified that it is not always needed to clearly define the competence needed for a product, sometimes appointments are not restricted to a certain seniority of doctors.

Finally, they had a desire for more of emphasis on the ‘control’ of HCPC. Something that is the most important differentiation at higher levels according to them both but acknowledge that it is hard to define. At a high level of maturity, you should be good at connecting actions to HCPC’s numbers and the problems connected to them. On this note, ‘Result and Agreements Follow-up’ was rephrased to ‘Follow-up and Control’ to, once again, consider control – a cornerstone of HCPC. This further motivates ‘Follow-up and Control’ as a separate dimension (as presented in *5.10 Follow-up and Control* and further motivated in *7.3.3 Measurement and control*).

6.3 Workshop 3 - RJL Practitioners

The final workshop was held with HC practitioners from RJL and two of its departments, oncology and skin. According to P3.1, both these departments were experienced KPS-users - a priority for us since that implied knowledge in the areas we were about to discuss. Initially, we expected participants from two more departments, but due to urgent staffing matters and sickness, this focus group decreased in size from the expecting six participants to four (Including P3.1 from Qulturum as well). One day before the workshop was scheduled to take place, material was sent to each participant via email. They all received the latest draft of the HCPCMM with revisions incorporated from the previous workshops, but also a document explaining the background to the project, a plan for the workshop, and remarks on how to use the model. They were not asked to use the model to assess their department, but to use this information to better prepare for the workshop about the content of the process areas.

In Workshop 3, the discussions took place right after the presentation of each process area. Due to lack of time, only a couple of process areas could be discussed. The selection of these was made after the presumed contribution from the practitioners. To give an example: ‘Culture’ was discussed since the practitioners obviously had ideas on how a suitable HCPC-culture is formed, but ‘Software Support for Analysis’ was not discussed since they were not expected to have opinions about that.

As the HCPCMM draft was reviewed, the focus group agreed that it was somewhat strange that the second highest level was named ‘Advanced’ instead of the highest level. In the discussion, we motivated how important it was to mark ‘proactiveness’ as the highest level of maturity and were responded with reasonable arguments regarding the meaning of ‘advanced’ and that it was more reasonable the other way around. We agreed that a change was necessary and after the workshop, we decided to change ‘Advanced’ to ‘Internally Integrated’, thereby avoiding that confusion completely (besides, that name also marked how the HCPC had progressed from ‘Active’). In addition, we also updated ‘Proactive’ to

better mark the difference from ‘Internally Integrated’. The name for the highest maturity level was thus decided to ‘Proactive & Holistic’.

Another observation concerned ‘Routines for scheduling’ and created additional discussion during the workshop. They all believed that time booking can be extended to more than four weeks (as described in the model). Besides, they also agreed that the model would benefit from a statement regarding medical priority as booking happens. The current formulation would namely make it unclear if one should consider this. Both these formulations were easily changed (and can be seen in Table 6.4 together with the change of level names). In general terms, the three practitioners, however, believed that the content of each presented process area matched their expectations and experiences from implementing HCPC:

- *“The text describes the journey very well. Culture is really important! You certainly need the co-workers on this journey.”* (P3.4)
- *“When you look at the model, you quickly recognize where we began. The word ‘KPS’ was initially hard to digest and the word ‘control’ broke us completely. Now, everyone has begun to understand it.”* (P3.3)
- *“Without doubt, agreements are important to make. Your developed maturity grade is reasonable, and I constantly connect it to our problems in the department.”* (P3.2)

Table 6.4: Changes made as a result of Workshop 3.

Area of discussion	Initially proposed	Opinions forwarded	Outcome	Comment
Overview, Maturity Level Name	‘Advanced’ as the name for second highest maturity level and ‘Proactive’ for the highest.	Questions on why ‘Advanced’ was lower than ‘Proactive’ since it potentially could have been the opposite.	‘Advanced’ was changed to ‘Internally Integrated’ and ‘Proactive’ Was changed to ‘Proactive & Holistic’.	Only internal discussions affected the change.
‘Routines for scheduling’.	Appointment scheduling should only be made for the four upcoming weeks.	They believed that this was not true.	The HCPCMM would only specify that routines for appointment scheduling existed.	
‘Routines for scheduling’.	That all patients are booked on the same premises.	The current formulation makes it unclear if one should consider medical priority, which is a necessity.	The HCPCMM would exemplify that medical priority is important for appointment scheduling.	

7 Development and Evaluation of Maturity Model

In this chapter, the main focus is a synthetization of the previous analysis and empirics into the HCPCMM. The different choices related to design, Maturity model levels, and cell-text formulation are discussed in the first sections. The development is based on literature, expert interview analysis, and workshops. Evaluation was done both through the workshops but also in a separate assessment round together with two new departments. The feedback from the separate assessments with the HCPCMM is already included in the discussion around maturity model development, but a complementing section discussing the findings from the assessments complement the already incorporated evaluation considerations in the chapter. Evaluation was also partly done during the workshops already presented and is hence a natural part of the sections discussing the design, maturity levels and analysis.

7.1 Design Selection

The literature review identified different designs possibilities for MMs, and our conceptual MM suggested to proceed with a grid model as the HCPCMM was developed. Some interviewees had requests regarding model design and those rhyming well with the purpose of creating a facilitating tool are shown in Table 7.1 (where similar opinions from the workshops also appear). During the interviews, all experts were presented with both the conceptual MM as well as the model by Grimson & Pyke (2007). This way, they both had the possibility to study our discovered process areas, as well as adequate cell-texts for a well-renowned MM. However, their reflections were naturally tainted from that exposure. From RJL (which is the primary receiver of the MM), it was clear that the HCPCMM should be a good basis for discussion. Interviewee C and Workshop 2 claimed that clarity and transparency for how to reach the next level was important. Compared to Grimson & Pyke's (2007) PPMM, the need to be more concrete in different steps was highlighted (interviewee G). She proposed to create specific sets of actions relating to HC and HCPC in particular. This would be a slightly atypical application of a grid model that often are general in their application and can apply to any industry without specifying procedures for processes (Maier et al., 2012).

After additional agreements during Workshop 1, the authors concluded that a grid model was desired, because it provides guidance and transparency for the users. Astrada employees further proposed a set of questions to complement the grid assessment, and similar viewpoints were put forward by several interviewees (B, D, E, and F). Non-grid models usually use Likert-scales, binary (yes/no) questions or checklists to enable assessment (Maier et al., 2012). The workshop's suggestion for questions was however interpreted mostly to guide the discussion. Such use of questions is seen in grid models, e.g., by Fraser et al (2003). Self-assessment could be work in an extensive and transparent grid model, but it was concluded that the most likely application would be that a centrally appointed individual assessed through discussions with representatives from the assessed department. Hence, questions were needed. Interviewee B emphasized that the cell-texts should be elaborate and easily understandable. She expected that the amount of such text would increase with as the level of detail did. Such criteria for the cell content, makes it similar to a checklist. Some grid models (e.g., Danese et al., 2017; Wagner et al., 2014) has an increasingly long list to fulfill for each maturity step and process area, showing that there are grid models with checklist-like content.

Alternating views were put forward. One interviewee (E) suggested that the assessed department should not have to see the grid. Another interviewee (F) put forward some criticism towards complex assessment tools, suggesting that reality is simple, and it only takes five minutes to figure out how

mature a department is with regards to HCPC. That represents a slightly different intent behind the MM, more focused on getting a final maturity rating. MMs could be used for certification of processes (Maier et al., 2012). However, as discussed earlier, that was not the main intent of this MM, but instead to facilitate internal discussions and inform about the maturity level.

Table 7.1: A summary of some aspects relevant for guiding the design of the framework

Assessment tool	Traits	Content
<p>A grid model is preferred (Workshop 1-2)</p> <p>The model should be equipped with questions for the assessment (interview B, D, E, F, Workshop 1-2)</p> <p>Questions need to complement a grid model (interview D, Workshop 1-2)</p> <p>External person that does the assessment with help of questions most likely application (interview E, Workshop 1)</p>	<p>Specific so that it can be used for final evaluation (Workshop 1-2)</p> <p>General enough to apply to several different departments (interview D)</p> <p>Good basis for discussion, and provision of clarity regarding what needs to be improved (interview C)</p> <p>Should be easy to understand what is needed to reach the next level (Workshop 2)</p> <p>There should be a clear summary of the final assessment (Workshop 1-2)</p> <p>A simpler overview of the grading is important (Workshop 1-2)</p> <p>Color-coding for visual effect (Workshop 2)</p>	<p>There is an opportunity to be concrete in efforts needed for different steps (interview G)</p> <p>Elaborate cell-texts should be in place for each level (interview B)</p> <p>Increased amount of content as maturity level progresses (interview G)</p>

One request from Workshop 1 was the option to give a final assessment of the maturity level. They requested a simpler summary of the model to complement a potentially text-heavy grid. The smaller version was proposed to include an overall description of the maturity levels. Workshop 2 further suggested that a summary with text emitted and replaced by color codes, could provide a good overview of the assessment and what areas a department needs to focus on. Such color-coded overview is presented e.g., in the PEMM (Hammer, 2007). A general description of the maturity levels of HCPCMM might complement such an overview (further discussed in 7.2 *Maturity Levels and Level Progression*). Rules regarding the final rating were brought forward in Workshop 2, and these were opted for due to their simplicity (see 6.2.1 *Discussion 1 – Deciding Rules for the Assessment with the HCPCMM*). There were no needs indicated for more complex evaluation algorithms, as no clear relative importance between process areas was identified. Rather, many identified process areas were intertwined; any internal weighting would be unnecessary complex to determine.

To summarize, it was found out that the HCPCMM:

- should be a grid model,

- should have cell-texts formulated as statements, but with additional questions for each process area,
- should preferably be reviewed by an external person and that internal discussions might be a suitable compliment,
- should use color-coded cells when it was assessed.

7.2 Maturity Levels and Level Progression

The choice of suitable names for different maturity levels was reviewed in the literature (2.3.4 *Maturity Levels of Relevant Maturity Models*). In the light of this, we suggested our conceptual MM (Figure 2.14) that used the same maturity levels as Grimson & Pyke (2007) did. When we now develop our final HCPCMM, the earlier suggested levels will naturally be discussed and refined based upon gathered empirics (Chapter 4 *Expert Interviews* and 6 *Workshops*). The discussion will arrive upon the following five maturity levels:

1. No HCPC
2. Reactive
3. Active
4. Internally Integrated
5. Proactive & Holistic

With these names selected, we intend to arrive at level names that are both distinct and illustrate a logical progression (Maier et al., 2012). Besides, the literature review also made it obvious that these levels normally create multiple interpretations of how to define them. To mitigate this confusion, we provide the readers with shorter definitions of each maturity level, found in 7.2.3 *Defining Logic Progression of HCPC Maturity* (Maier et al., 2012). But before that can be done, we also need to define maturity at a HC department level.

Based upon the literature review there are clear indications that *proactiveness* is a term that describes higher levels of HCPC maturity (Danese et al., 2017; Goh & Eldridge, 2015; Grimson & Pyke, 2007; SEI, 2010; Wagner et al., 2014) and should thus be an integral part of the maturity levels. The literature review further supports *reactiveness* for lower maturity levels, despite being defined differently between the literature sources. Both these terms would however be triangulated through the expert interviews: “*We need to be proactive rather than reactive*” (Interviewee C).

With the background above, we mean that defining maturity of HCPC on a scale containing ‘Reactive’ and ‘Proactive’ is easily motivated by the literature and empirics. But there is also a need to elaborate *proactiveness* based upon other important perspectives discovered. 7.2.1 *From Solely Operational to a Well-functioning Tactical Plan* will therefore address the perspective of tactical planning, and this will be followed by the other identified perspectives in 7.2.2.

7.2.1 From Solely Operational to a Well-functioning Tactical Plan

An important hypothesis from the extant literature was that of poor or insufficient tactical planning in HC. The issue of low tactical planning maturity (e.g., Hans et al., 2012; Kuiper et al., 2021; Larsson & Fredriksson, 2019) lead to problems being solved at an operational level (e.g., Hans et al., 2012; Kuiper et al., 2021; Rosenbäck, 2017). Almost all interviewees share this view, confirming the lack of tactical planning in HC (interview A, B, C, D, E, & G). It does, however, vary between departments and there are some islands with well-functioning tactical planning (interview B, C, E, F). It was hence possible

to identify several codes relating to aspects of tactical planning from the interviews (Appendix A.5), second-order themes relating to tactical planning could additionally be identified as seen in Figure 7.1.

Interviewees further confirm that the tactical level is needed to bridge the gap between an operational level and the strategic level (interview C, E, F, & G), whilst at the same time the operational plan needs to follow the tactical plan (interview F). Balancing should happen at all levels, but the tactical level balancing of demand and capacity creates the foundation for the operational level to work properly (interview G, E and F). One interviewee simply summarized it as the tactical level of HCPC is what takes place before the scheduling, that level should ensure that the department is sufficiently manned to adhere to HC production plans (interview G). This is in line with Vissers et al.'s (2001) description of decisions taken at the tactical level. The tactical level should be an active and dynamic tool (A, D, F, & G), to e.g., identify what manning is needed at different times (interview G). This theme is associated with following up and important analysis. The level is further a place where collaboration between departments is important (interview A, C, & E), like Vissers et al.'s (2001) definition of participants at the tactical planning level.

The **themes** (Figure 7.1) are general in their nature and a transition towards tactical planning is clearly connected to several different HCPC components and confirms the view of the connection between hierarchical levels presented in the conceptual framework. Staffing decisions and similar are decisions taken at a tactical level that sets a foundation for the operational level to work well. Establishing a well-functioning tactical level translates to a planning horizon of up to a year (Rosenbäck, 2017; Vissers et al., 2001), Such foresight opens up an opportunity to be more proactive than what is possible at a planning horizon of only a few weeks as is the case with scheduling. Due to this, inclusion of a tactical planning level has clear connections to a transition from a reactive state to a proactive state. This is a view presented by interviewees too. One interview say that a tactical planning level decreases the reactivity at a daily level (interview E). A situation with only operational/daily planning in place often results in a lot of firefighting and that you miss out on things (interview C, D).

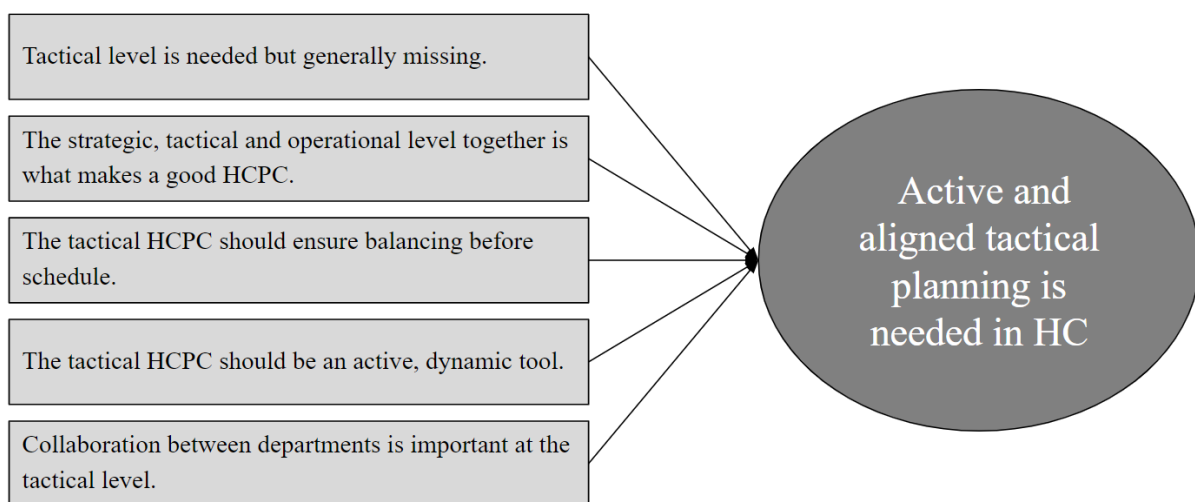


Figure 7.1: Coding tree for the aggregated dimension 'Tactical Planning in HC'.

7.2.2 Other Identified Perspectives Related to Proactiveness

A few other perspectives were identified in interviews, congruent with the transition from reactive to proactive. The perspectives are not mutually exclusive but provide different views on the transition

from reactive to proactive. Together with the degree of tactical planning, all these proactiveness-related perspectives are shown in Table 7.2.

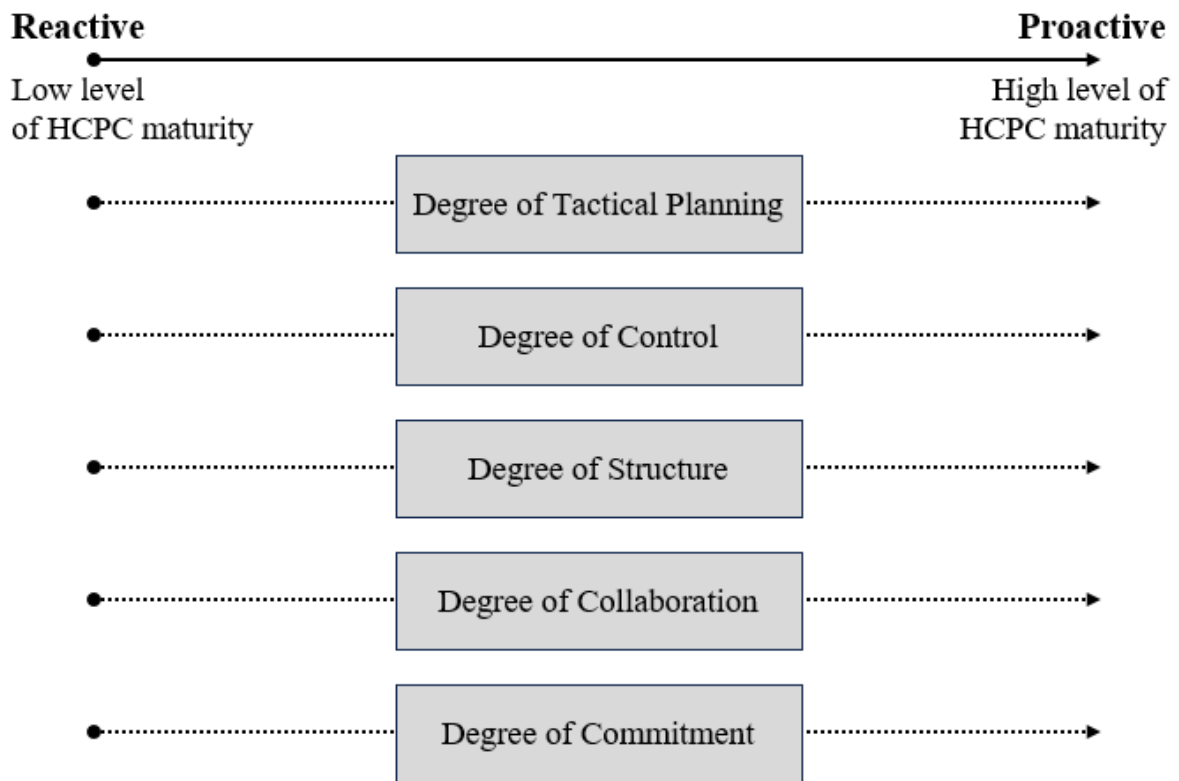


Figure 7.2: A maturity progression from Reactive to Proactive is supported by several different perspectives.

