WORKFLOW DESIGN PROCESS IN DELIVERY PROJECTS OF A PLATFORM SOLUTION

Lappeenranta–Lahti University of Technology LUT

Master’s Programme in Industrial Engineering, Master's thesis

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Examiner: Associate Professor Jouni Koivuniemi

ABSTRACT

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Workflow design process in delivery projects of a platform solution

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Keywords: workflow design process, delivery process, platform solution,

Despite positive advancements in digitalization the information systems and their deployments in healthcare sector still require improvements. The main objective of this diploma thesis was to develop a new workflow design process for Topcon Healthcare Solutions to improve the delivery projects of their platform solutions. The research conducted in this thesis consists of a theoretical framework on designing workflows in healthcare sector and a case study which completes a process development cycle producing the first version of the new process for the case company. The theoretical framework consists of workflow management and design concepts including previously used approaches to workflow improvement and workflow analysis in healthcare and presents common workflows in different organizational level. The research material in the case study was collected by conducting a semi-structured interview study for selected employees in the case company. Based on inductive content analysis on the collected material the current process maturity levels in the company were assessed. All collected material including the theoretical framework were utilized to determine the process maturity goals and developing the process solution. The suggested process solution was presented and refined in a workshop organized for the case company in which the process was also validated. The conclusions of the thesis highlight the importance of involving end users to the design process and analyzing the current workflows in all organizational levels to ensure the designed workflows fit the multiple levels of the healthcare organization in which the new information system is being deployed. The process developed for the case company supports the company's existing delivery process and focuses on improving customer understanding and communication especially in the early process phases. Topcon Healthcare solutions has started launching the improvement projects required to implement the process in early 2023.

TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

LUT Teknis-luonnontieteellinen

Tuotantotalous

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Työnkulun suunnitteluprosessi alustaratkaisun toimitusprojektissa

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Huolimatta digitalisaation edistymisestä terveydenhuollon tietojärjestelmät ja niiden käyttöönottoprosessit vaativat edelleen parannuksia. Tämän diplomityön päätavoitteena oli kehittää Topcon Healthcare Solutionsille uusi työnkulun suunnitteluprosessi, jolla kehitetään yrityksen alustaratkaisujen toimitusprosessia. Työssä tehty tutkimus koostuu teoreettisesta viitekehyksestä sekä tapaustutkimuksesta, jossa suoritettiin yksi prosessikehityssykli. Lopputuloksena on uuden prosessin ensimmäinen versio kohdeyritykselle. Teoreettinen viitekehys koostuu työnkulun hallinnan ja suunnittelun konsepteista, sisältäen aiemmin käytettyjä lähestymistapoja työnkulkujen parantamiseen ja työnkulun analysointiin terveydenhuollossa. Lisäksi esitellään yleisimpiä työnkulkuja terveydenhuollon eri organisaatiotasoilla. Tapaustutkimuksessa tutkimusmateriaali kerättiin tekemällä puolistrukturoitu haastattelututkimus kohdeyrityksestä valituille työntekijöille. Kerätylle aineistolle tehdyn induktiivisen sisältöanalyysin perusteella arvioitiin prosessin tämänhetkiset kypsyystasot kohdeyrityksessä. Lopuksi kaikkea kerättyä materiaalia, mukaan lukien teoreettinen viitekehys, käytettiin uuden prosessin kypsyystavoitteiden määrittämiseen ja edelleen prosessiratkaisun kehittämiseen. Ehdotettu prosessiratkaisu esiteltiin tapausyritykselle järjestetyssä työpajassa, jossa prosessi hienosäätämisen jälkeen validoitiin. Diplomityön johtopäätökset korostavat loppukäyttäjien osallistumisen tärkeyttä suunnitteluprosessiin ja nykyisten työnkulkujen analysointia kaikilla organisaatiotasoilla. Näin varmistetaan, että suunnitellut työnkulut sopivat asiakasorganisaation eri tasoille. Kohdeyritykselle kehitetty prosessi tukee yrityksen olemassa olevaa toimitusprosessia ja keskittyy asiakasymmärryksen ja kommunikoinnin parantamiseen erityisesti prosessin alkuvaiheissa. Topcon Healthcare Solutions on aloittanut prosessin käyttöönottoon tarvittavien parannusprojektien käynnistämisen vuoden 2023 alussa.