The degree of control can be described as actively working to reach balance. Taking your time to follow-up regularly and pairing that with appropriate actions is ideally going to create proactiveness. With pre-determined, well-established, control signals and actions connected to these, a sense of proactiveness is achieved even in situations of imbalance. Following-up, balancing and control was covered extensively in the expert interview analysis, 5.10 *Follow-up and Control*. Already then, connections to a lot of the other aggregated dimensions were demonstrated: analysis related to follow-up and control is additionally presented in sections 5.9 *Performance Measurement*, but also in parts in 5.2 *Competences for HCPC*, 5.8 *Meetings and collaboration* and 5.11 *Software support for analysis*. Mainly, it relates to the definition of HCPC as presented in the middle section of the conceptual framework. It additionally has connections to the process area of balance and integration, exemplified in conceptual MM, the performance measures in the ‘Product’ category of the conceptual framework that covers e.g., plan adherence and fulfillment of constraints and commitments. HCPC being unit-of analysis for this thesis, having control as something central for increased maturity should not come as a surprise.

Data, platforms and tools for executing control must be in place. A higher degree of structure around these is an alternative perspective of maturity in the sense that it will enable proactiveness. This perspective has many similarities with the ideas proposed in the conceptual framework under ‘Process’, such as when you should do things, the fact that you should develop routines and have meetings, confirming the importance of these aspects. But can additionally cover exactly how the available and required capacity should be calculated, and what you should aim at with regards to capacity and

demand. These are decisions that should be in place for fulfillment of the ‘Core HCPC activities’ of balancing. Data allow for exposing organizational gaps and creates a deeper understanding. Structure, routines, and agreements must be defined and followed in order to be proactive. Analysis touching upon this is presented in *5.4 Product Definition and Internal Resource Requirements*, *5.5 Calculation of Healthcare Demand*, *5.6 Structure for Capacity Utilization*, *5.7 Timeliness of Planning Activities* and *5.8 Meetings and collaboration*. After several rounds of HCPC with good follow-up and control, the structure is likely suited to the organization’s operations and is creating opportunities to act proactively.

Proactiveness can further be achieved through collaboration and cooperation. A willingness among employees to see themselves as a part of a bigger system and collaborate to help each other out is presented as a big cultural obstacle (*5.3 Culture*). As presented above, collaboration is important (Figure 7.1) at a tactical level. However already at an operational level, interviewees present collaboration as an important perspective and important for balancing and divide capacity. With well-functioning collaboration, common planning horizons or a logic around the order for scheduling, then decisions can be made early, and they can be trusted. Balancing and adjustments can be made smoothly both at a shorter- and longer term creating a proactive situation. Many capacity adjustments presented by Larsson & Fredriksson (2019) requires collaboration at a tactical level. On the other side, replanning of schedules and inability to adhere to schedules and production plans that be a result when there is a lack thereof. This uncertainty in the daily operations creates a reactive situation. These areas are found in e.g., *5.7 Timeliness of Planning activities*, *5.8 Meetings and Collaboration*, and *5.12 Systems Integration*.

There is a support for this from several different sources, integration of external partners, or highly integrated supply chains, is a common description of higher maturity levels (e.g., Wagner et al., 2014; Grimson & Pyke, 2007; Hammer, 2007; Lapidé, 2005). Similarly, cross-functionality was further seen as an important aspect in literature relating to S&OP performance measurement system (Hulthén et al., 2016) and lean maturity in HC (Kaltenbrunner et al., 2019). For commercial actor’s competition has to be carefully considered. Clinics, departments and units of a HC region in Sweden all work toward a common goal of providing HC to the region’s citizens. Collaboration is not limited to collaborative and there should be strong motives for taking on a holistic perspective. In theory this applies for both publicly, and privately-run practices.

Lastly, there needs to be a broad degree of commitment to HCPC, this is another enabler for proactive HCPC. Without this, none of the above can be achieved. It relates to a trust for HCPC efforts and the quality to data, and a willingness to change in accordance with these. Analysis related to this can be found in *5.1 Leadership*, *5.2 Organizational Competences for HCPC*, *5.3 Culture*, *5.11 Software support for analysis*, and *5.12 Systems Integration*.

7.2.3 Defining Logic Progression of HCPC Maturity

A scale that was described from reactivity to proactiveness in the conceptual framework could be supported from a several different perspectives. But the exact naming of maturity levels between the extremities can still be confirmed. The conceptual MM used the lowest maturity level ‘No HCPC’ and keeping this as the lowest maturity level was found beneficial. This covers organizations that yet have no structured way to deal with HCPC. They will likely also be very reactive but should be differentiated from organizations that make efforts for employing HCPC but are not (yet) successful. This is especially important with an experienced low HCPC maturity among HC departments in Sweden.

The use of ‘Standard’ in the conceptual MM (as inspired by Grimson & Pyke, 2007) carries a notion that there is an average degree of HCPC. A standard level of HCPC right above that of reactive, represents a rather idealistic view of HCPC in Sweden today in most regions. Additionally, a ‘standard’ was experienced to be associated to standardized measurements or procedures. Instead ‘Active’ was chosen to follow ‘Reactive’ after the first iteration in workshops, indicating that at this level HCPC influences the organization. ‘Advanced’ as the second highest level in the conceptual MM caused confusion among Workshop 3 participants, arguing that ‘Advanced’ is easily interpreted as superior to ‘Proactive’. Participants from Workshop 2 agreed that “*full proactiveness*” only could be achieved when their whole region is coordinated in the efforts around production planning. This motivated setting the second highest level to ‘Internal integration’ whilst the highest level was named ‘Proactive & Holistic’, representing the holistic perspective needed for “*full proactiveness*” (P2.2). A summary of the different levels were proposed in workshops, Table 7.2 includes a description of the different levels, based on this analysis.

Table 7.2: Identified maturity levels for the HCPCMM.

Level	Description
No HCPC	No HCPC at the department. Some emergency situations require HC production to be discussed. Structures like language and concept are re-invented for each new discussion.
Reactive	Structure for PC has started to form. But the few initiatives for PC existing arise in emergency situations, either as a result of concrete problems, or directives from above.
Active	PC is something the department works with consistently. The work is thoroughly planned, and an IT-system exists. Control signals are established with dedicated actions, but sometimes the ability to be executive is missing. Agreements are established within many areas, but their compliance is not followed up.
Internally Integrated	The PC is very mature within the department - it is integrated internally. The department has developed their routines and HC products, and agreements are established for all scenarios. All these are interconnected well. Cooperation with adjacent departments has started to happen but is clearly not as formalized externally as has been described for the internal department. Foresight is satisfactory, with routines if internal problems would arise.
Proactive & Holistic	There is good foresight, with routines in place if any problem would arise. The PC is very mature within the department, but also externally - both integrated with all departments in the patient flow, and with all those sharing resources. Structure like routines and agreements has now been adjusted to be operative both internally and externally. There is uniformity in these structures, and they also respond to the strategic goals for the department.

7.3 Synthesizing the Analysis into Process Areas with Cell-text Formulation

Process areas were identified based on the aggregated dimensions identified in *5 Expert Interview Analysis*. In total, twelve different process areas were identified, many directly from the aggregated dimensions. The identified aggregated dimensions and consequently also process areas touch upon slightly different areas of HCPC and were divided into categories. The categorization makes it easier to discuss the different process areas of a future MM in a structured way. The categories are not mutually exclusive, and there are strong interconnections both between both process areas and categories. Still, the categorization was straightforward:

1. Organization & Culture - covering leadership, and culture, and competences.
2. Structure & Routines - what creates structure and routines in HCPC and clarifies the decisions and agreements that has to be in place in order to define the correct data for HCPC
3. Measurement & Control - concerns the action of balancing and performance measurements.
4. IT - suggesting the capabilities required of different IT solution.

Following the structure of the categories, the synthetization of different process areas based on the aggregated dimensions will be explained in the following sections 7.3.1 – 7.3.4. A summary of the identified process areas and categories can be found in Table 7.3. In the respective sections, a summarizing discussion of how the cell text for each process area and maturity level was formulated will be included. Finally, snippets from the final MM of each process area will be introduced. Considerations from workshops and final evaluation rounds are already incorporated in this discussion.

Table 7.3: The resulting categorization and process areas of the HCPCMM.

Category	Process Area
Organization & Culture	Leadership for HCPC
	Organizational Competences for HCPC
	Culture
Structure & Routines	HC Product Definition and Internal Resource Requirements
	Structure for Calculation of HC Available capacity
	Production plan routines
	Routines for scheduling of resources and appointments
	Meetings and Collaboration
Measurements and Control	Measurements
	Follow-up and Control
IT	Software Support for Analysis
	Systems Integration

The chosen categories have similarities to the process areas identified in the conceptual MM (Figure 7.3). It becomes clear that what was process areas in many of the previously presented MMs, is now simply a categorization of process areas, thus making room for a deeper assessment. The HCPCMM was consequently more detailed than many other models. Some differences in names are due to the categories initially being named in Swedish, ‘People & Organization’ is not easily translated to Swedish and was hence named ‘Organization & Culture’. Similarly, the abbreviation of ‘Information Technology’ is more commonly used in Sweden. Other differences are made to better represent the content of an individual category. As can be seen in Table 7.3 ‘Meetings and Collaboration’ is merely a part of the category ‘Structure & Routines’.

The conceptual MM additionally included the process area of ‘Balance & Integration’, which was more evaluating in its nature. For instance, Grimson & Pyke (2007) discussed and used ‘S&OP Plan Integration’ indirectly to give support to the other dimensions, and Cecere et al. (2009) had a similar approach regarding balance in the plans. For the HCPCMM, ‘Balance & Integration’ was assimilated into process areas of all selected categories in accordance with Figure 7.3. Workshops did however desire to include follow-up and control as a separate process area due to its importance, and follow-up and control was added as a process area under the category of measurements and follow-up. A more direct link from ‘Balance & Integration’ to Measurements & Control is hence illustrated in Figure 7.3. The ‘Integration’ was relevant for all categories, and ‘Balance’ was explicitly considered in ‘Measurement & Control’.

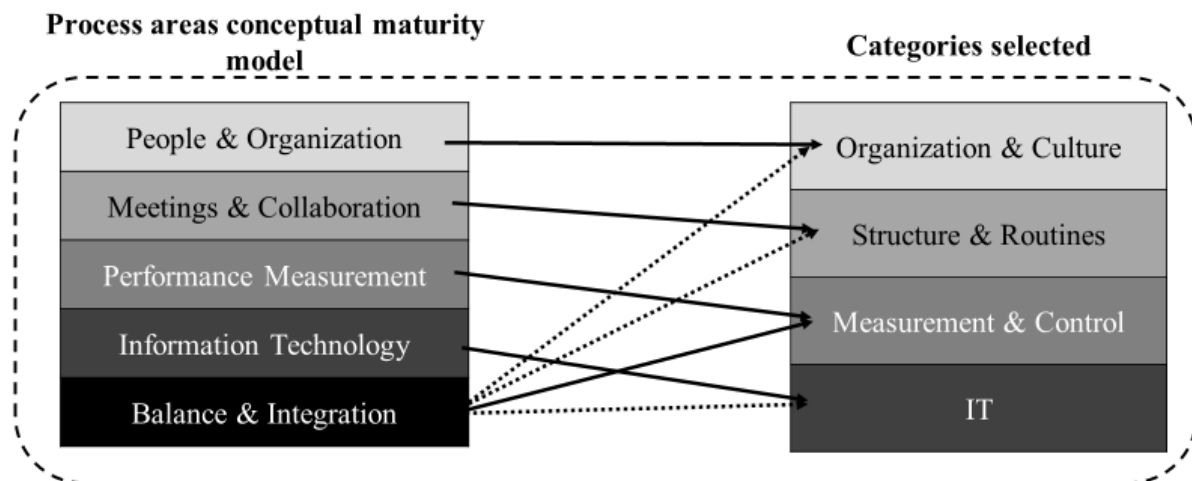


Figure 7.3: Similarities between categories suggested by the literature review and those categories that were selected.

7.3.1 Organization and Culture

The first category is Organization and Culture, encompassing three aggregated dimensions that were naturally interlinked: how the leadership should be adjusted for HCPC, competences in the organization that support HCPC, and the culture that encircles this organization. These three aggregate dimensions could directly be translated into process areas for the category in question:

- Leadership for HCPC
- Organizational competences for HCPC
- Culture

The reason for ‘People & Organization’ being the first category to be declared and in addition the MM has a practical reason. The category can be seen as including prerequisites for HCPC and sets the foundation for remaining process areas in remaining categories; there is a need for a positive culture influenced by a devoted leadership and a competent team.

Out of the three process areas that are explained to belong to this category, ‘Leadership’ is an especially important prerequisite, and is hence first in the final HCPCMM. Leadership and responsibility are proposed to be in place early in the HCPC process, as seen in the analysis in section 5.1 *Leadership for HCPC*, and one interviewee argued that positive change disappear after an enthusiast leave the organization (Interview E). Therefore, it is decided to let the full maturity-development for ‘Leadership’ be terminated already at the maturity level called ‘active’, thus limiting all organizations where the leadership is not working as intended to the three lower maturity levels in the final definition (see Table 7.4). One can additionally argue that leadership or management alone cannot create internally integrated nor proactive and holistic HCPC. For ‘Leadership’, the MM will distinguish ‘No HCPC’ from ‘Reactive’ based on the interest in working with HCPC. There must be an explicit interest, meaning a leadership with “*devotion and conviction*” (Figure 5.1) for the maturity development to start. The distinction between ‘Reactive’ and ‘Active’ will consist of all other discovered indicators of a mature leadership; HCPC communication, implemented initiatives regarding HCPC with earmarked time, and a responsiveness towards employees’ feedback. These indicators all rely on the adequate second order themes presented in Figure 5.1. The word ‘Leadership’ being used instead of management is indicating that the responsible person for HCPC, does not have to be part of management. However, it is probably preferred to have someone with authority and respect from management leading HCPC.

Table 7.4: The HCPCMM’s process area ‘Leadership’.

	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Leadership for HCPC	*The leadership is uninterested in changing the operations through PC.	*The leadership has an interest in PC. *The leadership does not allocate resources or allow for significant prioritization of PC.	*The leadership sees a clear purpose in PC to improve the operations. * The leadership can effectively communicate the purpose of PC to the organization. * The leadership establishes PC initiatives within the operations and allocates sufficient resources for their implementation. * The leadership is receptive to feedback from employees.	Same as active	Same as active

Another prerequisite or must-have for an organization intending to improve the HCPC is the correct competence among co-workers. The HCPCMM (Table 7.5) suggests that people responsible for (or working with) HCPC should have knowledge in what HCPC is, a general competence in logistics and planning, and be comfortable with data analytics (Figure 5.2). In addition, it can also be suitable with

experience in improvement work. Competences like these rhymes well with an initial ability to exercise appropriate measures for HCPC control. For the two highest levels of maturity, it is therefore specifically highlighted that the competence for follow-up and routines should be established. It is additionally visualized how competences are no longer isolated to few people in the organization, co-worker involvement is increased. No clear differentiation was found between the two highest levels, rather the change between these levels were experienced as something more related to culture than individuals' competencies.

Table 7.5: The HCPCMM's process area 'Organizational Competences for HCPC'.

	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Organizational Competences for HCPC	*No one in the organization has specific knowledge in production management.	*The person responsible for PC in the organization has some knowledge in PC. *The person who controls production in the organization can oversee a situation and make decisions in stressful situations.	* The person responsible for production management has a sense for numbers, understanding of logistical concepts, and can perform simple analyses. *In addition to knowledge in PC, the responsible individual in the organization also possesses an understanding of improvement work. * Other employees know what production control is and why it is done.	*The person responsible for PC is comfortable working with numbers and understands logistical concepts. *They can perform analyses to identify problems and prioritize them based on their expected impact on the organization. *The individual responsible for PC, in addition to knowledge in PC, also understands improvement work. *Other employees have an idea of how their actions and efforts can affect the effectiveness of PC.	Same as internally integrated.

As explained in 5.3 *Culture*, the cultural resistance will complicate the implementation of HCPC, but on the other hand, a positive culture comes with many positive implications. This concludes that culture should be a process area in the HCPCMM. In the HCPCMM, culture regards the willingness to change, curiosity towards HCPC, and co-worker's own willingness to contribute. In addition, we also highlight the trust for calculating on HC, both with and without software support. There is a need for co-workers to take responsibility beyond their own sphere, perhaps even consider themselves highly important for making an impact on the HC-system as a whole and help out where needed, to reach 'Holistic' HCPC. This mindset requires the co-workers to consider both patient flows, departments sharing resources, and departments spread across the region as care is produced. Many of the examples of bad culture were ones where personal interests dominated and there was a competitive atmosphere, this allows for a transition between maturity as demonstrated in Table 7.6.

Table 7.6: The HCPCMM's process area 'Culture'.

	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Culture	<p>*There is a low willingness for change among the employees, as they prefer things to remain as they have always been.</p> <p>*Criticism of quantifying HC with numbers</p> <p>*Employees generally tend to focus on personal interest and lack the ability of seeing themselves as parts of a larger HC system.</p>	<p>*There is a low willingness for change among the employees, as they prefer things to remain as they have always been.</p> <p>*There is an understanding that there may be a need to analyze capacity, HC needs, and HC production to improve accessibility or identify problems.</p> <p>*Employees generally tend to focus on personal interests and lack the ability of seeing themselves as parts of a larger HC system.</p>	<p>*Some employees show curiosity and change routines based on the improvement initiatives driven within the organization.</p> <p>*Several employees have trust in those responsible for PC and understand the reason behind quantifying HC with numbers.</p> <p>* Employees have started to put aside personal interests, but generally lack the ability of seeing themselves as parts of a larger HC system.</p>	<p>*Several employees themselves want to contribute to the improvement of the operations and take initiatives and come up with suggestions.</p> <p>*Procedures are changed based on improvement initiatives driven within the organization.</p> <p>*Several employees have trust in those responsible for PC and the IT systems associated with PC. Additionally, there is trust in quantifying HC with numbers.</p> <p>*Employees are generally open to help where needed to improve the organization's operations.</p>	<p>*A majority of employees want to be an active part in the continuous improvement of the operations.</p> <p>*Procedures are changed based on improvement initiatives driven within the organization.</p> <p>*The majority of employees have trust in those responsible for PC and the IT systems associated with PC. Additionally, there is trust in quantifying HC with numbers.</p> <p>*Employees generally see themselves as important resources for improving the HC system as a whole and are willing to assist where needed.</p>

7.3.2 Structure and Routines

For Structure and routines there were five aggregated dimensions identified:

- Product Definition and Internal Resource Requirements
- Meetings and Collaboration
- Structure for Capacity Utilization
- Calculation of HC Demand
- Timeliness of Planning Activities

The first two can arguably be directly translated into process areas. Product definition with its internal resource requirements is a prerequisite for HCPC, one has to have something to plan around, and the resource requirements' role is stressed in Figure 5.4. A natural maturity progression will be that of ill-defined or non-existing products to those who are used effectively and kept relevant for the organization (Table 7.7). This implies that resource requirements should be well-defined and be based on how the organization actually operates. The other way around naturally applies at higher maturity levels, people adhering to the defined resource requirements when possible is important. At higher levels HC products are suggested to be defined in alignment with other departments providing the same service.

Table 7.7: The HCPCMM's process area 'Product Definition and Internal Resource Requirements'.

	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Product Definition and Internal Resource Requirements	*The offered HC services are not adequately structured.	<p>*The organization is aware of the HC services they provide.</p> <p>*Some grouping of HC services into HC products is done.</p>	<p>*A number of HC products are actively used in the PC of the operations, and they are maintained when deemed appropriate.</p> <p>*Internal resource requirements are partially defined to the HC products, utilizing factors such as time consumption as examples.</p>	<p>* HC products are carefully selected to match the needs of the organization and are effectively utilized in the management. Outdated products are removed, and products are easily revised when necessary.</p> <p>* All relevant internal resource requirements are defined for the HC products.</p> <p>* The resource requirements are aligned with the organization's work processes and are largely followed.</p> <p>* The organizations that have high overlap with others and require coordinated planning define their HC products to ensure compatibility with these adjacent operations.</p>	<p>* HC products are carefully selected to meet the needs of the organization and are effectively utilized in the management. Outdated products are removed, and products are easily revised when necessary.</p> <p>*All relevant internal resource requirements are defined for HC products.</p> <p>*The resource requirements are aligned with the organization's work processes and are adhered to whenever possible.</p> <p>*The definition of HC products is designed to work well with all adjacent organizations. Ideally, the instrumentalization is jointly developed with these operations.</p>

Meetings create an important connection between the different hierarchical levels, clearly connecting it to the 'Increased Tactical Planning' dimension of maturity. Meetings are additionally described as a place where HCPC decisions are made and that enable collaboration between departments in terms of agreeing and division of capacity as described in *5.8 Meetings and Collaboration*. Going from no meetings, to having meetings ahead of each planning round internally or with departments that can help the balancing of capacity and demand at both a tactical (longer-term) and operational (shorter-term) level, will ensure that an accurate progression for meetings is found. The act of balancing and control will be interlinked with higher level of meeting maturity. At a proactive and holistic level, actions resulting from meetings can be balancing both between and inside departments and clinics. Many interviewees additionally highlight software's role in enabling smooth connections between meeting

platforms and making sure all participants are well informed, this was additionally chosen as something to increase with higher maturity (Table 7.8). Grimson & Pyke (2007) highlights “Real time access to external data” as something important at their highest stage of S&OP maturity, connecting to data being an important part of meetings and collaboration. It should be noted that meeting and collaboration is important in historic MMs, as demonstrated in the conceptual MM.

Table 7.8: The HCPCMM’s process area ‘Meetings and collaboration’.

	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Meetings and collaboration	<p>* In the organization, there are no meetings or individual agenda items specifically addressing production management.</p>	<p>* PC is occasionally discussed in meetings. * PC is discussed ad hoc and often prompted by specific situations.</p> <p>*Meeting discussions are based on experiences rather than data.</p>	<p>*Separate meetings addressing PC or having PC as a fixed agenda item on meetings, do occur. *Meetings primarily discuss the outcome of the planning and the need for changes in light of this.</p> <p>*Data regarding production is used as a basis for discussions in meetings.</p>	<p>*Meetings are held regularly both prior to scheduling and during the creation of a new production plan. *Meetings discuss and follow up on the balancing of capacity and needs at different levels.</p> <p>*There exist meetings for planning together with departments that one may need to collaborate with.</p> <p>*The PC software is used as a basis in meetings.</p>	<p>*Meetings are held regularly both prior to scheduling and during the creation of a new production plan. *Meetings discuss and follow up on the balancing of capacity and needs at different levels.</p> <p>*There are regular meetings for planning together with all departments that one may need to collaborate. *All departments have a common planning horizon. *If necessary, additional meetings with collaborating departments can be easily scheduled.</p> <p>*Decisions are made regarding the allocation of volumes/access to shared resources where needed.</p> <p>*Thesoftware for PC is used as an interactive tool in meetings.</p>

Translating the last three dimensions into process areas is not straightforward. The reasons for this are that there can be two planning levels concerned at the targeted HC department, the tactical and operational level. The two have been described as having the outputs of production plan and schedule respectively. To create balanced plans, the available capacity as well as the required capacity needs to be calculated and actions taken to balance it out at both levels. To include all three aggregate dimensions

and their specifications in one process area is difficult due to the nature of the three dimensions being quite different. Thus, the structure for capacity utilization capacity is broken out into its separate process area. This can be done by viewing the 'Structure of Capacity Utilization' as the mere defining of data, i.e., decisions of capacity utilization, just like the definition of HC products. Further motivation for this decision will follow below.

Structure for capacity utilization is purely about creating a structure and having agreements in place, the interviewees mainly highlighted scheduling agreements to control specialist allocation to HC products, as can be seen in *5.6 Structure for Capacity Utilization*. This can be due to schedules being a necessity and a general low experience of the more tactical level's production plan. The calculation of capacity as an input for the production plan was instead defined from literature and only relates to the Rough-cut Capacity Plan (RCCP). The transparency of scheduling agreements was further something that was highlighted to reduce bad scheduling culture and increase experienced fairness. The progression from low to high maturity is based on the detail of the agreements, and them being defined clearly enough to be used for scheduling without any prior knowledge about people's competences. Similarly, competence mapping can be included under this section, to create structure and enable long term competence development as well as further guidance of the scheduling process. The full process area is demonstrated in Table 7.9.

The two aggregated dimensions of 'calculation of demand' and 'timeliness of planning activities' are directed towards an actual development of planning products. The process areas of timeliness and calculation of demand alone adds limited value alone, they are however matched well when production plan development and schedule development can be separated. Contrasting both the product definition and capacity calculation that can be seen as enablers for the final process. For the production plan and schedule, the higher maturity levels should aim at a balance between capacity and demand. Hence, all the defined data (i.e., product definition, resource requirements and capacity calculation guidelines) should be included in this. The data and connected ways of working is additionally probably refined with the balancing in mind. The two new process areas are called 'Production plan routines' (Table 7.10) and 'Routines for scheduling of resources and appointments' (Table 7.11), and they will have connections to the other areas in the category.

Table 7.9: The HCPCMM's process area 'Structure for capacity utilization'.

Structure for Capacity Utilization	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
	<p>* Scheduling is based on personal agreements and has limited alignment with the needs of the organization.</p>	<p>*There are unofficial agreements within the organization that enable scheduling.</p> <p>*Knowledge of employees' skills is held by one or a few individuals as tacit knowledge.</p>	<p>*There are established agreements regarding capacity, including staffing levels, work hours, and distribution of duties for individual staff members.</p> <p>*There is also some awareness of the required competencies among the employees.</p> <p>*Agreements regarding scheduling are somewhat aligned with the organization.</p> <p>*Scheduling agreements are centrally stored.</p> <p>*Knowledge of employees' competencies is documented.</p>	<p>*There are established agreements regarding capacity, including staffing levels, work hours, and distribution of duties for individual staff members.</p> <p>*There is also a widespread awareness of the required competencies among the employees.</p> <p>*Scheduling agreements are well established in the needs of the organization.</p> <p>*The skills of the employees match the organization's competence requirements.</p> <p>*Scheduling agreements are centrally stored and accessible to all employees.</p> <p>*Detailed knowledge of employees' skills is centrally stored, for instance in a competence matrix.</p>	<p>*There are established agreements regarding capacity, including staffing levels, work hours, and distribution of duties for individual staff members.</p> <p>*There is also a widespread awareness of the required competencies among the employees.</p> <p>*Scheduling agreements are well aligned with the long-term best interests and needs of the organization, potentially through multiple iterations, and are maintained as stable as possible.</p> <p>*The skills of the employees match the organization's competence requirements.</p> <p>*Agreements are centrally stored and accessible to all employees.</p> <p>*Detailed knowledge of employees' skills is centrally stored, for instance in a competence matrix.</p>

Table 7.10: The HCPCMM's process area 'Production plan routines'.

Production Plan Routines	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
	<p>*The planning horizon for the organization does not extend beyond the schedule.</p>	<p>*The organization has a more general production plan in place.</p> <p>*The production plan is based on perceptions of HC needs and insufficient historical data.</p> <p>* The production plan lacks clear alignment to the organization.</p>	<p>*An overall production plan is made at least once a year.</p> <p>*The production plan is based on a forecast of HC needs.</p> <p>*The production plan is somewhat aligned with the organization.</p>	<p>*An overall production plan is created and released at least once a year with sufficient foresight before it becomes valid.</p> <p>*There is a routine for creating the production plan.</p> <p>*The production plan is based on a well-founded forecast of HC needs.</p> <p>*A balance between HC needs and production is achieved in the production plan through alignment with a RCCP</p> <p>*The RCCP, agreements regarding resource utilization, and competencies are aligned with each other.</p> <p>*The production plan is linked to the strategic goals and the structure of the organization.</p>	<p>*An overall production plan is created and released at least once a year with sufficient foresight before it becomes valid.</p> <p>*There is a routine for creating the production plan.</p> <p>*The planning horizon and level of detail are consistent with adjacent operations.</p> <p>*The production plan is based on a well-founded forecast of HC needs.</p> <p>*A balance between HC needs and production is achieved in the production plan through alignment with a RCCP</p> <p>*The RCCP, agreements regarding resource utilization, and competencies are aligned with each other.</p> <p>*The production plan is linked to the strategic goals and the structure of the organization.</p>

Table 7.11: The HCPCMM’s process area ‘Routines for Scheduling of Resources and Appointments.

	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Routines for Scheduling of Resources and Appointments	Same as reactive	<p>*Scheduling is done with a short and irregular foresight.</p> <p>*The sequence for developing different schedules is not determined based on the best interests of the organization.</p> <p>* Scheduling is largely based on tradition.</p> <p>*Individuals' personal interests play a significant role in scheduling.</p>	<p>*Scheduling is done either with a short or irregular foresight.</p> <p>*Scheduling is coordinated among the different resources within the organization.</p> <p>*Scheduling has some alignment with care needs, agreements on capacity utilization, and the production plan.</p> <p>*Some unfavorable behaviors related to scheduling and appointment scheduling still persist.</p>	<p>*Scheduling is done approximately three months in advance.</p> <p>*Scheduling is coordinated among the different resources within the organization and, if necessary, with other organizations with shared resources.</p> <p>*Scheduling is anchored in care needs, agreements on capacity utilization, and the production plan.</p> <p>*Scheduling considers the natural variations of the organization, meaning that scheduled capacity exceeds the needs in the production plan.</p> <p>*Procedures for appointment scheduling are in place, resulting in high adherence to the schedule.</p>	<p>*Scheduling is done approximately three months in advance.</p> <p>*The planning horizon is the same for all organizations that share common resources.</p> <p>*Scheduling is coordinated among the different resources within the organization and, if necessary, with other organizations with shared resources.</p> <p>*Scheduling is anchored in care needs, agreements on capacity utilization, and the production plan.</p> <p>*Scheduling considers the natural variations of the organization, meaning that scheduled capacity exceeds the needs in the production plan.</p> <p>*Procedures for appointment scheduling are in place, resulting in high adherence to the schedule.</p> <p>*The procedures also cover how appointment scheduling should be done with the relevant departments involved in patient flows.</p>

For the two new process areas it is important to clarify what a plan is based on. The aggregated dimension of ‘Calculation of HC demand’ highlight e.g., increased forecasting, something that the production plan should be based on. The proposed alignment between production plan and schedule is

proposed to be moved from the aggregated dimension of ‘Follow-up and Control’ aggregated dimension area to here. Communication of decisions between levels is important and, as proposed in the conceptual framework, an important part of the control aspect of HCPC. This is covered under the two process areas as well, as another part of the control dimension. With relation of the internal alignment between planning product, appointment scheduling is included. No matter the degree of scheduled appointments in the organization, there should be an alignment between how appointments are scheduled and resource schedules. There should also be alignment between the structures created for calculating available capacity, scheduling and staffing agreements, and the actual schedule. The creation of process areas from the five aggregated dimensions of this category are illustrated in Figure 7.4. All four except meetings and collaboration and highly connected and is presented in firstly.

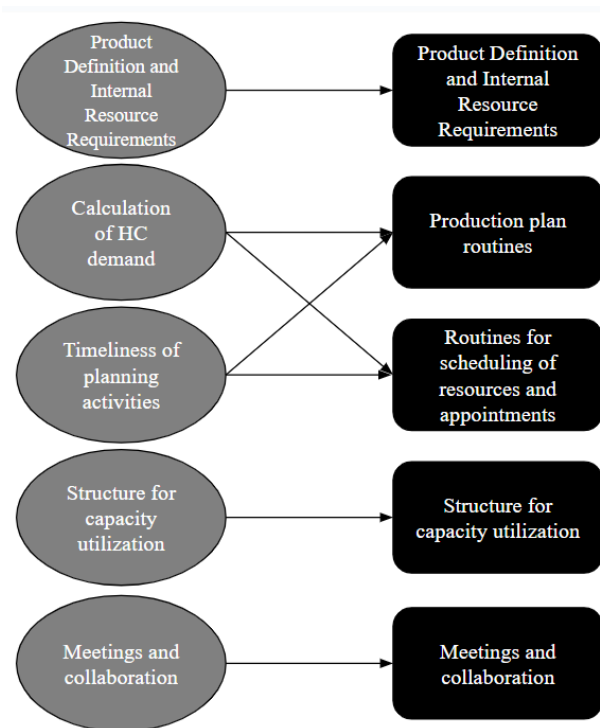


Figure 7.4: Illustration of how the aggregated dimensions of the category ‘Structure and Routines’ are translated into process areas.

7.3.3 Measurement and Control

The process areas covered under this category are ‘Performance Measurement’ and ‘Follow-up and control’. The aggregate dimensions can be directly translated into process areas, see Table 7.12 and Table 7.13.

‘Performance Measurement’ primarily considers what to measure, and the final process area is shown in Table 7.12. From the analysis in 5.9 *Performance Measurement*, it can be explained how the focus shifts from solely result measures, such as HC equitability- and HC accessibility measures, to an increased presence of PC measures, such as measuring deviations from the production plan but also how the production plan and different schedules align. This transition, in what to measure, increases the tactical activity and is also of importance for being able to control the HC organization. Although result measures should not be used actively to control the department at this level, the relationship between HCPC and working environment is presented as important to motivate people to start working with HCPC. A concern from employees that HCPC will result in them working harder can be read into this

theme, connected to an overall skepticism towards putting numbers on HC. It will be important to show that the results are the opposite, and if they are not, be careful in the implementation process. Work environment is an aspect that potentially could have been implemented from the lower levels of maturity already. But by explaining that such measures must be put in relation to the production plan specifically, we aim to emphasize the importance of tactical planning. Finally, adjacent organizations must be taken into consideration for those measures relating to either patient flow or resource utilization. From this perspective, there is also a degree of collaboration within this process area.

Table 7.12: The HCPCMM's process area 'Performance Measurement'.

	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Performance Measurement	*The organization measures only the type of production metrics that are linked to overall goals and requirements demanded by higher authorities (such as HC guarantees).	*The organization measures, among other things, the type of production metrics that are linked to overall goals and requirements demanded by higher authorities (such as HC guarantees) *Measurement of delivered HC (historical data) and the ability to meet future HC needs (capacity and demand) is done only on a short-term basis during crisis situations or for consolidated reports.	*The organization measures, among other things, the type of production metrics that are linked to overall goals and requirements demanded by higher authorities (such as HC guarantees) *Measurement of delivered HC (historical data) and the ability to meet future HC needs (capacity and demand) is done on a regular basis. *Deviation of the schedule from the production plan is regularly measured. * Key performance indicators related to flow and resource utilization are established and measured as needed.	*Measurement of HC guarantees is done solely for reporting to higher authorities. *The work environment is regularly measured and related to changes and activities in PC. *Measurement of delivered HC (historical data) and the ability to meet future HC needs (capacity and demand) is done on a regular basis. *Deviations from the plan are measured regularly at different levels of aggregation and for different types of deviations: *Deviation of the schedule from the production plan. *Deviation of the appointment schedule from the resource schedule as well as the production plan. *Measures related to flow and resource utilization are established with adjacent organizations and measured as needed.	Same as internally integrated

The process area under this category (Table 7.12), ‘Follow-up and Control’, makes an integral part of the term ‘HCPC’. Control is a central perspective for increased maturity and is hence embedded in many of the other process areas as well. By additionally presenting it as a separate process area, we have the opportunity to distinguish many other second-order themes, and also mark its strong connections to ‘Measurements’. Because being able to follow-up and control (usually deviations and agreements) is rooted in measuring the right data. And as explained earlier ‘control’ is about actively working to reach balance, but another purpose of controlling is to increase the importance of tactical planning.

Table 7.13: The HCPCMM’s process area ‘Follow-up and Control’.

	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Follow-up and Control	*Improvement work is initiated ad hoc without any connection to production data.	<p>*Possible control signals that exist are not well-integrated into the organizations.</p> <p>*Improvement efforts can be initiated, but often based more on intuition rather than on data and HC production metrics.</p>	<p>*Some control signals are established.</p> <p>* There is an understanding of how to respond to control signals.</p> <p>*Inability to meet HC needs specifically, leads to analysis of the situation and can send signals saying that improvement work should be initiated.</p>	<p>*Control signals are established for well-balanced situations.</p> <p>*There are several concrete alternative actions associated with control signals.</p> <p>*Identified variations, inability to meet HC needs, and deviations from plans and agreements are investigated.</p> <p>*When necessary, signals are sent to initiate improvement work to eliminate unnecessary deviations and variations.</p> <p>*There is a clear structure in place to address identified problems, improvement opportunities, and initiatives from employees.</p> <p>*The competence of the organization is reviewed with a long-term perspective</p>	<p>*Control signals are established for well-balanced situations.</p> <p>*There are several concrete alternative actions associated with control signals.</p> <p>*Capacity adjustments for collaboration and assistance between organizations are an established possibility.</p> <p>*Identified variations, inability to meet HC needs, and deviations from plans and agreements are investigated.</p> <p>*When necessary, signals are sent to initiate improvement work to eliminate unnecessary deviations and variations.</p> <p>*There is a clear structure in place to address identified problems, improvement opportunities, and initiatives from employees.</p> <p>*The production plan is updated if the underlying conditions on which it is built change.</p>

The transition towards balance between capacity and demand through control starts with improvement work. It has earlier been described how improvement work and PC are separate aspects, but we emphasize the importance of maintaining both. For the improvement work, it is important to use all

knowledge in the organization to improve established processes or needs. Considering control, we stress a focus on the establishment of control signals, but also to act correctly based upon them. In addition, each organization must also adjust either capacity or demand (see Figure 2.3) when that is needed for the balance. To reach full proactiveness, the production plan must also be updated if the underlying conditions on which it is built change. Besides, we also underline the collaboration to make capacity adjustment together with other organizations when needed.

7.3.4 IT

The very last category to be broken down into process areas is 'IT'. We motivate this placement based on the fact that IT only has an impact on the overall maturity for the highest levels, according to the results from Grimson & Pyke (2007). The same experience was also shared by Workshop 2 as the relevance for IT was discussed. For the category, we have identified two different aggregate dimensions, and the two process areas can be directly identified from them with the same names; Software Support for Analysis, and Systems Integration. They both have the possibility to be usable for the assessment, and are distinguished by their different focuses on functionalities:

- Software Support for Analysis: Focuses on what the software engine is capable of mastering. It could be different methods for delivering solutions, or a tool for discussions and insights.
- Systems Integration: Focuses on the technical interoperability of the software, its connections to other systems, and how it enables high data quality.

With a good software support for production analysis, the HC organization primarily has the possibility to be better controlled. These tools for analysis build upon the existence of decent HC products and internal capacity requirements (see 7.3.2 *Structure and Routines*), but in this process area (Figure 7.14) we also stress the importance of managing and storing this data by the use of the software. Visualization is something that can be developed quite early in the maturity. Together with simulation, it has the possibility to inform the department about what decisions to make. Using these tools in meetings, for instance, can both bring more structure and better insights to the discussions on how the demand should be met. Visualization and simulation can thus be necessary to use for the follow-up and control of the department, since it is a measure for informing about outcome of different decisions. 5.11 *Software Support for Analysis* addressed a fear regarding AI, optimization and automation bringing false results due to bad data quality. But with improved software engines that also takes adjacent organizations into account, the software's abilities will increase the trust for the tools and will thus diminish the problem.