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Espoo, 31st January 2023

Sami Heinonen

SYMBOLS AND ABBREVIATIONS

Abbreviations

THS	Topcon Healthcare Solutions
HRS	Harmony Referral System
PMO	Project Management Office

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1 Introduction

Healthcare sector is currently facing huge changes and challenges. Population in Europe is aging, and digitalization is shaping the societies in all sectors. For a long time, healthcare sector has been behind with this digitalization development. Now it has become one of the most significant sectors where growth and utilization potential is seen. Technology and data are the drivers of this development. (Sitra 2022.)

Despite positive development, information systems in healthcare sector still require improvements. These systems are not just archives for data but essential tools in everyday patient contacts. According to a survey conducted in Finland in 2020 information systems do not support co-operation between different professionals enough. When deploying new information systems, the experiences of healthcare professionals also highlight the importance of taking into account not just the system itself but also the operational organization model which is built behind it and changes to that model during the deployment. (Lääkäriliitto 2021; Terveyden ja hyvinvoinninlaitos 2020)

1.1 Research background

Analyzing and improving processes and workflows in healthcare sector are usually done from the healthcare organization's perspective or from software development perspective if the work is done by the information system provider. Numerous methodologies such as Six Sigma, Lean or Theory of constraints can be used to systematically study and improve quality of processes in organizations (American Society for Quality 2022a). In software development methodologies such as Human centric design are used to improve workflows built in software products as part of general product development (Holtzblatt et al. 2016). However, it is much harder to find research on how information system providers should design workflows in their customer delivery projects in which new systems are being deployed.

When healthcare providers analyze their workflows, the analysis aims to identify any possible target for improvement. Quite often the answer is to get a new information system. When the companies which offer these solutions develop their products, they gather

requirements from the market and aim to develop their products to answer the market needs. However, when the healthcare provider is making the procurement decision and plans the delivery together with the system provider the questions that still needs to be answered is "How this particular information system should be used in this particular organization?". The question becomes even more relevant if the information system is a highly configurable platform solution capable of integrating into other systems and devices, which enables numerous possibilities for different workflows. The answer to this question is important for both sides. The healthcare organization obviously wants the best possible value-addition from their investment and the system provider has interest to increase customer satisfaction to grow their reputation and business. This is the reason Topcon Healthcare Solutions (later THS) was interested in researching the topic and improving their processes to ensure better customer and end user satisfaction in the delivery projects of their platform solutions.

1.2 Objectives and research questions

This thesis aims to develop a new workflow design process for THS to be used in its delivery projects. In these projects the company delivers their platform solutions to their customer organizations which are parts of the eyecare ecosystem. The solutions are highly configurable and able to integrate with third party solutions (Wuotila 2022). This increases the complexity of matching the underlaying user needs with the best possible solutions that the products and their integrations enable. Understanding the current workflow more comprehensively is the key for identifying improvement possibilities which can be solved with the offered solution. Creating a consistent process for workflow design increases changes for succeeding in these goals and would therefore be beneficial for the customer projects that THS's delivers.

The research questions to be answered in this thesis are the following:

1) How to design workflows in healthcare sector?
2) Which process solutions fit the case company's needs to become the basis for the new workflow design process and what kind of process is to be built from this?
3) How the developed solution meets the company's requirements?