The last process area is named 'Systems Integration' (Table 7.15). Having the software system interlinked with other necessary systems certainly comes at handy for increasing the automation of the HCPC-process. Based on the analysis in 5.12 *Systems Integration*, it certainly seems like the technical interoperability has the possibility to increase collaboration between both systems and organizations, especially if the connections are seamless. As said earlier, the collaboration will become high between departments working with the same patient flows and those sharing resources. It is then of great importance that the systems can communicate with each other so that the software analysis can be correctly done. This will most likely also contribute to improved data quality, especially if human interaction can be avoided. Naturally, this can only happen if the software system has capacity for this, but on such a high maturity level, that should be the reality. Finally, high systems integration and good data quality increases the trust for the IT. Not only does this impact the software support, but also the reliability to the data and hence the commitment for HCPC.

Table 7.14: The HCPCMM's process area 'Software Support for Analysis'.

No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
<p>*Data for HC production can be visualized, but this is done solely for monitoring purposes. The lack of well-defined HC products makes it a highly manual process.</p>	<p>* Data for HC production can be visualized. However, the absence of well-defined HC products makes it a highly manual task. * Visualization is done both for monitoring purposes and to provide an overview of the already planned activities.</p>	<p>*Selected HC production data can be managed and stored in the software support.</p> <p>*Visualization of the data can be easily performed on a regular basis. *Visualization is used for monitoring purposes, but also regularly to provide an overview of and revise already planned activities.</p> <p>*Simulations are used to some extent, primarily to test the feasibility of a proposed plan.</p>	<p>*A large portion of the required HC production data can be managed and stored in the software support.</p> <p>*Visualization of the data is performed regularly, and centrally accessible dashboards facilitate this process. *Visualization is used for monitoring purposes, but also regularly to provide an overview of and revise already planned activities. This applies to both future tactical and operational planning.</p> <p>*The software can generate proposals using both simulation and optimization. The proposals are feasible with minor modifications. *Input data can be varied to perform sensitivity analyses and explore alternative suggestions.</p>	<p>*A large portion of the required HC production data can be managed and stored in the software support.</p> <p>*Visualization of the data is performed regularly, and centrally accessible dashboards facilitate this process. *Visualization is used for monitoring purposes, but also regularly to provide an overview of and revise already planned activities. This applies to both future tactical and operational planning.</p> <p>*The software can generate proposals using both simulation and optimization. The proposals are directly implementable and take adjacent organizations into account. *Input data can be varied in different ways to perform sensitivity analyses and explore alternative suggestions.</p>

Software Support for Analysis

Table 7.15: The HCPCMM's process area 'Systems Integration'.

	No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Systems Integration	<p>* No specific software for PC is used.</p> <p>*A significant amount of relevant data for PC is either completely missing or incomplete.</p>	<p>* No specific software for PC is used.</p> <p>*A lot of relevant data for production management is either missing or not being utilized. However, in certain urgent situations, relevant data can be extracted and utilized.</p>	<p>*The software for PC can be integrated with other internal systems used to administer HC production. Partial separate registration occurs.</p> <p>* Data for HC production is partially defined and used to some extent.</p> <p>* Poorly integrated systems result in varying data quality, and data often needs to be reviewed.</p>	<p>* The software for PC can automatically retrieve data from other internal systems used to administer HC production, thus eliminating the need for separate registration.</p> <p>* Information from the organization can be automatically transferred into other systems.</p> <p>* The software for PC is similarly connected to similar systems in adjacent organizations.</p> <p>* Data for HC production is completely defined, and internal quality can be ensured through well-integrated systems. External data needs to be reviewed.</p> <p>* Both the data itself and its connections between different terms are comprehensible.</p>	<p>*The software for PC can automatically retrieve data from other internal systems used to administer HC production, thus eliminating the need for separate registration.</p> <p>*Information from the organization can be automatically transferred into other systems.</p> <p>*The software for production management is seamlessly integrated with similar systems in adjacent operations.</p> <p>* Data for HC production is completely defined, and its quality is ensured through well-integrated systems both internally and externally.</p> <p>*Both the data itself and its connections between different terms are comprehensible.</p>

7.4 Maturity Model Evaluation and Finalization

First, we intend to present the final version of the HCPCMM with some comments and remarks. This will be followed by the evaluation that was carried out for the purpose of testing the HCPCMMs applicability, and simultaneously assess departments in line with the research purpose. With this chronology in mind, it should however be stressed that there was a last model iteration taking place right after the evaluation with the HCPCMM was made. Therefore, the 'final version' presented before the evaluation, is in fact the result of the evaluation.

7.4.1 Maturity Model Design Considerations

Based on the discussion in 7.3 *Synthesizing the Analysis into Process Areas with Cell-text Formulation*, we arrive at twelve process areas grouped under four categories, and together with the maturity levels

(presented in Table 7.2), the model grid can be constructed as shown in Table 7.16. The cell-texts for each process area were presented in 7.2.1-7.2.4. For practical reasons the combination of process areas and cell-texts into the full model will only be shown in Appendix A.1. Since HCPCMM primarily was developed for a Swedish audience, the combined version provided in Appendix A.1 is the Swedish version, the English translation of separate process areas in 7.2.1-7.2.4 was deemed sufficient. A blank assessment sheet for clearer visualization of the final assessment, much inspired by Hammer's (2007) separate color-coded assessment column was provided. This sheet is identical to Table 7.16, and an exemplary assessment with this sheet can be seen in Appendix A.2.

The final model was complemented with question material and examples for process areas, see Appendix A.3 in Swedish. The intent of this material is to guide the future users and satisfy requests from the stakeholders, and it should not be seen as part of the MM, hence its placement in the Appendix. Both of these facilitate the assessment but should not be needed.

Table 7.16: The HCPCMM with its specified dimensions in English.

Categories	Process Areas	Maturity levels				
		No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Organization & Culture	Leadership for HCPC					
	Organizational Competences for HCPC					
	Culture					
Structure & Routines	Product Definition and Internal Resource Requirements					
	Structure for Capacity Utilization					
	Production plan Routines					
	Routines for Scheduling of Resources and Appointments					
	Meetings and Collaboration					
Measurements and Control	Measurements					
	Follow-up and Control					
IT	Software Support for Analysis					
	Systems Integration					

7.4.2 Evaluation: Validation

Some level of validation has taken place in the workshops, confirming the choice of process areas and definition of maturity levels, including the intent behind the maturity level definitions. They confirmed that they understood the meaning from seeing a phrasing of process areas. The content of process areas was further refined and iterated, mostly correcting wording of issues than the context, which many agreed upon and related to.

The evaluation consisted only of two HC departments and one representative from each ‘department’. A manager from a primary care health center²⁶ and one manager from a women’s health center, both ambulatory HC service and primary care providers according to the definitions of Hulshof et al. (2012) and Rosenbäck (2017). The women’s health clinic was one of the first that had introduced KPS and were hence expected to have a higher maturity of HCPC. The primary care health center had not yet started implementing KPS and was expected to have a low maturity or be defined as a department with ‘No HCPC’. Some reflections from the assessments will be summarized and were used for further refinement of the model.

A general reflection was made with regards to the first HCPC process area, ‘Leadership’. It did not feel considerate to assess the leadership of the same person that was going to answer the questions. Instead, we opted for assessing maturity of the leadership last, based on a general perception of the interview rather than questions that would make the subject interviewee self-reflect on their leadership. From both interviews a need to move ‘HC Product Definition and Internal Resource Requirements’ from the last category previously named ‘IT & Data’ to the category ‘Structure & Routines’ was identified. When discussing scheduling and production plan the HC products naturally were discussed, and upon further reflection the previous placement did not have support from the content in the cells. That resulted in a re-naming of the last category to simply ‘IT’.

The general experience of the primary care health center was that it was easy to do the assessment for all process areas except one. That process area was that of HC products, where the assortment of HC services provided by a primary care health center was big (e.g., specialist nurse clinic, physiotherapy, general practitioners) and it was difficult to quantify the number of services. The difference between ‘No HCPC’ and ‘Reactive’ had to be refined. ‘Reactive’ was proposed by the interviewee to be more related to if you are discussing the produced HC services from a production perspective or not, and that suggestion was implemented after the evaluation round. And the set of questions was developed to capture earlier if any resource requirements are defined. Except for this the rankings were generally low and there was not an issue matching the current situation with the different levels. The final ranking was ‘No HCPC’.

It was more difficult to identify the expected high maturity player. This had in parts to do with the set algorithm for final evaluation that stated fulfillment of all process areas was required to reach a certain maturity level. When the high maturity player did not acknowledge the development of a production plan based on forecasts and done yearly, that punished them significantly. At this point in time the production plan update regime was based upon Rosenbäck’s (2017) description of rolling updates. Reflecting upon this it might have been a little idealistic considering that the coding from interviews provided little support for the production plan update routines other than the fact that there should be some sort of production plan and it should be updated yearly. Especially due to HC demand being

²⁶ Swedish: *vårdcentral*

described as “*plannable*” and “*even*”, the production plan could hold if done well. Some relaxed requirements regarding the updating of the production plan were decided upon, whilst still requiring the production plan to be based on forecasts. This would still have ‘punished’ the assessed department, but that punishment would be intended as the tactical planning level’s importance is highlighted when defining ‘proactiveness’. Additionally, the importance of an individual’s department’s final evaluation is not central for the model that has repeatedly been stressed as a discussion

Some chunks of text were identified that could be moved between departments. Where necessary for both the assessments, questions were added if the assessment was difficult. The full set of questions can be found in the appendix, but should be seen as a working document as the future testing and evaluation

7.4.3 Evaluation: Verification

As suggested by Maier et al. (2012), the verification of the HCPCMM was made against the success criteria stated in *1.4 Problem Formulation*:

- A model used for assessing the maturity of HCPC on a department in a Swedish region. This model will be named HCPCMM.
- The possibility to make assessments ‘external’ for overlooking ongoing as well as potential implementations. Department could be benchmarked, but not for certifying the maturity in any way, rather to prepare for upcoming changes.
- The possibility to make assessments with the HCPCMM internally for each department by co-workers to raise awareness of the as-is situation.

Based upon these criteria and the outcome from the two assessments, we argue that the HCPCMM has been fully developed for this thesis. The improvement aspects stressed in the validation have now been taken care of. The efforts of making the model applicable in a Swedish context, and not only for RJL, can for instance be seen in the choice of the phrases ‘HCPC’ or ‘PC’ over ‘KPS’. However, the validation against RJL departments implies a need for further evaluation with departments in other healthcare regions and will be addressed in *8.4 Limitations and Future Research*. On the other hand, the existence of both an English and a Swedish version of the HCPCMM makes it more applicable for evaluations of departments in foreign countries.

As the authors executed the assessments, it can further be argued that it was possible to make this externally. The improvement aspects (that were taken care of after the assessment) would now make it possible to repeat the evaluation with a distinct positive outcome. The questions and examples visible in the HCPCMM were a particularly good support for us but could also aid the possibility to make self-assessments with the HCPCMM. The proof for this is that the managers both had studied the HCPCMM alone before the assessments and had already made opinions about the positioning in the assessment sheet. These observations conclude the verification, knowing that it is a shortcoming that only two departments could evaluate the HCPCMM.

8 Discussion and Conclusions

This chapter intends to conclude the thesis by first bringing answers to the research questions. This will be followed by the theoretical contributions, and practical contributions for the customers in question. The thesis' limitations will be discussed, and thereby also recommendations for future research. Finally, we will give our concluding reflections of discoveries from this thesis.

8.1 Answering the Research Questions

The purpose of our thesis was to develop a model used for assessing and raising awareness of the maturity of HCPC within Swedish HC, as well as contributing to the discussion of HCPC maturity. More specifically, this was done on an operational and tactical level with a focus on individual departments or organizations.

The first research question, RQ1, was: *“How can HCPC maturity be defined at a HC department level?”*. Its purpose was to better understand how maturity is expressed within the context of HCPC.

Since the HCPCMM assesses maturity, one must also understand what ‘maturity’ means in the studied context of HCPC. From the maturity levels in the MM a clear transition from being reactive to being proactive is seen as a strong indicator of maturity, confirming views from many previous MMs. More specifically, the two highest steps were described as ‘Internally Integrated’ and ‘Proactive and Holistic’. From these definitions it becomes clear that HCPC that is well-integrated in the department and, in addition to that, is used to tackle more holistic HC problems, is a strong indicator for high maturity. This transition was found to be supported by several, non-exhaustive perspectives.

‘Balance & Integration’ was found used as a general, more evaluating, process area in the conceptual MM. ‘Integration’ is covered by the maturity level progression (as described above) and could relate to several of the process areas identified such as ‘Culture’. ‘Balance’ was additionally found to be important for almost all process areas for the HCPCMM. The act of actively steering the organization to a situation where there is a balance between capacity and healthcare need, lies within the definition of HCPC and is naturally of importance for the maturity of departments. Achievement of a balance is of course ideal but not a guarantee just because you work towards it, unexpected events or people quitting can affect the feasibility of plans. Once again, returning to the central *proactiveness* a department should not only plan for feasibility, but also prepare for certain unexpected events.

Alternatively, one could look at the individual process areas, as each of them have a clear maturity progression and are described to be of equal importance. Then the maturity would relate to simply the fulfillment of all the different process areas highlighted in the maturity model, as seen in Appendix A.1 or Figure 7.4 – 7.14. The most straightforward answer to the research question is arguably the one relating the maturity levels of the final HCPCMM: maturity can be described as a transition from ‘No HCPC’ to ‘Proactive & Holistic’. These maturity levels are found together with the rest of the HCPCMM in Table 8.1, right below the answer to RQ3.

The second research question, RQ2, *“What model design will be best suited for assessing maturity within Swedish HCPC?”* aimed to realize how the HCPCMM should be designed to best fit with the described intentions by RJL. The literature review informed possible design choices between maturity

grid, a spider web representation, and a ladder representation. The best suited design was to develop a maturity grid since that fulfilled the purpose of being:

- Easy to overlook, but possible to fill with very specific content.
- Possible to assess for someone external to the department, but meanwhile involved in the overall organization. This assessment preferably happens together with crucial representatives from the department.
- A suitable facilitator for internal discussions.

We suggest that process areas should be specified on the vertical axis of the model grid, while the maturity levels were laid out on the horizontal axis. Further, an assessment of the overall maturity level, when aggregating the assessment of each process area, was requested. This made it necessary to clearly define an administration mechanism that can define whether a maturity level was achieved or not. Based on the inputs from Workshop 2, we concluded that:

- All maturity requirements for a cell needed to be achieved for the cell to be assessed fulfilled.
- All cells in one maturity level column needed to be fulfilled to mark that aggregated maturity level as fulfilled.

RQ3 asked “*What would be a suitable model for evaluating maturity in a HCPC-process?*”, aiming to establish that a MM was to be developed. The HCPCMM is a maturity grid consisting of five maturity levels and twelve process areas. Unlike many other MMs found, the HCPCMM has the process areas grouped into four categories: ‘Organization & Culture’, ‘Structure & Routines’, ‘Measurement & Control’, and ‘IT’. The model with some remarks was presented in *7.4.1 Maturity Model Design Considerations* and is once again shown in Table 8.1. The presented Table 8.1 can double as an assessment sheet for filling in the judgement. Cell texts are only provided in the split up maturity model in 7.3.1 – 7.3.4. *Appendix A.1* shows the Swedish concatenated model with full cell texts.

Table 8.1: The HCPCMM with its specified dimensions and maturity levels in English.

Categories	Process Areas	Maturity levels				
		No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Organization & Culture	Leadership for HCPC					
	Organizational Competences for HCPC					
	Culture					
Structure & Routines	Product Definition and Internal Resource Requirements					
	Structure for Capacity Utilization					
	Production plan routines					
	Routines for Scheduling of Resources and Appointments					
	Meetings and Collaboration					
Measurement and Control	Performance Measurement					
	Follow-up and Control					
IT	Software Support for Analysis					
	Systems Integration					

8.2 Theoretical Contribution

The findings from this MM are building upon the works of Vissers et al. (2001) that defines HCPC and exemplifies the activities at different hierarchical levels. It further has many similarities with how Rosenbäck (2017) defines the different levels. The concept of HCPC maturity has not been discussed before. One theoretical contribution consists of identifying which key aspects from Rosenbäck (2017) and Vissers et al. (2001) that need to be in place for mature HCPC. Extant literature is scarce that take a more general perspective of resource capacity planning in HC and HCPC, and we contribute to the general discussion of HCPC.

Although many papers present solutions of specific HC problems (as illustrated in Hulshof et al., 2012), the actual implementations of what are low and risk being unsatisfactory to HC departments. The developed HCPCMM complements the literature by describing reasons behind the low implementation of resource capacity planning solutions, taking on a more practical approach of what needs to be in place before such implementation.

Larsson & Fredriksson (2019), that recently examined tactical HC planning, proposed a model for that and argued that their model can be used for assessment. Adding to this literature, the HCPCMM takes a perspective of both operational and tactical planning and identifies process areas related to 'Organization and Culture' to be important for the HCPC to be successful. The same goes for the structural prerequisites of setting up a structure around the definition of HCPC data, such as HC products and their internal resource requirements. The definition of these data points is not explicitly mentioned as something to assess a department based upon, but it is an important area to make decisions around as highlighted by Rosenbäck (2017) and Vissers et al. (2001).

Previous applications of existing planning models of Lapide (2005) have been seen (Larsson & Fredriksson, 2019), but only selected dimensions from that model were chosen for assessment. The HCPCMM is the first identified MM related to HCPC, extending the current literature of MMs in processes, supply chain and tactical planning to a more concrete application (e.g. Wagner et al., 2014; Grimson & Pyke, 2007; Hammer, 2007; Lapide, 2005; Lockamy & McCormack, 2004). The application on both a tactical and operational level is additionally unique and motivated by an emphasis on control executed through schedules described in interviews. This is an indication that the operational HCPC additionally might be of low maturity.

The perspective of a MM does not only describe an ideal scenario but also considers the progression towards the ideal. It presents a unique contribution to HCPC literature. That leads us to the discussion of practical contributions.

8.3 Practical Contribution

The practical contribution has been in mind for the whole development of the model. The thesis was ordered from Astrada with RJJ in mind, and the practical application in RJJ will be the most straightforward. In RJJ the HCPCMM will aid the assessment of HC departments HCPC maturity during their work with KPS. It will be able to show areas where a department is lagging or needs to be prioritized. The highest step of the MM being proactive and holistic, with an emphasis on activities being taken together with other departments, can induce a change of planning horizon at hospital departments across the region. As a result, it could make departments more proactive rather than reactive. As highlighted in the *7.4.2 Evaluation: Validation and Verification*, a final assessment might show that although some departments have a well-developed operational HCPC level, they are not yet actively working with a more tactical HCPC. This should ultimately both guide the implementation of KPS, by prioritizing efforts needed, and ensure that results from the implementation remain a while after the implementation.

There are also possible practical contributions outside RJJ, for Astrada to recommend to other clients or to Swedish HC in general. Similar to the application in RJJ, it can be seen as a way for departments to start working with HCPC, identify their shortcomings and where they need to prioritize efforts. This application would be interesting when increased efforts for HCPC is expected due to increased regional

and governmental interest. The national incentives for increased HCPC were discussed in the background and further supported during interviews highlight the importance of tools that can aid one HC regions in their development.

8.4 Limitations and Future Research

A limitation is that the main focus of the MM is not to get a final rating of maturity. Thus, the model should not, without special consideration, be used for benchmarking between departments.

Another limitation is that the applicability of the model has not yet been fully investigated. Future testing will thus be needed to understand the exact applicability. The evaluation round was limited to two different departments within ambulatory HC services and primary care within RJL. Applications for other types of HC services need to be tested, as well as applications in different HC regions (possibly also abroad). As experts and literature outside RJL was used, no major differences are not expected to be found. To extend transferability, an HC region that operates slightly differently, with many bigger independent hospitals would be interesting for further testing of the model.

Additionally, some improvement opportunities were identified from the evaluation round, resulting in the final model being revised after the evaluations. The final MM has consequently not gone through any testing of its applicability and ease of making an assessment. This is an important reservation to make, since it might affect the credibility of the HCPCMM. It indicates that further refinement and updating of the model could potentially happen after the model is released. And any actual successful application to primary care should ideally be reconfirmed. That such refinements happen of natural reasons was, however, captured by Maier et al. (2012) as they defined ‘Maintenance’ as an additional step after model evaluation and -finalization. Such future research can thus be seen as measures for increasing dependability when new conditions affect the relevance. Nonetheless, the HCPCMM will serve as an important material for discussion.

Currently, the application could be limited to Swedish HC applications, due to there only being Swedish expert interviewees and a Swedish context confirming the relevancy of HCPC. To increase transferability, following the above discussion, further testing and evaluation of the MM is the main area for future research. Other possible research areas could relate to the agreements on how the final assessment could be done, or how the model evaluation possibly can be formed. For the evaluation, one would like future research to elaborate on the work of Grimson & Pyke (2007) as they evaluate how ‘S&OP Plan Integration’ relates to the other process areas.

Another interesting aspect would be to investigate to which degree mathematical optimization and automation algorithms and decision support solutions are implemented in Swedish HC today. The literature identified from this area was from other countries, older, and quite fragmented. A study could be done of trying to map the general implementation of mathematical solutions, but one could also investigate the link between HCPC maturity and the implementation of mathematical solutions. A positive connection would further show the importance of well-defined structure for HCPC.

8.5 Concluding Reflections

Surprisingly, the mere defining of HC products, their resource requirements and agreements around available capacity calculation is proven relevant for maturity. This is enablers for calculations of

available capacity and required capacity needed to satisfy the healthcare need. HC, with a distinct focus on treatment of patients, clearly does not have the same tradition around product definition and bill-of-materials as manufacturing has. Similarly, IT systems to support this, such as ERP systems in industrial applications is rare in healthcare. The need to define new type of data is something that sets HC apart from manufacturing industry and disqualifies the many PPMMs from truly fruitful applications in this context.

The contrasting views of HCPC are demonstrated by the many different abbreviations and definitions used across regions and public authorities: production control, capacity- and production control, production- and capacity control, or production and capacity planning. Additionally, there are conflicting views on the role of improvement work in HCPC. Many want to interconnect the two, whilst one expert was strictly against it. Many examples provided by interviewees showed problems where they had successfully done efficiency-increasing efforts. In the MM, this was solved by claiming that HCPC visualizes improvement opportunities. There seems to be a consensus among most that the ultimate goal is to find a resolution for the bad accessibility in HC, and that the solution can no longer be to simply hire more personnel. No matter how strong ties are made between improvement work and efficient HC in the different healthcare regions, HCPC will be an important tool for keeping track of demand, capacity and how it is dimensioned.

Many factors indicate that HCPC is a trending subject in Swedish HC, but HCPC is not a new phenomenon. One of the core literature sources was written over 20 years ago (Vissers et al., 2001). The fact that little seems to have happened since then is interesting. It makes us question what so far has limited the implementation of HCPC and if HC has substantially changed to become more receptive since. The limited HCPC could be a problem for Sweden specifically, but that was not studied further. However, similarities between the literature of HCPC and Swedish HC would suggest that HC faces similar issues around Europe. This make us question how successful the current wave of HCPC will be.

The reasons for less successful HCPC could be many. Sweden has independent HC regions which leaves HCPC implementation as a task for individual regional councils and sometimes individual departments or hospitals. Although NBWH recently has received a coordinating role, gathering knowledge around HCPC, this could be something that makes roll-out slow. Central efforts could additionally be limited by the independence creating varying ways of working and contrasting views on what HCPC is, limiting the opportunity to learn from each other. Alternatively, the more urgent operational issues will continue to stand in the way for the structured roll-out of HCPC, never allowing HC to reach a tactical level. One of NBHW's mission have prioritized a focus on freeing up hospital beds over the development of HCPC guidelines. But other than this, the big governmental support of today should probably be seen as an indicator that HCPC is getting increasing attention and might be here to stay. After writing this thesis we look forward to seeing what will come next!

9 References

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Appendix

A.1 Maturity Model (Swedish)

Organisation & Kultur					
	Ingen Produktionsstyrning	Reaktiv	Aktiv	Internt Integrerad	Proaktiv & Holistisk
Ledarskap	*Ledarskapet är ointresserade av att förändra verksamheten genom produktionsstyrning.	*Ledarskapet har ett intresse för produktionsstyrning *Ledarskapet avsätter inte resurser eller tillåter ej större prioritering av produktionsstyrning	*Ledarskapet ser ett tydligt syfte med att produktionsstyra för att förbättra verksamheten *Ledarskapet kan kommunicera syftet med produktionsstyrning väl till organisationen *Ledarskapet etablerar produktionsstyrning sinitiativ i verksamheten och avsätter tillräckligt med resurser för att de ska genomföras *Ledarskapet är lyhört mot medarbetares feedback	Samma som aktiv	Samma som aktiv
Kompetenser i verksamheten	*Ingen i verksamheten har särskild kunskap i produktionsstyrning	*Den som produktionsstyr i verksamheten har viss kunskap i produktionsstyrning. *Den som produktionsstyr i verksamheten kan överblicka en situation och ta beslut i stressiga situationer	* Ansvarig för produktionsstyrning har en känsla för siffror, förståelse för logistiska koncept, och kan utföra enklare analyser *Verksamhetens ansvariga för produktionsstyrning har, utöver kunskap i produktionsstyrning, även förståelse för förbättringsarbete *Övriga medarbetare vet vad produktionsstyrning är och varför det görs	*Ansvarig för produktionsstyrning är bekvämt att arbeta med siffror och har förståelse för logistiska koncept *Personen kan utföra analyser för att identifiera problem och prioritera mellan dessa efter deras förväntade påverkan på den egna verksamheten *Verksamhetens ansvariga för produktionsstyrning har, utöver kunskap i produktionsstyrning, även förståelse för förbättringsarbete *Övriga medarbetare har en idé om hur deras agerande och insatser kan påverka produktionsstyrningens effekt	Samma som Internt Integrerad

<p>*Låg förändringsvilja bland medarbetarna, vill att saker ska vara som det alltid varit</p> <p>*Kritik mot att sätta siffror på vård</p> <p>*Medarbetare tenderar att fokusera på personliga intressen och brister i att se sig som delar av ett större sjukvårdssystem.</p>	<p>*Låg förändringsvilja bland medarbetarna, vill att saker ska vara som det alltid varit</p> <p>*Förståelse för att det kan finnas behov av att räkna på kapacitet, vårdbehov och vårdproduktion för att förbättra tillgänglighet eller synliggöra problem</p> <p>*Medarbetare tenderar att fokusera på personliga intressen och brister i att se sig som delar av ett större sjukvårdssystem.</p>	<p>*Vissa medarbetare visar nyfikenhet och ändrar rutiner efter de förbättringsinitiativ som drivs i verksamheten.</p> <p>*Flera medarbetare har tillit till ansvariga för produktionsstyrning och kring syftet med att sätta siffror på vård.</p> <p>*Medarbetare fokuserar generellt mindre på personliga intressen men brister i att se sig som delar av ett större sjukvårdssystem.</p>	<p>*Flera medarbetare vill själva bidra till förbättring av verksamheten, tar egna initiativ och kommer självmant med förslag.</p> <p>*Rutiner ändras efter förbättringsinitiativ som drivs i verksamheten</p> <p>*Flera medarbetare har tillit till ansvariga för produktionsstyrning och IT-system kopplade till produktionsstyrning. Dessutom finns det en tillit för att sätta siffror på vård.</p> <p>*Medarbetare är öppna inför att hjälpa till där det behövs för att förbättra vården som helhet</p>	<p>*Majoriteten av medarbetarna vill vara en aktiv part i kontinuerlig förbättring av verksamheten</p> <p>*Rutiner ändras efter förbättringsinitiativ som drivs i verksamheten</p> <p>*Majoriteten av medarbetarna har tillit till ansvariga för produktionsstyrning och IT-system kopplade till produktionsstyrning. Dessutom finns det en tillit till att sätta siffror på vård.</p> <p>*Medarbetare ser sig som en viktig pusselbit till att förbättra sjukvårdssystemet som helhet och hjälper till där det behövs</p>
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Strukturer & Rutiner

Vårdprodukter och dess interna resursåtgång

Ingen Produktionsstyrning	Reaktiv	Aktiv	Internt Integrerad	Proaktiv & Holistisk
*Erbjudna vårdtjänster är ej tillräckligt strukturerade	<p>*Verksamheten har koll på vilka vårdtjänster som de erbjuder.</p> <p>*Viss gruppering av vårdtjänster är gjord till övergripande vårdprodukter.</p>	<p>*Ett antal vårdprodukter används aktivt i produktionsstyrning av verksamheten och de underhålls när det anses lämpligt.</p> <p>*Intern resursåtgång är delvis definierad för vårdprodukterna, med hjälp av exempelvis tidsåtgång.</p>	<p>*Vårdprodukter är väl utvalda för att passa verksamhetens behov och används effektivt i styrningen. Förlegade produkter är borttagna och produkter revideras vid behov med lätthet.</p> <p>*All relevant intern resursåtgång är definierad för vårdprodukterna, *Resursåtgången är förankrad i verksamhetens arbetssätt och efterföljs till stor grad</p> <p>*De verksamheter som har högt överlapp med andra och där samplanering krävs, definierar sina vårdprodukter för att säkerställa kompatibilitet mot dessa angränsande verksamheter</p>	<p>*Vårdprodukter är väl utvalda för att passa verksamhetens behov och används effektivt i styrningen. Förlegade produkter är borttagna och produkter revideras vid behov med lätthet.</p> <p>*All relevant intern resursåtgång är definierad för vårdprodukterna, *Resursåtgången är förankrad i verksamhetens arbetssätt och efterföljs alltid när det är möjligt</p> <p>*Definieringen av vårdprodukter är gjord för att fungera väl med alla angränsande verksamheter. Idealt är instrumentaliseringen gemensamt utvecklad med dessa verksamheter.</p>

Struktur för kapacitetsutnyttjande

<p>* Schemaläggning sker baserat på personliga överenskommelser och med liten förankring i verksamhetens behov</p>	<p>*Det finns inofficiella överenskommelser i verksamheten som möjliggör schemalaggningsen</p> <p>*Kännedom om personalens kompetens finns hos en eller ett fåtal medarbetare i form av tyst kunskap.</p>	<p>*Det finns etablerade överenskommelser om kapacitet gällande verksamhetens bemanningsnivåer, tjänstgöringsgrad och arbetstidsfördelning för enskild personal.</p> <p>*Det finns även viss kännedom om vad för kompetens bland medarbetarna som behövs</p> <p>*Överenskommelser kring schemaläggning har en viss förankring i verksamheten</p> <p>*Överenskommelser kring schemaläggning finns centralt lagrade</p> <p>*Kännedom om personalens kompetens finns dokumenterad</p>	<p>*Det finns etablerade överenskommelser om schemaläggning gällande verksamhetens bemanningsnivåer, tjänstgöringsgrad och arbetstidsfördelning för enskild personal.</p> <p>*Det finns även en utbredd kännedom om vad för kompetens bland medarbetarna som behövs.</p> <p>*Överenskommelser kring schemaläggning är väl förankrade i verksamhetens behov</p> <p>*Kompetensen matchar verksamhetens behov av kompetens</p> <p>*Överenskommelser kring schemaläggning finns centralt lagrade och är tillgänglig för alla medarbetare</p> <p>*Kännedom om personalens kompetens är utförlig och finns lagrad centralt, i exempelvis en kompetensmatris</p>	<p>*Det finns etablerade överenskommelser om schemaläggning gällande verksamhetens bemanningsnivåer, tjänstgöringsgrad och arbetstidsfördelning för enskild personal.</p> <p>*Det finns även en utbredd kännedom om vad för kompetens bland medarbetarna som behövs.</p> <p>*Överenskommelser kring schemaläggning är väl förankrade i verksamhetens bästa och dess behov på lång sikt, eventuellt genomflånga iterationer, och hålls stabila i den mån det är möjligt.</p> <p>*Kompetensen matchar verksamhetens behov av kompetens.</p> <p>*Överenskommelser kring schemaläggning finns centralt lagrade och är tillgänglig för alla medarbetare</p> <p>*Kännedom om personalens kompetens är utförlig och finns lagrad centralt, i exempelvis en kompetensmatris</p>
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Rutiner för produktionsplanen

<p>*Planeringshorisonten för verksamheten sträcker sig inte längre än schemat.</p>	<p>*Det finns en mer övergripande produktionsplan.</p> <p>*Produktionsplanen baseras på uppfattningar om vårdbehov och bristfälliga historiska data.</p> <p>*Produktionsplanen har ingen tydlig förankring i verksamheten.</p>	<p>*En övergripande produktionsplan görs åtminstone en gång per år,</p> <p>*Produktionsplanen baseras på en prognos för vårdbehovet.</p> <p>*Produktionsplanen har viss förankring i verksamheten.</p>	<p>*En övergripande produktionsplan görs och släpps åtminstone en gång per år med god framförhållning inför att den börjar gälla.</p> <p>*Det finns en rutin kring när produktionsplanen skapas.</p> <p>*Produktionsplanen baseras på en välgrundad prognos för vårdbehovet.</p> <p>*En balansering mot vårdbehovet görs i produktionsplanen genom matchning mot en grov kapacitetsplan.</p> <p>*Kapacitetsplanen och överenskommelser kring resursutnyttjande och kompetenser är i linje med varandra.</p> <p>*Produktionsplanen är kopplad till de strategiska målen och hur verksamheten fungerar</p>	<p>*En övergripande produktionsplan görs och släpps åtminstone en gång per år med god framförhållning inför att den börjar gälla.</p> <p>*Det finns en rutin kring när produktionsplanen skapas.</p> <p>*Planeringshorisont och detaljeringsgrad är samma som angränsande verksamheter.</p> <p>*Produktionsplanen baseras på en välgrundad prognos för vårdbehovet.</p> <p>*En balansering mot vårdbehovet görs i produktionsplanen genom matchning mot en grov kapacitetsplan.</p> <p>*Kapacitetsplanen och överenskommelser kring resursutnyttjande och kompetenser är i linje med varandra</p> <p>*Produktionsplanen är kopplad till de strategiska målen och hur verksamheten fungerar</p>
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Rutiner för schemaläggning och tidsbokning

<p>Samma som reaktiv</p>	<p>*Schemaläggning sker med kort och oregelbunden framförhållning.</p> <p>*Ordningen för framtagning av olika scheman är inte beslutad efter verksamhetens bästa.</p> <p>*Schemaläggning är till stor del baserad i tradition</p> <p>*Individens personliga intressen får spela stor roll i schemaläggningen.</p>	<p>*Schema läggs antingen med kort eller oregelbunden framförhållning</p> <p>*Schemaläggning är koordinerad mellan verksamhetens olika resurser.</p> <p>*Schemaläggning har viss förankring i vårdbehov, överenskommelser om kapacitetsutnyttjande och produktionsplan.</p> <p>*Vissa ofördelaktiga beteenden kring schemaläggning och tidsbokning ligger kvar</p>	<p>*Schema läggs med cirka tre månaders framförhållning.</p> <p>*Schemaläggning är koordinerad mellan verksamhetens olika resurser och, vid behov, även med verksamheter med gemensamma resurser.</p> <p>*Schemaläggning är förankrad i vårdbehov, överenskommelser om kapacitetsutnyttjande och produktionsplan</p> <p>*Schemaläggning tar höjd för verksamhetens naturliga variationer, vilket innebär att schemalagd kapacitet överträffar behov i produktionsplan.</p> <p>*Rutiner för tidsbokning finns och medför hög följsamhet till schemat.</p>	<p>*Schema läggs med cirka tre månaders framförhållning.</p> <p>*Planeringshorisont är samma för alla verksamheter som delar gemensamma resurser.</p> <p>*Schemaläggning är koordinerad mellan verksamhetens olika resurser och, vid behov, även med verksamheter med gemensamma resurser.</p> <p>*Schemaläggning är förankrad i vårdbehov, överenskommelser om kapacitetsutnyttjande och produktionsplan.</p> <p>*Schemaläggning tar höjd för verksamhetens naturliga variationer, vilket innebär att schemalagd kapacitet överträffar behov i produktionsplan.</p> <p>*Rutiner för tidsbokning finns och medför hög följsamhet till schemat.</p> <p>*Rutiner täcker även hur tidsbokning ska ske med berörda avdelningar i patientflöden.</p>
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Mötesrutiner och samarbete

<p>*Varken möten eller enstaka mötespunkter som berör produktionsstyrning förekommer i verksamheten.</p>	<p>*Produktionsstyrning diskuteras i enstaka fall på möten. *Produktionsstyrning diskuteras ad-hoc, ofta föranlett av en specifik situation. *Mötesdiskussioner är grundade i upplevelser snarare än data</p>	<p>*Enskilda möten som berör produktionsstyrning, eller produktionsstyrning som en fast agendapunkt på möten, förekommer. *Möten diskuterar främst utfallet av planeringen och behovet av förändringar i ljustet av detta. *Data gällande produktion används som underlag i möten.</p>	<p>*Regelbundna möten hålls både inför schemaläggning och skapandet av en ny produktionsplan. *Möten diskuterar och följer upp balanseringen av kapacitet och behov på olika nivåer. *Det förekommer möten för planering tillsammans med avdelningar som man kan behöva samarbeta med. *Mjukvara för produktionsstyrning används som underlag i möten.</p>	<p>*Regelbundna möten hålls både inför schemaläggning och skapandet av en ny produktionsplan. *Möten diskuterar och följer upp balanseringen av kapacitet och behov på olika nivåer. *Det finns regelbundna möten för planering tillsammans med alla avdelningar som man kan behöva samarbeta med *Alla avdelningar har en gemensam planeringshorisont *Vid behov kan extra möten med samarbetande avdelningar med lätthet sättas in. *Det finns beslut kring tilldelning av volymer/tillgång på gemensamma resurser där det behövs. *Mjukvara för produktionsstyrning används som ett interaktivt underlag i möten.</p>
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Mätning & Styrning