However, THS's project management office (later PMO) handles various sizes of delivery projects from independent optician stores consisting of only one store to international optician store chains. This means variation to the income generated by different-sized delivery projects. It is expected that the process created in this thesis requires more resources than it is profitable to spend in small projects. Therefore, the new process is limited to be used only with the large-scale enterprise customers and those projects which may have a larger impact to the business success. In addition, this thesis does not consider the applicability of the new process in other project types that PMO executes such as data migration projects and Proof-of-concept projects. Some parts of the new process may be applicable entirely or partially to these projects as well, but this thesis does not take a stand on the matter because the workflow design requirements for these project types differ from delivery projects. Considering the organizational structure of THS this thesis will concentrate on THS Operations which includes PMO, Solutions team, and Customer Success teams. PMO will have the main responsibility of orchestrating the workflow design process during the delivery projects, but parts of the process may be included already in the Presales phase. This is important because Sales makes definitions and limitations to the project which is going to be delivered to the customer by Operations. These definitions and limitations may significantly impact the possible workflows. However, this thesis will not consider how other functions outside of THS Operations such as Product management utilize the information in their internal processes. Another limitation is that this thesis does not consider the applicability of the new process outside EU markets because of possible regulatory and cultural differences.

1.3 Research process and methods

The research process (Figure 1) starts by gathering the theoretical framework. Information is collected using descriptive literature analysis. The key search terms used are "workflow design", "workflow design frameworks", "workflow redesign" and "workflow analysis". LUT Primo is the main database utilized in searching the material but also Google scholar is used to collect additional material for example on specific workflow analysis methods. The results of the analysis form the theoretical framework of this thesis based on workflow management and design concepts and workflows in healthcare sector. This includes workflow classifications, workflow improvement methods, workflow management systems,

principles of healthcare processes, common workflows used in the specific healthcare field and previously used approaches to and workflow analysis in healthcare field. The objective of the theoretical part is to familiarize with the research topic and to collect potential approaches to be utilized in building the new process.

Descriptive literature analysis as a method provides an overview of the research topic without strict and precise rules. The materials utilized can be extensive and there are no methodological restrictions on how the materials are chosen. However, it makes possible to describe the research phenomena in an extensive way to classify its characteristics. (Salminen 2011).