Ingen Produktionsstyrning	Reaktiv	Aktiv	Internt Integrerad	Proaktiv & Holistisk
*Verksamheten mäter enbart den typ av produktionsmått som är kopplad till övergripande mål, och krav som efterfrågas av högre instans (exempelvis vårdgarantier)	*Verksamheten mäter bland annat den typ av produktionsmått som är kopplad till övergripande mål, och krav som efterfrågas av högre instans (exempelvis vårdgarantier) * Mätning av producerad vård (historik) och förutsättningar för att möta framtida vårdbehov (kapacitet och behov) görs enbart på kort sikt i krissituationer, eller för sammanställningar	*Verksamheten mäter bland annat den typ av produktionsmått som är kopplad till övergripande mål, och krav som efterfrågas av högre instans (exempelvis vårdgarantier) *Mätning av producerad vård (historik) och förutsättningar för att möta framtida vårdbehov (kapacitet och behov) görs regelbundet. * Schemats avvikelse mot produktionsplan mäts regelbundet. * Mätetal kring flödet och resursutnyttjande är etablerade och mäts vid behov.	*Mätning av vårdgarantier görs enbart för rapport till högre instans. * Arbetsmiljö mäts regelbundet och relateras till förändringar och aktiviteter i produktionsstyrning. *Mätning av producerad vård (historik) och förutsättningar för att möta framtida vårdbehov (kapacitet och behov) görs regelbundet. *Avvikelse mot plan mäts regelbundet, på olika aggregationsnivåer och för olika sorters avvikelser: *Schemats avvikelse mot produktionsplan * Tidbokens avvikelse mot schema, och produktionsplan *Mätetal kring flödet och resursutnyttjande är etablerade med angränsande verksamheter och mäts vid behov	Samma som internt integrerad

Mätetal

<p>*Förbättringsarbete startas upp adhoc utan anknytning till produktionsdata.</p>	<p>*Eventuella styr signaler som finns är inte välintegrerade i verksamheten</p> <p>*Förbättringsarbeten kan inledas, men ofta mer på känsla än med grund i siffror och vårdproduktionsdata.</p>	<p>*Vissa styr signaler är etablerade.</p> <p>*Det finns en förståelse för hur man ska agera vid styr signaler.</p> <p>*Oförmåga att möta specifikt vårdbehov leder till analys av situationen och kan skicka signaler om att förbättringsarbete ska inledas.</p>	<p>*Styr signaler är etablerade för väl avvägda situationer</p> <p>* Det finns flera konkreta alternativ på åtgärder kopplade till styr signaler.</p> <p>*Identifierade variationer, oförmåga att möta vårdbehov, och avvikelser från plan och överenskommelser undersöks.</p> <p>*Vid behov skickas signaler om att förbättringsarbete ska inledas för att eliminera onödiga avvikelser och variationer.</p> <p>*Det finns en tydlig struktur för att fånga upp identifierade problem, förbättringsmöjligheter och initiativ från medarbetare.</p>	<p>* Styr signaler är etablerade för väl avvägda situationer</p> <p>* Det finns flera konkreta alternativ på åtgärder kopplade till styr signaler.</p> <p>*Kapacitetsjusteringar för samarbete och hjälp mellan avdelningar är en etablerad möjlighet.</p> <p>* Identifierade variationer, oförmåga att möta vårdbehov, och avvikelser från plan och överenskommelser undersöks</p> <p>*Vid behov skickas signaler om att förbättringsarbete ska inledas för att eliminera onödiga avvikelser och variationer.</p> <p>*Det finns en tydlig struktur för att fånga upp identifierade problem, förbättringsmöjligheter och initiativ från medarbetare.</p> <p>*Produktionsplanen uppdateras om förutsättningarna på vilken den är byggd förändras.</p>
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IT

Ingen Produktionsstyrning	Reaktiv	Aktiv	Internt Integrerad	Proaktiv & Holistisk
<p>*Data för vårdproduktion kan visualiseras men detta görs enbart i uppföljande syfte. Avsaknad av välvalda vårdprodukter gör det till ett mycket manuellt arbete.</p>	<p>*Data för vårdproduktion kan visualiseras. Avsaknad av välvalda vårdprodukter gör det till ett mycket manuellt arbete. *Visualisering görs uppföljande men även för att få en översikt av redan planerad verksamhet.</p>	<p>*Utvald vårdproduktionsdata kan hanteras av och lagras i mjukvarustödet.</p> <p>*Visualisering av datan kan utföras regelbundet med enkelhet *Visualisering används i uppföljande syfte, men även regelbundet för att få en översikt av och revidera redan planerad verksamhet.</p> <p>*Ansatser till simulering förekommer, främst för att testa genomförbarhet av en tilltänkt plan.</p>	<p>*Stor andel av behövda vårdproduktionsdata kan hanteras av och lagras i mjukvarustödet.</p> <p>*Visualisering av datan utförs regelbundet och det finns centralt tillgängliga dashboards som underlättar detta. *Visualisering används i uppföljande syfte, men även regelbundet för att få en översikt av och revidera redan planerad verksamhet. Både för framtida taktisk och operativ planering.</p> <p>*Mjukvaran kan generera förslag både med simulering och optimering. Förslagen är genomförbara efter mindre modifieringar *In-data kan varieras för att göra känslighetsanalyser och alternativa förslag.</p>	<p>*Stor andel av behövda vårdproduktionsdata kan hanteras av och lagras i mjukvarustödet.</p> <p>*Visualisering av datan utförs regelbundet och det finns centralt tillgängliga dashboards som underlättar detta. *Visualisering används i uppföljande syfte, men även regelbundet för att få en översikt av och revidera redan planerad verksamhet. Både för framtida taktisk och operativ planering.</p> <p>*Mjukvaran kan generera förslag både med simulering och optimering. Förslagen är direkt genomförbara och tar hänsyn till angränsande verksamheter *In-data kan varieras på olika sätt för att göra känslighetsanalyser och alternativa förslag,</p>

Mjukvarustöd för analys

Integrering av system

<p>* Ingen specifik mjukvara för produktionsstyrning förekommer.</p> <p>* Mycket relevant data för produktionsstyrning saknas helt eller inte.</p>	<p>* Ingen specifik mjukvara för produktionsstyrning förekommer.</p> <p>* Mycket relevant data för produktionsstyrning saknas eller används ej. I vissa akuta situationer kan relevant data dock extraheras och nyttjas.</p>	<p>*Mjukvaran för produktionsstyrning kan kopplas till andra interna system som används för att administrera vårdproduktion. Separat registrering förekommer delvis.</p> <p>* Data för vårdproduktion är delvis definierad och används i viss utsträckning. * Sämre integrerade system medför att datakvalitén varierar och att data ofta behöver ses över.</p>	<p>*Mjukvaran för produktionsstyrning kan hämta data från andra interna system som används för att administrera vårdproduktion automatiskt och ingen separat registrering krävs. *Information från verksamheten kan automatiskt föras in i andra system. *Mjukvaran för produktionsstyrning är på samma sätt kopplad till angränsande verksamhetens liknande system.</p> <p>* Data för vårdproduktion är fullständigt definierad och den interna kvalitén kan säkerställas genom välintegrerade system. Extern data behöver ses över. *Både datan och dess kopplingar mellan olika benämningar är begripliga.</p>	<p>*Mjukvaran för produktionsstyrning kan hämta data från andra interna system som används för att administrera vårdproduktion automatiskt och ingen separat registrering krävs. *Information från verksamheten kan automatiskt föras in i andra system. *Mjukvaran för produktionsstyrning är sömlöst integrerad med angränsande verksamhetens liknande system.</p> <p>* Data för vårdproduktion är fullständigt definierat och kvalitén säkerställs genom välintegrerade system internt och externt. *Både datan och dess kopplingar mellan olika benämningar är begripliga.</p>
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A.2 Example of HCPCMM Assessment (English)

An example assessment of a department/clinic/organization rated 'Active'.

Categories	Process Areas	Maturity levels				
		No HCPC	Reactive	Active	Internally Integrated	Proactive & Holistic
Organization & Culture	Leadership for HCPC	Green	Green	Green	Green	Green
	Organizational Competences for HCPC	Green	Green	Green	Yellow	White
	Culture	Green	Green	Green	Yellow	White
Structure & Routines	Product Definition and Internal Resource Requirements	Green	Green	Green	Yellow	White
	Structure for Capacity Utilization	Green	Green	Green	Green	White
	Production plan routines	Green	Green	Green	Yellow	White
	Routines for scheduling of resources and appointments	Green	Green	Green	Green	White
	Meetings and Collaboration	Green	Green	Green	Green	White
Measurements and Control	Measurements	Green	Green	Green	Green	Yellow
	Follow-up and Control	Green	Green	Green	Yellow	White
IT	Software Support for Analysis	Green	Green	Green	Yellow	White
	Systems Integration	Green	Green	Green	Yellow	White

A.3 Question Material for Maturity Model and Examples (Swedish)

Process-område	Exempelfrågor	Exempel och Förtydliganden
Ledarskap	<p>Finns det någon som är ansvarig för produktionsstyrning? Hur visar sig ledarskapets engagemang för produktionsstyrning gentemot medarbetare? Driver ni några projekt kopplade till produktionsstyrning? Om ja, vad för sorts projekt? Vad för möjlighet har medarbetare att bidra till produktionsstyrning?</p>	<p>Den ansvariga personen behöver ej vara del av ledningsgruppen. Men ledningsgruppens engagemang och vilja att lokalisera tid och resurser är viktig ändå.</p>
Kompetenser i verksamheten	<p>Hur ser kompetensen gällande förbättringsarbete ut? Hur ser kompetensen gällande siffror och logistik ut i verksamheten? Hur spridd är ovan kompetenser för produktionsstyrning i verksamheten? Vem gör analys av produktionsstyrning i verksamheten? Finns det någon yttre resurs som ni tar hjälp av för att göra analyser?</p>	<p>Om verksamheten har gott stöd utifrån behöver det inte finnas kunskap för avancerad analys inom avdelningen. En förståelse kring förbättringsarbeten och möjliga förbättringar för att bättre matcha behov och kapacitet, är viktig oavsett hur avancerad den egna analysen är.</p>
Kultur	<p>Vad är inställningen till produktionsstyrning i verksamheten? Hur demonstreras en positiv inställning till produktionsstyrning i verksamheten (vilja att delta, egna initiativ osv.)? Finns det tillit till IT-system och människor för produktionsstyrning? Vad är inställningen till att hjälpa andra personer, yrkesgrupper, angränsande verksamheter?</p>	
Vårdprodukter och dess interna resursåtgång	<p>Vad för vårdprodukter används för att styra verksamheten? Hur har dessa produkter valts ut? Är resursåtgång definierad för produkterna? Arbetar man efter vad som beslutats centralt gällande resursåtgång? Till vilken grad? Hur är kvaliteten på vårdprodukterna och dess interna resursåtgång? Är mängden vårdprodukter lätthanterlig? Har vårdprodukterna gemensamma beröringspunkter med andra verksamheter som den samarbetar mycket med?</p>	<p>En vårdprodukt är en gruppering av vårdtjänster som används för produktionsstyrning.</p> <p>En vårdtjänst kan vara mer detaljerad, till exempel med koppling till en viss diagnos, behandling och behandling.</p> <p>Väl utvalda vårdprodukter kan definieras som vårdtjänster med liknande resursåtgång.</p> <p>Intern resursåtgång är ofta tid hos olika personer. För en operation kan det vara både olika specialisters läkartid, sjukskötersketid, sal för operationssalen, och eventuellt även material. Definierandet offentliggör resursåtgång.</p>

Struktur för uträknande av tillgänglig kapacitet	<p>Finns det tagna beslut kring hur kapacitet ska utnyttjas? Finns det överenskommelser om schemaläggning, vad individer ska spendera sin tid på och bemanningsnivåer? Hur väl täcker dessa beslut och överenskommelser verksamhetens behov? Har verksamheten koll på kompetensen hos sina medarbetare? Hur lagras sådana bestämmelser och information om kompetens?</p>	<p>Strukturer för schemaläggning och kapacitet är viktigt. Många av besluten som ska gälla för schemaläggning tas på mer taktisk nivå, det är inte eftersträvansvärt att på hög nivå ha överenskommelser som inte är förankrade i hur vårdbehovet faktiskt ser ut.</p>
Rutiner för produktionsplanen	<p>Görs en produktionsplan? Hur ofta görs en ny produktionsplan? Vad baserar ni produktionsplan på? Hur görs prognoser av vårdbehov? Matchar ni vårdbehov från produktionsplan med övergripande kapacitetsberäkning, exempelvis bemanningsnivåer? Hur kopplar produktionsplan an till överenskommelser från struktur för uträknande av tillgänglig kapacitet? Delar ni schemalägningshorisont med andra verksamheter? Vilka? Hur yttrar sig planeringshorisonten?</p>	<p>En produktionsplan är en övergripande årlig plan</p> <p>Att en produktionsplan är baserad på överenskommelser om egen kapacitet, vårdbehov och kring användning av kapacitet innebär att en produktionsplan är genomförbar, detta är målet på de två högsta nivåerna.</p> <p>Genomförbarheten begränsas så klart av hur väldefinierade överenskommelserna är och hur välintegrerade de är i verksamheten.</p> <p>God framförhållning på skapandet av en produktionsplan innebär att den är en bra bit längre än horisonten för schemaläggning. En produktionsplan kan också innebära att nya månader tillfogas rullande, till exempel så att det alltid är ett år framåt inplanerat i produktionsplanen.</p> <p>En välgrundad prognos för vårdbehovet baseras på en mängd olika data, det kan vara historiska data, men även köer och eventuella leveransspecifikationer med angränsande verksamheter.</p>
Rutiner för schemaläggning och tidsbokning	<p>Hur ofta läggs schema? Delar ni schemalägningshorisont med andra enheter som ni behöver koordinera era insatser med? Till vilken grad är schemaläggning baserad i överenskommelser om schemaläggning och bemanningsnivåer? (se Struktur för uträknande av tillgänglig kapacitet) Till vilken grad görs schema mer på känn och med grund i personliga intressen? Hur väl kopplat är tidsbokningen med schemaläggningen? Kopplas schemat ihop med prognostiserat vårdbehov och produktionsplan? Finns det rutiner för tidsbokning hos andra verksamheter?</p>	<p>Notera skillnaden mellan denna och beräkning för tillgänglig kapacitet. Det förra handlar om att definiera data som vi här säkerställer används för att lägga in schema.</p>

Mötesrutiner och samarbete	<p>I vilken utsträckning håller ni driftmöten om produktionsstyrningen? Vad avhandlas på dessa möten? Med vilka håller ni möten om produktionsstyrning? Med vilken frekvens och regelbundenhet hålls möten? Vad för underlag används till produktionsstyrningsmöten? Vilken roll har mjukvara i detta underlag?</p>	
Mätetal	<p>Vad kollar ni på för mätetal i er organisation? Har ni någon mätning av avvikelser mot överenskommelser? Mäter ni avvikelse mot produktionsplan? Mäter ni avvikelse mot schema? Hur mäter ni tillgänglighet? Hur mäter ni arbetsmiljö? Relaterar ni arbetsmiljö till förändringar för produktionsstyrning? Har ni några etablerade mått för patientflöden eller andra flöden?</p>	
Uppföljning & Styrning	<p>Hur agerar ni på situationer där planering inte går ihop? Vad händer om inte längre en plan är genomförbar? Har ni samarbete över verksamhetsgränser för att lastbalansera vid behov? Har ni bestämt några styrsignaler med tydliga åtgärder för detta? Hur jobbar ni med förbättringsarbeten? Hur hanterar ni initiativ från medarbetare för att effektivisera och förbättra saker relaterade till produktionsstyrning? Hur jobbar ni med kompetensförsörjning i ljuset av hur produktionen presterar?</p>	<p>Åtgärder kopplade till styrsignaler bör i första hand gällande i första hand kapacitetsjusteringar och i andra hand vårdbehovsjusteringar, om inte annat är lämpligt.</p> <p>Befintlig produktionsplan kan uppdateras om ny personal anställs tillfälligt eller permanent. Detta kan exempelvis göra att man snabbare kan jobba ikapp en vårdskuld. Likaså ska förändringar göras om flera personer slutar en månad, då måste man realistiskt dra ner den vård man tänkt producera.</p>
Mjukvarustöd för analys	<p>Vad för IT-system/mjukvara använder ni er av idag för att göra er produktionsstyrning? Hur ofta använder ni er av detta/dessa system? Vad för beslut hjälper mjukvaran er med, på vilket sätt? Vilka har tillgänglighet till produktionsstyrningssystem? Hur kopplar IT systemet ihop verksamheter och kan hjälpa till att visualisera flöden? Kan mjukvarusystemet hantera definierade data för produktionsstyrning?</p>	<p>Känslighetsanalyser kan göras exempelvis per enskild produktgrupp, per patientflöde eller efter flöden från angränsande verksamheter.</p>
Integrering av system	<p>Vad för kopplingar har er mjukvara? Var hämtar den informationen från? Krävs det mycket manuell registrering för att skapa produktionsdata? Kan produktionsdata genereras automatiskt med hjälp av kopplingar till andra system? Bidrar verksamhetens system till en enhetlig bild av produktionsstyrning? Finns det en logisk koppling till hur data definieras i andra system? Kan mjukvara automatiskt uppdatera vissa data i andra system?</p>	<p>Exempel på system som administrerar vårdproduktion kan vara tidbokning, schemaläggning, journalsystem, rapporteringssystem av olika slag, telefonsystem. Detta kan skilja sig mellan verksamheter.</p>

A.4 Coding making up the process areas (English)

Interviewee	Code	Second order theme	Aggregated Dimension
A	"We have to adhere to agreements, employees should understand the agreements that we have decided upon, we should have a leadership that trust and rely on the agreements made"	A leader should lead improvement- and change initiatives and play an active role in creating a culture with a willingness to change and improve processes	Leadership for HCPC
A	There are still coworkers not adhering to agreements. A manager must then clearly communicate the agreements that have been made.		
B	A leader has to be curious about the organization's performance and actively try to understand e.g. the connections between HC needs and scheduling.		
B	There is no resting, control have to be done continuously (by the leader) when getting to know their operations better		
B	When controlling a department, you have an advantage if you've got earlier experience within HC. This in order to reduce the questioning from personnel. You need to be humble for their high level of education.		
F	Challenging old mindsets and cultures must start happening.		
F	A challenging approach in the leadership contributes to both culture and process.		
F	As a leader, you need to engage co-workers act upon performance indicators.		
F	Someone needs to act on the deviations, that requires competent leaders		
B	A leader has to clearly point out a direction and communicate the goals and motives behind HCPC.	It is important for a leader to communicate the goals and purpose behind HCPC and show his/her devotion and conviction.	
D	The leader must take an active role as the HCPC work is carried out.		
D	Leaders have to listen to their employees, and persuade without dictating too much.		
E	Devoted managers are needed to create a good foundation for HCPC		
E	Surveys for co-workers say that the knowledge about the overall goals with the departments is bad.		
E	The leadership should be able to communicate the purpose behind HCPC, especially since HCPC might come with personal conflicts of interests. Have to be able to communicate how this translates back to the patients.		
F	A manager or leader has to create enthusiasm among their employees and be convinced that they together can create a change and lead by example. They cannot feel like the victim of change.		
B	One person might have more than one role in HCPC	Someone in the organization must have an ownership of HCPC	
C	A manager must lead the HCPC work		
D	"It is important with someone in a planning function, that feels a clear ownership over these questions. This would be a role with similarities to the production		

	manager at a manufacturing firm, a role that has not had a counterpart within HC before"		
D	One person in management team should be able to support the organization in HCPC questions		
C	PC tends to become tasks for the scheduler - without any thoughts on why.	Assigning coworkers with the competence in question must be done with the department's best in mind	Organizational competences for HCPC
C	It is a waste of resources when a doctor is responsible for scheduling.		
E	People responsible for planning have not traditionally had the 'best plan' in mind, but rather other incentives such as making a career		
F	Not all scheduling people are aware of the HC demand or the staffing requirements for different operations		
F	Doctors should not be the ones responsible of scheduling, they are more helpful at other places.		
G	Motivating change in schedules based on the need can be difficult when you are scheduling your own colleagues		
B	Controllers are good at providing data		
B	Knowing questions to ask around graphs looking a certain way can be beneficial		
C	Controllers, HR, and business development must be involved in PC		
E	An increased responsibility to HCPC should be given to someone already working with finance or planning.	The planning competence must be secured	
E	Planning roles must be better established.		
D	Scheduling control and evaluation is a valuable competence	There is a need for an improved competence in logistics generally, and planning specifically to enable HCPC	
D	The need for logistics competence		
D	Knowledge in logistics is increases in importance the higher up in the organization you go.		
D	Education in logistics is an important add-on to existing knowledge for all co-workers.		
D	Someone must know how to plan.		
D	Competence in planning is needed. One must both know how to book and how to schedule.		
F	HC managers are usually doctors or nurses and are not educated in logistics specifically. That can be an obstacle for HCPC		
F	"I believe there is a need to educate engineers in HC and hospital logistics."		
F	To be able to work with processes in a stochastic environment, forecasts, and scheduling are specific competences regarding logistics that we completely miss today.		
C	KPS requires knowledge within measurements, scheduling, planning, and data handling.		
B	"I think that people worry that a doctor will quit his job and move to another region if his schedule is changed. Then we lose that competence."		A strive for personal flexibility, coworker's high

D	HC personnel are used to being able to make personal adjustments and tweaks to their schedule, e.g. 'wishful schedules' and prioritizing research. There are not enough internal regulations around scheduling.	education, and a low incentive for working efficient impacts the current HC culture.			
F	There is no incentive for working efficiently in public HC today.				
G	The fact that a majority of the workforce consists of well-educated production personnel affects the HC in a particular peculiar way.				
A	In a destructive culture, the focus for co-workers is just their own patients and not the department's. Similarly, a clinic not open to support other clinics is also a destructive behavior.	Implementing HCPC in a department can have a positive impact on the current culture			
A	A positive culture can be achieved by increasing the co-worker's participation.				
A	There are still coworkers not adhering to agreements.				
B	There must be an internal trust				
C	Willingness to make changes based on facts and numbers is important				
F	Before we started with HCPC, people talked about each other in the corridors: "That urologist cannot have our production capacity. We are not going to do surgeries this Monday, but do not tell him."				
F	Transparency in scheduling prevents internal resource priorities (e.g., doctor's schedule)				
F	departments must co-operate instead of competing against each other				
G	Schedules where co-workers have wished for time slots originate from the risk of losing staff. If you instead consider structures around scheduling, less wishes will be put forward and it will be easier to handle it.				
A	Implementing KPS implies a huge cultural impact.			Implementing HCPC in a department will be complicated by a cultural resistance	
A	Changing processes and working routines can irritate.				
A	Horizontal cooperation tends to initially irritate the clinics.				
A	"Culture is really important for KPS and PC"				
C	Talking about 'control' within HC is generally not accepted.				
C	KPS concerns culture and behavior a lot.				
C	It is not that hard to make a production plan, but instead hard to implement it among co-workers.				
C	Co-workers react differently to changes.				
E	Surveys for co-workers say that the knowledge about the overall goals with the departments is bad.				
B	Low maturity when the production plan not sufficiently covers the need because the department do not know the need	Calculation of demand should be properly done, based in forecasts	Calculation of HC demand		
C	The demand for each HC product must be possible to forecast.				

C	"Forecasting on both tactical and operational level is central"		
D	You cannot base your schedules solely on general beliefs around staffing and historic data		
G	There is a need for more demand forecasts for production plans.		
G	A forecast should be even.		
G	If you base the demand forecast on last years' production, there is a risk that unnecessary variations will simply be transferred.		
A	Looking at historical data of inflow to create a production plan gave surprising patterns that we were not aware of before	HC demand is generally even and very plannable over time	
B	A less mature department has built in a great variation in their plans.		
C	"Developing a production plan based on demand is very easy"		
E	Other countries are able to have a completely even HC production, but in Sweden we're building a queue over summer		
E	HC is very plannable. In emergency care there could be experienced variations in a day, but transparency around demand inflow shows that the same patterns are repeated over time		
G	"HC production is very even. It's no mobile phones (...) HC is consistent over time!"		
A	If you look at a HC product, such as referrals, to see how many first visit appointment per week we should divide per full-time employee. Then calculate how many re-visits every first visit results in and how much scheduled phone time is needed	Patient processes should be considered when calculating demand	
F	One must have patient processes in mind when the demand is planned. Upstream patients should be included in the forecast.		
B	In order to achieve a holistic view, there need to be discussion with other departments when your department has an increased need of their services	Agreements should be made and communicated between departments regarding care volumes	Meetings and Collaboration
E	Agreements can be made between departments around volumes on a yearly basis		
G	Agreements around available common capacity is making it easier for individual departments to plan their operations independently		
G	Big volumes were moved from one department to another but without that decision was communicated clearly, they were completely unaware of the changes		
B	"Let me take an example from this fall. One colleague from orthopedics became frustrated at a bigger meeting. She is doing a great job, planning her clinic. But Jönköping centrally had not yet communicated which operating theatre and days they would have access to. Then she cannot do anything since surgeries has to be prioritized before outpatient clinic planning. She has to know the days for surgeries in order to	Common planning horizons are important for collaboration between departments	

	schedule specialist doctors. She cannot do anything without those days specified."		
B	Meetings should happen a sometime before a new schedule or plan is rolled out		
E	Common planning horizons' matters and make a big difference.		
G	In order to plan surgeries all surgical sub-specialties should have done their planning first		
C	It is not good when all professions make their schedules independent of each other	Co-planning of schedules between professions and resources should be done	
F	No co-planning or coordination between doctors and nursing staff scheduling is problematic		
G	Scheduling of different resources simultaneously can sometimes be a big improvement		
G	The leading resource should generally be the one that is scheduled first		
G	Coordination between the different schedules is important to ensure the optimal capacity is in place every day		
C	Everyone making their own production plans can be good enough, but does not ensure synchronization between departments	Meetings allow for collaboration between departments to solve imbalances and divide capacity	
E	Collaborative planning needs to be structured between departments who share resources		
F	There should be an organizational platform where department managers can come together and help each other out when there are gaps between capacity and demand		
B	"There has to be meetings on both a strategic, tactical and operational level to facilitate HCPC"	There should be meetings with HCPC and gaps on both a daily level and more tactical level	
C	There is no need having meetings where you look at measures if nothing is happening		
D	Meetings have to start discussing the gaps in production		
E	Daily control can be made via pulse meetings		
C	Departments have to prepare for what they will do if someone leaves, and they lose that competence	Mapping of competences is important for calculating available capacity, guide appointment scheduling and long-term competence development	Structure for capacity utilization
E	There is a need to map competences in a matrix.		
E	Competence matrices are also useful for creating a foresight in available capacity.		
E	Competence development must be considered in order to also provide long-term competence		
G	There is a need to map competences in a matrix.		
A	There should be agreements made regarding substitute coworkers to emergency shifts e.g. when someone gets sick. The leader should communicate it clearly. There should be room in the schedules for such adjustments.	Scheduling agreements allow anyone to make a schedule and counteracts many unfavorable behaviors related to the scheduling process	
B	"In the best of worlds, you should be able to make appointment in each other's calendars"		
D	HC personnel are used to being able to make personal adjustments and tweaks to their schedule, e.g. wishful		

	schedules and prioritizing research. There are not enough internal regulations around scheduling.		
D	Knowledge is inherited and bound to each profession.		
E	Agreements around volumes between departments should be preceded by an actual need		
G	Establishing structure around schedule, will reduce to individual's wishful schedules and make it easier to handle scheduling		
G	Schedules where co-workers have wished for time slots originates from the risk of losing staff. If you instead, consider structures around scheduling, less wishes will be put forward and it will be easier to handle it.		
G	The personnel have big mandates over their schedule, making scheduling a pretty unsatisfactory role to have		
G	Scheduling involves a lot of discussions with individuals around their wishes for scheduling etc.		
G	Having decisions made on a tactical level ready and documented in form of a competence matrix would allow anyone to schedule.		
A	Scheduling agreements can start by looking at what activities are required from a full-time worker. (...) then you scale that number if someone is working part-time.	Scheduling agreements should be established and is important for calculating capacity	
A	Having a basic schedule for a generic full-time worker allows us to match capacity against need		
C	All things that you have to do during a working day should be considered in agreements around scheduling.		
C	Having agreements around scheduling allows us to use schedules as an effective control measure		
D	A structured approach to schedules can help us understand where the problem lies, otherwise the solution tends to be that we need to hire more personnel		
E	Basing planning and scheduling on silent knowledge is both risky and inefficient		
F	Clear staffing directives needs to be established, e.g. "this department needs to be manned with seven full-time doctors Monday through Friday"		
F	Not all scheduling people are aware of the HC demand or the staffing requirements for different operations		
G	Competence matrix can clarify what tasks someone should spend their time on and what competence level a person has for specific tasks, being a guide for scheduling		
A	Equal opportunities and expectations for employees create a good working environment.		Transparency around scheduling agreements creates an experienced fairness and clarity
A	Employees should understand the agreements that we have decided upon		
F	There is a dimension of fairness for employees when letting agreements around how much time should be spent on e.g. research are transparent		
F	There should be a transparency around staffing directives, not be kept in an anonymous excel sheets		
F	Have a schedule and know what you should do every day		

G	You want to better understand what you should do		
A	Having a standardized routine for when to wish for vacation is good, especially if the foresight is long.	Establish routines for when things are done throughout the year	Timeliness of Planning Activities
B	You should know when a new schedule is coming and prepare for that, so you do not start scheduling patients according to some old schedule		
C	"Then you have to make a production plan on the aggregated situation. After that you need to make in on a departmental level and later for each product. Plans must be overseen once a year, and some departments might need to do it ever twice a year to keep track of it."		
D	There must be routines for planning absence.		
F	You should have a plan for when next year's production plan is developed		
B	Scheduling should be done in advance, at least 12 weeks	Schedule should be produced about 3 months in advance	
E	Scheduling 13 weeks in advance is what we have decided upon		
E	"Traditionally we've had shorter scheduling periods. The patient could call a clinic for time booking only to get the answer: 'We have not released a schedule for that yet, so we cannot offer you a time'. We cannot work like that."		
B	It must be specified what each product will require in terms of resources, these requirements could include downstream capacity demand in patient flows	Attributing resource- or capacity requirements of a product should be done	Product Definition and Internal Resource Requirements
C	Usually, a document is appended to each product, thus specifying product characteristics and requirements further.		
C	Time and competence are important parameters when products are defined.		
C	"When a cardiology patient is at investigation for heart failure, you need to know the duration of the appointment and what competence to invoke"		
E	HC products should have a list added to them where required resources are specified.		
F	A break-down of HC demand into its capacity requirements (beds, operating theatres, staffing, rooms) is required in order to remove the current disconnect between HC need and schedule and produce good schedules.		
F	"The dimensioning (of products) is in fact an estimate of how much capacity should be in place, and what competences are required to fulfill the task. That dimensioning is an important input to the scheduling system"		
C	"How is such a visit conducted? Who performs what? In what room?"		
E	Measuring process times creates a solid foundation for declaring products correctly.		
F	Capacity requirements needs to be established in order to make a yearly plan		

C	"We must define what it is. We cannot have a variation in how things are defined between departments. Those variations must be prevented."	Between departments that provide similar services there should not be differences in how products are defined
A	Productification is a crucial tool for KPS.	Carefully selected and well-defined products is important for unlocking to opportunities of HCPC
A	Well-functioning HC products are enabling the development of a production plan	
B	The yearly production plan should not be too detailed in terms of products used etc.	
B	Product names have to be helpful for the clinic	
C	Products and product names must be defined.	
D	There is a risk that production planning gets too complex and detailed, have to make it based on selected products	
D	The selection of names should be based in what the department use for controlling the production.	
F	Production plan should be based on groups of care services, not all possible patient cases	
F	A care flow can first be optimized when it is correctly categorized.	
G	You do not want to look at too small pieces when making the production plan.	
C	Product names and guidelines should be updated on a yearly basis.	Products and their resource requirements should be revised and maintained regularly
D	A sign for higher maturity is to delete products not being in use	
F	Needed changes in e.g. the capacity dimensioning of HC demand should be considered between planning rounds.	
G	Old products should be removed from the product mix.	
G	Changes in the care provided by a hospital should be reflected in the HC products for that very hospital.	
A	HC products could be defined after the type of visit and time required.	HC services can be divided into HC products based on many different criteria, but should have similar resource requirements
B	Time is an important component for product definition	
D	A care product can be named with 'process', 'category', and something else that the department use for controlling.	
E	Care products might differ between departments	
E	Measuring process times creates a solid foundation for declaring products correctly.	
G	If there are different routines required for one type of care service (operations for instance), those routines should be considered as different products.	
G	You could define products in your system based on competence requirements	
G	"In Stockholm, we gathered products that the department did not have any central agreement within an common group"	

C	Some HC products have priority over others	There will be a natural internal priority between products	
A	Individual adherence regarding schedules must be measured	Adherence to agreements around scheduling and capacity requirements should be measured and followed-up upon.	Measurements
D	Lead time measures for patient processes is needed, instead of waiting time for individual departments		
E	Measuring process times is important to find deviations		
E	Agreements should be followed up upon		
A	Equal opportunities for, and expectations on, employees create a good working environment.	Employee's working situation is important to measure	
C	Employee's working situation is an important parameter to measure. When people are stressed, they tend to divert from routines, which can be a cost driver.		
D	It is important to measure the perceived work environment, the feeling that you know what you're doing is important		
H	Work environment is also connected to HCPC. Many co-workers have not been able to have time for recovery during the Covid-19-pandemic.		
D	Availability is more of an indirect measure	Measures related to HC availability are considered as result measures.	
G	Patient waiting time is a result measure		
H	The regions report access measures to a national database that SALAR is responsible for. These measures are for instance waiting times, waiting lists, production levels and hospital beds.		
H	The absence of overcrowding, patients treated outside of the desired clinic, or waiting time at emergency clinics are good indications on a well-executed planning.		
B	"We've seen examples where the focus from above is on improving the availability for new visits with economic compensation offered, then that becomes the biggest focus. As a result, the queues for re-visits increase significantly. I would wish for a more holistic perspective"	The focus on result measures must be redirected to a focus on HCPC measures.	
B	"Many clinics want better availability. But what does that mean? Better availability for whom? How much better? When do you want to achieve it? You cannot introduce HCPC simply on the notion 'better availability'"		
G	"You should follow up on measurements regarding the production plan instead of looking at queues"		
G	Result measures can be used for reporting upwards, but those are not measuring to use when controlling your performance.		
G	There is a difference between result measures and HCPC measures.		
G	"Many discuss the reporting of waiting times and how they want to improve those numbers. Then I say: Yes, but that is a result measure, let's find something else to measure!"		

H	Measuring the production is preferably made close to the department in question.	You have to measure capacity and demand imbalances, and how actual outcomes differ from expected outcomes.	
H	A focus on shortening the average time of treatment might lead to undesired consequences. Today quicker discharge from hospital to free up hospital beds can result in patients returning to us.		
H	A focus on shortening waiting times according to the national Guarantee Act might imply that less complex patients are prioritized in order to show good productivity levels		
A	It must be measured how well the demand is covered by the schedules.		
B	Weekly variances in schedule and production plan should be measured, a mature organization has eliminated variances		
B	The schedule should not deviate from the production plan		
B	An immature department have built in a great variation in their plans.		
B	How well the capacity covers the HC demand must be measured		
C	Degree of coverage and variations should be measured		
C	Measuring the production plan is of importance		
E	Deviations from plan is important to consider for measuring things correctly.		
F	Needed changes in e.g. the capacity requirements of HC demand should be considered between planning rounds.		
G	Control measures are brought from the existence of a production plan		
G	Deviations from inflow and available capacity must be measured		
G	"You have to measure that the production plan holds, that the input is intact and has not changed"		
G	Deviations from the production plan are important to measure.		
G	Early in maturity, one needs to make a production plan. Thereafter, you need to be able to make follow-ups on it.		
H	"A well-performed HCPC must contribute to a balance between inflow and outflow. (...) A big gap between the two is an important indicator to follow up on"		
C	The HC need can be changed with an improved technology and a medical development	A production plan should be updated when drastic changes are made	Follow-up & Control
F	Changes should be included in a new production plan		
G	You should not update your production plan all the time, with every single new input. Needs to be relatively stable to have something to follow up on.		
G	Improved technology, medical development, national directives, changed processes, that is what can cause a change, all these should be incorporated.		

G	It is important that decided changes in the production plan are well-communicated throughout the organization		
G	"If three people during a month quit, then we have to make a change to the production plan, or else it will not be feasible!"		
A	Internal capacity adjustments are prioritized over external ones, the latter type affects the patients.	Adjustments are necessary to create a balance between capacity and demand	
A	Adjustments must often be made to meet the care demand.		
F	In order to make the capacity suffice and solve experienced issues, adjustments, such as borrowing staff, can be made		
F	Adjustments of capacity must be made for all planning levels: Tactical, operational and daily		
G	"If there is an issue with low capacity in a certain operation theatre, the first measure should be to make capacity adjustments with the departments involved."		
B	There is no resting in interpreting the numbers, control have to be done continuously (by the leader)		Control is deeply connected to measuring, and must be done continuously
C	One must make a change when problems are identified		
C	Willingness to make changes based on facts and numbers is important		
F	Adjustments need to be based on data		
G	Measure is deeply connected to follow-up.		
A	"How big of an impact does a prick test have on an asthma investigation? The doctor could not find any research support for that test anymore. We have done those tests in 40 years, but other, much more efficient, and specific test have been launched. Today, we do not do prick test anymore, something that have implied us saving a lot of HC resources."	HCPC can draw attention to important improvement opportunities regarding capacity requirements	
B	"One department discussed the actual duration of each patient appointment. They have seen that the co-workers who managed the appointment on time initiated the relevant patient measures immediately, and that they thus had time to take care of deviations during the visits. In contrast, those co-workers who did not manage the appointment on time prioritized small talk in the beginning and did the patient measures in the end of the appointment time. If they noticed any issues, they were out of time and needed to reappoint the patient."		
C	"Different ways of working and required capacity for activities is one way where we build variation, we have to be able to follow up on this"		
D	It is a problem that improvement work does not get so much attention in the operations today.		
E	"I took part a project a couple of years ago where it differed significantly in the number of surgeries per doctor and day. Some did 3 to 4 surgeries and some took much longer and only did 2. That is a big difference for a breast cancer patient. Then a standard of four surgeries per day had to be established for these specific operating theatres. They had to train		

	themselves to be faster and some had to do changes in order to address the times needed for the surgery"		
E	If we are able to clearly visualize in how many different ways we are doing things, self-regulation at departments will create standards and simplifications		
E	"One orthopedics department had 32 types of implants used for almost the same thing. When we questioned that, they were able to reduce it to only three types."		
E	It is important to act on gaps with justified improvements		
G	"Regions claim that they work with increasing the capacity in their departments, but I do not consider that as PC since it is only an improvement initiative. It is really hard for the regions to understand this difference."		
G	"If there is a persistent issue that capacity is low in a certain operating theatre, and you cannot solve it by making capacity adjustments, then you can start thinking about how you make other operating theatres with more available capacity equipped for those surgeries"		
E	By identifying differences in how the work is executed, one creates good opportunities for control.	It is crucial to act upon deviations and imbalances.	
E	PC should be executed based on the deviations		
F	Someone needs to act on the deviations, that requires competent leaders		
G	Early in maturity, one needs to make a production plan. Thereafter, you need to be able to make follow-ups on it.		
G	Deviations from the production plan must be prevented, investigated, and act upon.		
A	Employees knows best and should have a say when we need to make improvements		
E	If we are able to clearly visualize in how many different ways we are doing things, self-regulation at departments will create standards and simplifications		
F	As a leader, you need to make co-workers act performance indicators.		
G	"I've perhaps changed my mind since started working in HC. I would say I trust the HC employees more when they say that something must be done in a certain way than I trust the strategic management who want to standardize. If you do a deep interview, you will often see that there is a reason behind why things are done in a certain way that is very important in order to take care of the patient correctly."		
A	How well you adhere to production plan is important to follow-up on		There should be a link between the production plan, and scheduling of staff and appointments
A	Some are responsible for scheduling their own appointments, loyalty to the schedule becomes extremely important when the schedule is actively used for control		
B	The production plan should be aligned with the schedules		