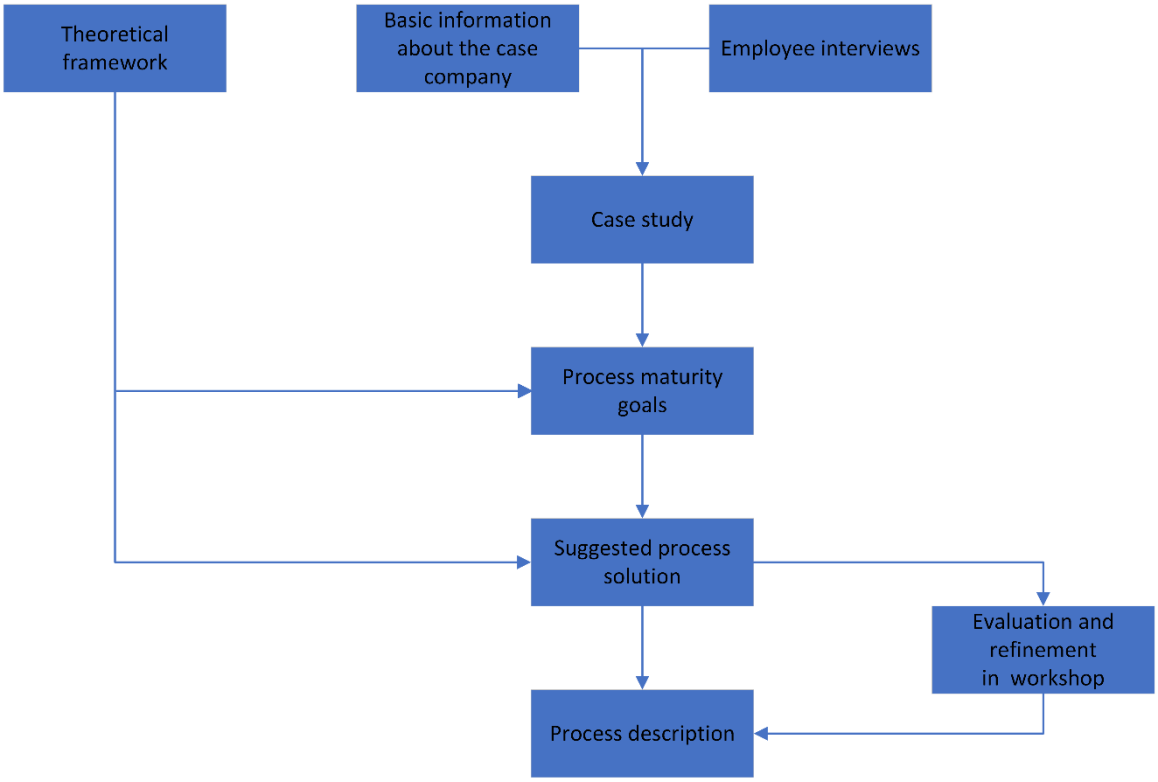

Figure 1 Thesis research process description

The empirical part of the research is conducted as a case study and by completing a process development cycle in Topcon Healthcare Solution. In case study research a limited event is studied in its natural operation environment. The event can also be a process like in this case study. Case study aims to describe and explain the case using descriptive methods. The goal is to describe the research object systematically and precisely in a truthful manner. (KvaliMOTV 2022b).

The case study results serve as a starting point for the process developing cycle by presenting the assessment of current workflow design process maturity levels in the case company. All research material including theoretical framework, interview analysis results and basic information about the company are then utilized to build the suggested process solution.

The research is planned to be started in August 2022 and finished by the end of January 2023. The descriptive literature review and collecting basic information about the case company will be completed during August and September. Planning, executing, and analyzing the interviews will be done in October. Suggested solution will be developed in November and validated in December. The finalization of the report is done during January 2023.

1.4 Structure of the thesis

This thesis report is divided is two main sections which are the theoretical framework and the empirical research study. The seven main chapters are introduction, workflow management and design, workflows in healthcare sector, research methodology, empirical results, conclusions, and summary.

Figure 2 illustrates the input-output diagram which represents the structure of the thesis. The left side of the diagram presents the inputs for each chapter. In the chapters, issues are discussed and researched. These produce results presented on the output side.

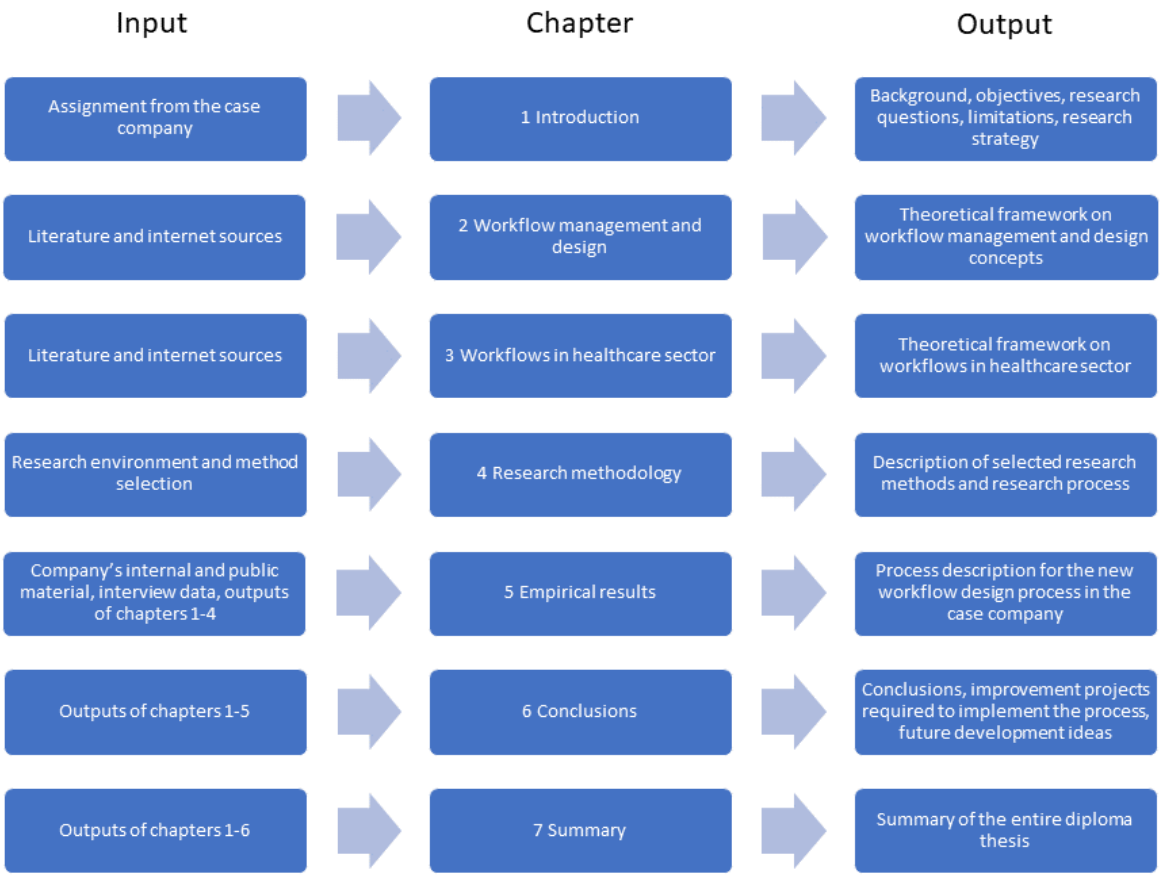

Figure 2 Input-output diagram of the thesis structure

The first chapter introduces the research background, objectives, research questions, limitations, brief description of the research process and methods, and the structure of the report. Chapters 2 and 3 form the theoretical framework of this thesis. Chapter 2 starts with defining what process and workflow mean in the context of this thesis. Then the chapter continues by introducing other literature related to analyzing, designing, improving, and managing processes and workflows. Chapter 3 concentrates on workflows in healthcare sector in different organizational levels and information systems related to them. It also presents approaches which have been used to analyze and manage workflows in healthcare sector.

Chapter 4 starts the empirical section of this thesis. It describes the research methodology and how the research proceeded starting from collecting interview data to describing the final version of the developed process. In Chapter 5 the empirical results of the thesis are described. First subchapter introduces the case company as a starting point for the

development work. Then the results from each step of the development process are presented in their own sub-chapters.

In Chapter 6 presents the conclusions of the research process. The chapter evaluates how well the research project met its objectives and how useful the new process is for the case company and for wider use. Improvement projects required in the case company to implement the first version of the new process and future development ideas for the process itself are also discussed. Chapter 7 summarizes the entire diploma thesis.

2 Workflow management and design

Managing and designing customer's workflows requires a well-defined business process to understand and satisfy the needs of the customer organization. Generally, a business processes consists of coordinated set of different activities, which are then executed to achieve a goal or target that was predefined. Activities are individual process steps, which can be operated either manually by a human agent, or by using a machine. An activity usually consists of one or several tasks. (Dumas, van der Aalst & ter Hofstede 2005, 22-24; Stohr & Zhao 2001.)