B	On a high maturity level, demand coverage must be ensured, and variations should be limited			
C	"Different ways of working and required capacity for activities is one way where we build variation, we have to be able to follow up on this"			
D	"It is a shortcoming that we do not translate the actual production plan into the schedule, they live separate lives"			
A	Control signals, or 'traffic lights' with dedicated actions give us clear indicators that allow us to be proactive"	There should be agreements regarding, specific actions and tools for balancing, in case of imbalances		
A	Agreements can be made about what can be down prioritized if needed or what will happen if someone gets sick			
C	Control signals with actions should be decided upon, you should have a plan B in place, and know what you can down-prioritize if faced with problems			
D	By creating routines for what to do when a given deviation occurs, we make control easier.			
B	People should be able to connect need to suitable actions with schedule	Using schedules as a control tool is a good way to balance capacity and need		
C	Having agreements around scheduling allows us to use schedules as an effective control measure			
D	"We have to talk about scheduling control and how you evaluate schedules. What is a good schedule?"			
D	There is no way to connect actual needs with capacity without structure in scheduling			
D	Work actively to bridge gaps in capacity and demand with schedules			
E	Schedules adapted to the need and how the operations work is a basic thing that not always is in place.			
F	Should work actively on schedule adjustments based in actual needs			
F	Adjustments for schedules must be made if a department underperforms.			
H	"There is a lot of data in the HC, but we could get better at using it for optimizing processes and flows."		AI, automation and optimization are considered as useful methods, but it is necessary to feed the engine with correct data for the methods to be efficient.	Software support for analysis
B	The constraints fed into the software should be correct and cover all relevant aspects			
B	Optimization might be very useful, but is most suited for high maturity.			
B	Optimization must be controlled by the users themselves if it should be effective enough.			
B	Someone must manually check automatically generated solutions before their go live.			
D	AI can be useful for scheduling control			
D	The trust for AI is still rather low, and hence not used a lot today.			
D	Automatically generated solutions might be very effective.			
G	The software support must not change production plans automatically.			

G	Optimization is difficult to enable within HC due to so many variations		
C	Simulation of plausible solutions could have been a good contribution to the software support.	Simulations can widen the understanding for how variables affect future scenarios Simulations can widen the understanding for how variables affect future scenarios.	
C	The software support creates a possibility for being proactive.		
H	Simulations can create an understanding for how different variables affect future scenarios		
H	Regions want tools for forecasting		
D	Need an information structure for common resources and processes	Software support is an important facilitator when aiming for improved structure, and data-handling.	
D	By using a dashboard, processes are easily measured.		
E	Have to create something that makes people stick to routines. IT can be a solution.		
E	IT is an important facilitator when aiming at having structured ways of working based in data		
E	We believe that an IT system can help us to maintain the correct behaviors		
F	Excel becomes ineffective because it requires additional manual work, e.g. for visualizing big sets of data.		
A	The productification should be included in the visualization		
B	The software support must be able to handle productification.		
E	When a care product is 'produced', the software system should ensure activation of its associated resources.		
E	Information regarding the co-worker's competences must be accessible in the software system		
F	There must be a capacity system that allows for simultaneous planning of all resources, and that cooperates with a production plan and its internal resource requirements.		
F	capacity requirements should be available in the scheduling system		
A	Support for visualization of data is important	The software support must enable good visualization of data	
C	There is a need to know what we are doing and we have the data, but there has been no way of creating a holistic view		
C	The software support helps us to visualize		
D	Being able to visualize data is of importance.		
D	Flows and production plans must for instance be visualized.		
D	The software support must both visualize and simplify		
B	It is important to register correctly in order for the right computations to happen in the system for PC.		
B	You need to have data awareness. Registering correctly is necessary so that decisions are based on accurate data.		

D	"The correct data must be found, it must be packaged, and connected in order to get an understanding of the flows.	
E	A single source of truth needs to be established with the information you regard as correct. There should not be room for alternative interpretations of that data	
E	Requesting specific data improves registration and hence data quality	
E	Having high data quality is important	
H	"Reporting of data cannot be a heavy administrative task (...) Right now HC personnel has to report in many different systems and registers, but we should be able to use the data we already have"	
A	There is no sole system that can handle everything we need	Technical interoperability between systems used for planning activities and data for such activities are important
B	It would be very beneficial if the systems were able to communicate with each other	
B	When a schedule is created it should be loaded directly into an HR-system	
B	All software systems should be able to transfer data in between each other	
B	Many possible synergies can be achieved from having a HR-system that can communicate with a system for PC	
B	The systems for PC, staff scheduling, HR, EMR systems, and appointment scheduling systems.	
E	It is a problem when you cannot combine datasets	
H	Seamless connections between different software are desired	
H	Automation is facilitated with good connections between systems	
H	HC's technical and semantic interoperability has to be improved	
C	Important to get visualize the greater HC system in an IT system	A holistic view of HC is needed, but today's patchwork of IT-solutions is an issue
G	IT systems must take entire HC systems into account	
E	Patchwork of different IT-solutions is an obstacle for collaboration.	
H	HC in Sweden has too many different software systems	
H	Many departments want customized interfaces.	

A.5 Coding for tactical planning (English)

Interviewee	Code	Second order theme	Aggregated Dimension
A	Tactical level can cover the whole regions production ahead and follow-up	Collaboration between departments is important at the tactical level	Leadership for HCPC
C	The tactical control is often executed together with other departments		
E	Tactical level requires coplanning between departments, and everyone on board		
A	"We need to move it up one level in order [<i>eds. from a micro system level</i>] for the management level and support fuctions to be helpful where it's needed"	Tactical level is needed but generally missing	
B	"Some have tactical planning, but a minority achieves a good tactical plan"		
C	"At some islands there is tactical planning, but we want it to spread across the region"		
D	"The tactical level is the weak link"		
E	"The maturity in the tatical level is low"		
E	"The more mature you are, the further forward you need to move your gaze. If your gaze is still on the emergency all day long, the entire management are just looking at the same point. That is a waste."		
G	"You could say that the tactical level is often missing altogether. On the other hand, there always has to be a someone making the schedule"		
C	Competences must be ensured, both on a tactical and strategic level.	The strategic, tactical and operational level together is what makes a good HCPC	
E	Cannot send unsolved problems from the strategic level downwards, because the receiving end right know is focused on operational and daily cannot handle it.		
E	It is a broken system, we have the operative daily and strategic levels but no way of communicating in between these levels. The tactical control is the weak point		
F	Production control regards capacity issues and is hierarchical in its nature		
F	Balancing needs to be done at all levels, with an organization that allows for that		
G	"Tactical planning takes place before scheduling"		
A	The level in which you execute control and plan on should be a little more general		The tactical HCPC should be an active, dynamic tool
D	Making analysis at the tactical level requires maturity		
F	Learn from history when it is time for the next tactical planning round		

F	There is a lack of involvement from management, and the tactical plan risks becoming something static	The tactical HCPC should ensure balance before scheduling	
G	"On a tactical level, I would say that one measures the follow-up of the production plan. I.e, that the input to the production plan has not been drastically changed."		
G	"At the tactical level, we want to ensure that the forecast we did was correct"		
E	"A departmental manager has to look further. Of course, we can focus on the urgent matters when there is a crisis, but we have to ensure that we have investments in both capacity and skill development so we can handle the daily operations"		
F	The tactical PC level is needed for balancing capacity with a yearly planning horizon.		
F	A yearly tactical production plan has be broken down and matched with capacity and scheduling otherwise it's to no use		
G	"At the tactical level it is important to ensure that you have the sufficient capacity for production, before moving on to scheduling."		
G	Tactical level have to secure that there is enough capacity		

A.6 Interview Guide, Version 1 (Swedish)

This version of the interview guide was used for all interviewees but Socialstyrelsen.

Bakgrund

Vi introducerar oss och vårt arbete. Taktisk planering + produktionsstyrning

Titel + vill du vara med med namn

Introduktion av dig och din roll/erfarenhet med kapacitet- och produktionsstyrning.

- Berätta lite kort om vilka HCPC-relaterade projekt som ni driver i regionen just nu!
- Individuell styrt per sjukhus vs regionalt?
- Inblandning med privata aktörer?

Drivkrafter och förändringsvilja i Sverige

- Vad upplever du är de största drivkrafterna till att börja arbeta mer med produktionsstyrning i Sverige?
 - Vad för problem finns det med hur **planeringen** sköts idag på en generell avdelning eller vårdenhet?
 - Finns det stor intern förändringsvilja? Eller kommer den utifrån pga. vårdgarantin och socialstyrelsens förpliktiganden?
 - Existensberättigar vår modell, vad vill man komma åt genom att ha en mognadsmodell
- Är vården utrustad för förändring till mer aktivt arbete med HCPC?
 - *eller krävs det investeringar för detta?*
 - Ger också lite mer bakgrund, och vad de ser för förändringar på gång

Conceptual MM visualization Grimson & Pyke (2007)

Presenteras kort: "Vårt arbete handlar ju om att ta fram en mognadsmodell för taktisk planering inom sjukvården. Här är ett exempel på hur en mognadsmodell för planering kan se ut..."

De olika aspekterna presenteras

Vad tror du är viktiga aspekter för planeringsprocess mognad, givet att sjukvårdens viktiga perspektiv ska inkluderas?

Planeringsprocessen och organisation

- Är det någon typ av planering som saknas eller är bristfällig i svensk sjukvård?
 - Hur är det när det är som sämst?
 - (Ser du några fördelar med en ökad taktisk planering?)
- Vilka är delaktiga i planeringsprocessen och dess möten, är det något som hade kunnat bli bättre?
- Hur ser kompetensen ut hos de arbetar med taktisk och operativ kapacitet och produktionsstyrning och schemaläggning?
 - Hur bör ansvarsfördelning inom planeringsarbetet fördelas enligt dig?
 - Vilken utbildning bör en vårdplanerare ha enligt dig? Varför?
- Vilka rutiner är viktiga att etablera för att säkerställa planeringsprocessens kvalitet?
- *Ex på rutiner: Framförhållning, uppföljning, rullande schema, semestersökning, omplaneringar?*

- Hur kommuniceras omplaneringar och justeringar av scheman?
- Är olika sorters organisationer olika lämpade för produktionsstyrningsaktiviteter?

Mätning/uppföljning av planeringen

- Vad är de viktigaste indikatorerna på att man har lyckats med sin (taktiska) planering?
 - *Är det att det görs en produktionsplan som faktiskt kan följas. En genomförbar produktionsplan.*
 - *Är det att strategiska mål får genomslag i operativ verksamhet*
 - *Är det att rätt sorts processer är på plats*
 - *Är det att planeringen ger positivt utslag på vårdköer*
- Hur ser du på vårdgarantins roll i huruvida en planering är lyckad eller ej? Hur går dina tankar kring att mäta tillgänglighet?
- Hur sker uppföljning av planeringens resultat i vården idag och finns det möjlighet att förbättra uppföljningen?
 - *Worst case och best case, sweet spot*
 - Hade det behövt ske några förändringar i hur det mäts för att förbättra planeringen enligt dig?

IT och optimering

- Hur ser IT-stödet ut inom den taktiska och operativa planeringen?
 - Ser du några förändringspunkter för IT-stödet?
- I vilken mån används mjukvara för att skapa den taktiska och operativa planeringen? Hur sofistikerad är denna mjukvara?
 - *ex optimering, simulering, heuristik*
 - *Väldigt mycket litteratur i detta området*
 - *Automatisk inbokning, optimering av exempelvis gemensamma resurser*
- Vilken roll anser du att IT-stödet ska ha inom sjukvårdsplaneringen?
 - Vad får det för effekter på planeringens resultat?

Produktifieringens roll

- Hur ser du på att nedbrytande av vårdtjänster till produkter? I vilken utsträckning sker det idag (worst case och best case)?
 - Ser du sätt som detta kan förbättras?
 - Är det mer eller mindre viktigt för vissa specialiteter eller organisationer?
 - e.g. olika besökstider för olika sorters besök
 - e.g. besökstider som är mer befästa i verkligheten än var det är idag
 - e.g. vad är en rimlig nivå av nedbrytning? Kanske inte frågan i sig, men enligt Ritva finns det ibland behov av att bryta ner "knäledsoperation" på till exempel unga och äldre personer eftersom den ena är mer komplikationsfylld. Vi vill liksom fiska efter vad respektive avdelning står inför för utmaningar, fast samtidigt inte säga "så här ska ni göra". Kanske "Förstår att, detta är specifikt för enskilda mottagningar... hur bör en rimlig nivå av nedbrytning bestämmas?"
- Revideras produktifieringen/nedbrytning till schemalägningsblock regelbundet?

Patientflöden och gemensamma resurser

- Hur bör man ta hänsyn till cross-funktionella patientflöden och gemensamma resurser som delas mellan avdelningar?
 - *Möten*
 - *Ta med pre-decessors och antecedents i prognosticeringen*

Prognoser av vårdbehov och kapacitet

- Till vilken grad görs prognostisering?
 - När funkar det som bäst och som sämst?

Framgångskriterier för en lyckad mognadsmodell

- För att kunna konstatera att mognadsmodellen uppnår sitt syfte är det viktigt att utövare kan ha möjligheten att bedöma modellen enligt vissa kriterier. Vad anser du är kriterier som mäter avgör om det är en bra sådan modell?
 - *Användbarhet?*
 - *Applicerbarhet?*
 - *Lätt att göra en bra bedömning? (vägledning, gränssnitt ex)*
 - *Snabbhet i bedömning?*
 - *Slutbedömningen är insiktsfull/vägledande?*
- För varje av dessa aspekter, hur skulle man definiera själva framgången?
 - *Ex: När påvisar en modell hög användbarhet?*

Wrap-up

- Är det något som vi skulle ha frågat dig om som vi inte har frågat än?

A.7 Interview Guide, Version 2 (Swedish)

Bakgrund

Vi introducerar oss och vårt arbete. Taktisk planering + produktionsstyrning

Titel + vill ni vara med med namn

Introduktion av dig och din roll/erfarenhet med kapacitet- och produktionsstyrning.

- Berätta lite kort om vilka HCPC-relaterade projekt som ni driver inom Socialstyrelsen just nu!
- Hur upplever ni att detta arbetet sker ute i regioner och kommuner?
 - Individuell styrt per sjukhus, avdelning eller regionalt?
 - Inblandning med privata aktörer?

Drivkrafter och förändringsvilja i Sverige

- Vad upplever ni är de största drivkrafterna till att börja arbeta mer med produktionsstyrning i Sverige?
 - Var kommer förändringsviljan ifrån? *Patienter, medarbetare inom vård, verksamhetsledning, regioner, er, regeringen?*
 - Existensberättigar vår modell, vad vill man komma åt genom att ha en mognadsmodell
- Vad för problem finns det med hur planeringen sköts idag på en generell avdelning eller vårdenhet (*eller vad för perspektiv de nu har*)?
- Är vården utrustad för förändring till mer aktivt arbete med HCPC?
 - *eller krävs det investeringar för detta?*
 - Ger också lite mer bakgrund, och vad de ser för förändringar på gång

Grimson & Pyke (2007)

Presenteras kort: "Vårt arbete handlar ju om att ta fram en mognadsmodell för taktisk planering inom sjukvården. Här är ett exempel på hur en mognadsmodell för planering kan se ut..."

De olika aspekterna presenteras

Vad tror ni är viktiga aspekter för planeringsprocess mognad, givet att sjukvårdens viktiga perspektiv ska inkluderas?

Planeringsprocessen och organisation

- Är det någon typ av planering som saknas eller är bristfällig i svensk sjukvård?
 - Hur är det när det är som sämst?
 - (Ser ni några fördelar med en ökad taktisk planering?)
- Vilka är delaktiga i planeringsprocessen och dess möten, är det något som hade kunnat bli bättre?
- Vilka rutiner är viktiga att etablera för att säkerställa planeringsprocessens kvalitet?
- *Ex på rutiner: Framförhållning, uppföljning, rullande schema, semestersökning, omplaneringar?*
- Hur kommuniceras omplaneringar och justeringar av scheman?
- Är olika sorters organisationer olika lämpade för produktionsstyrningsaktiviteter?

Mätning/uppföljning av planeringen

- Vad är de viktigaste indikatorerna på att man har lyckats med sin (taktiska) planering?

- *Är det att det görs en produktionsplan som faktiskt kan följas. En genomförbar produktionsplan.*
- *Är det att strategiska mål får genomslag i operativ verksamhet*
- *Är det att rätt sorts processer är på plats*
- *Är det att planeringen ger positivt utslag på vårdköer*
- Hur ser ni på vårdgarantins roll i huruvida en planering är lyckad eller ej? Hur går era tankar kring att mäta tillgänglighet? *Finns det några uppenbara förbättringsområden?*
- Hur sker uppföljning av planeringens resultat i vården idag och finns det möjlighet att förbättra uppföljningen?
 - *Worst case och best case, sweet spot*
 - Hade det behövt ske några förändringar i hur det mäts för att förbättra planeringen enligt dig?

Prognoser av vårdbehov och kapacitet

- Till vilken grad görs prognostisering?
 - När funkar det som bäst och som sämst?
 - *Matematiska modelleringar*
 - *Prognostisering inför framtagande av produktionsplan och kapacitetsplan*

IT och optimering

- Vilken roll anser ni att IT-stödet kommer ha när arbetet med sjukvårdens kapacitet- och produktionsstyrning intensifieras?
- Vad får det för effekter på planeringens resultat?
- *ex optimering, simulering, heuristik*
- *Väldigt mycket litteratur i detta området*
- *Automatisk inbokning, optimering av exempelvis gemensamma resurser.*

Produktifieringens roll

- Hur ser ni på regionernas nedbrytande av vårdtjänster till produkter?
- Vad har det för roll i rapporteringen till er? Vad har den för betydelse för er?
 - Vilken utsträckning sker det idag (worst case och best case)?
 - Är det mer eller mindre viktigt för vissa specialiteter eller organisationer?
 - *e.g. olika besökstider för olika sorters besök*
 - *e.g. besökstider som är mer befästa i verkligheten än var det är idag*
 - *e.g. vad är en rimlig nivå av nedbrytning?*
- Revideras produktifieringen regelbundet?
- *Är IT-stödet som finns idag hjälpande eller stjälpande i detta arbete?*

Patientflöden och gemensamma resurser

- Hur bör man ta hänsyn till cross-funktionella patientflöden och gemensamma resurser som delas mellan avdelningar?
 - *Möten*
 - *Ta med predecessors och antecedents i prognosticeringen*

Wrap-up

- Är det något som vi skulle ha frågat er om som vi inte har frågat än?