Stohr & Zhao (2001) determine workflow as "complete or partial automation of a particular business process, supporting the necessary task, document, and information flow, governed by a set of business rules." In workflow systems a set of tasks that a user should perform is called a 'worklist'. These worklists are prepared by Workflow Management Systems (WfMS) and then displayed on the user's screen. To put it another way, a workflow can be described to be a distinct process, that involves an information system, the Workflow Management System, which manages the progress of the process as a whole, and the transition between these activities or 'worklists'. (Dumas et al. 2005, 22-24; Stohr et al. 2001.) This approach sees workflow as automation. Other, more general definitions for workflow exist as well, one of them being the one by Karsh (2009). It defines workflow as "the flow of work through space and time, where work is comprised of three components: inputs are transformed into outputs." Karsh also includes cognitive workflows in his definition, which means that in addition to the observable workflows, also the flow of ideas and thoughts in a person's head can be considered as a workflow. (Karsh 2009.) Because workflows are considered to be specific kind of processes, it can be stated in general level that the same theories and methodologies can be used for developing and improving both.

2.1 Workflow classifications

There are several ways to classify workflows depending on the point of view. The classification can be based for example on

- the type of the supported work
- the level in which workflow takes place in the organization
- the logic used to move between tasks

One of the most used classification of workflows divides workflow in four categories based on **the type of supported work**: production, administrative, ad hoc, and collaborative. This classification is endorsed for example by the Workflow Management Coalition (WfMC). (Deokar, Kolfschoten, & de Vreede 2017; Stohr et al. 2001.)

Production workflows are suitable for automating repetitive and structured tasks. They have high potential for productivity improvements since they involve highly complicated tasks. and the workflow system makes several decisions along the process. The system may also be integrated to various enterprise applications. Billing activities and order entries are typical examples of automated production workflows. (Deokar et al. 2017; Stohr et al. 2001.)

In administrative workflows tasks are less complicated compared to tasks in production workflows and have also more simple coordination rules. In these workflows user's decision-making and task execution are assisted with software applications. Routing and document approval processes such as travel expense processes are common use cases. (Deokar et al. 2017; Stohr et al. 2001.)

Ad hoc workflows are most usable in situations when process flexibility is essential. They are commonly used in situations where spontaneous ordering and coordination of task is done under user control. A common scenario is a small group of experts collaborating on a short project with a defined set of activities. Because these projects have low repeatability automating and facilitating the task coordination is not needed. (Deokar et al. 2017; Stohr et al. 2001.)

Collaborative workflows or collaboration processes include collaborative problem solving, drawing on the knowledge and experience of multiple stakeholders. Developing a new product, planning business strategy, and organizational design are typical examples of

knowledge-intensive business processes in which collaborative workflows often occur. Another difference to other workflow categories is that production, administrative and ad hoc workflows are supported by WfMS but collaborative workflows are supported by collaboration tools instead. Some workflow tools support collaboration tools but according to Deokar they lack process-based support for collaborative activities. (Deokar et al. 2017.)

Another way to classify workflows is based on **the organizational level** in which they take place. According to Karsh (2009) to achieve good results with health information technology it is essential to ensure that the technology fits within the multiple levels of a healthcare organization. Their multilevel model (Figure 3) describes three levels of fit between the four levels of organization. Holden and Karsh highlight that the fit means different things in different levels, and that the fit impacts the outcomes such as acceptance of technology and its appropriate use. (Holden & Karsh 2009.)

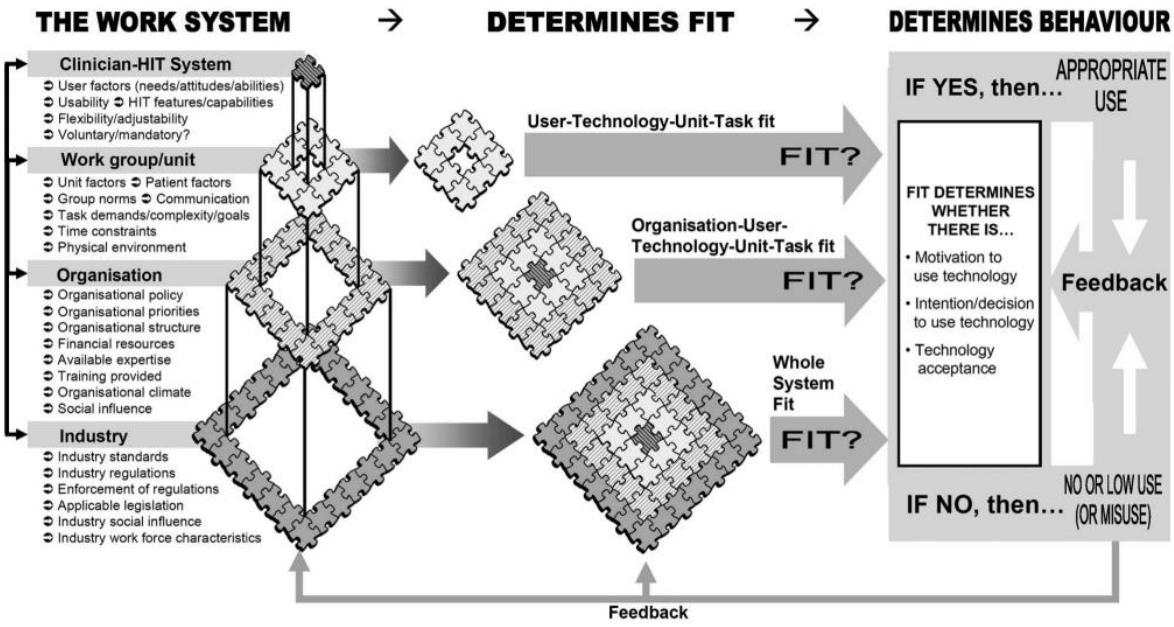

Figure 3 A theory-based multilevel model of health information technology behaviour (Holden et al. 2009)

Sheehan and Bakken (2012) have approached workflow analysis by using the model created by Karsh. In their study workflow is defined as occurring at three levels which are

- individual level
- organizational level and

- inter-organizational level.

Their classification includes work group and unit level presented in Karsh's model into the organization level. According to them several approaches for classification exist and therefore the approach should be chosen based on the project needs and goals. (Sheehan & Bakken 2012).

In addition, workflows can be classified based on the **types of logic** which can be used to move between the tasks in the workflow. The types are sequential workflows, state machine workflows, and rules-driven workflows. This is more technical approach used with computed assisted workflows and for categorizing the WfMS themselves (Smartsheet 2019.)

2.2 Workflow management systems

Workflow management is an organization process which aims to support business processes so that the work is efficiently done. This includes correct timing, correct tools and the right person. Instead of individual tasks it focuses on the process structure as a whole. Workflow management connects the end users and other workflow participants to the specific application programs which then support completing the required individual tasks. (Dumas et al. 2005, 22-24.)

Workflow management systems (WfMS) facilitate and support workflows through the execution of workflow schema. A workflow schema describes the process on a higher level and it can be seen as a template for executing workflow instances. For each workflow instance, there must be one organizational instance that own the workflow and approves the decision for example to change it. (Dumas et al. 2005, 22-24.) WfMS should be flexible enough and allow defining the needed workflows for varying conditions and processes. Often WfMS's can also analyze and measure the processes they support, which enables organizations to identify improvement and streamlining opportunities. (Smartsheet 2019.)

To support the execution of workflow schemas many WfMS's have features such as automatic routing and processing, and capability to combine several separate systems and integrate with existing infrastructure. This way systems and processes are combined to form a cohesive structure. WfMS's may also provide notifications and information for the next

person to complete their part of the process while following up task completion. (Smartsheet 2019.)

WfMS can have three different types of workflows built in depending on process needs. These types are sequential workflows, state machine workflows, and rules-driven workflows. The use of each type depends on the type and requirements of the process. Sequential workflows can be described to follow a straightforward and linearly progressive path, in which they proceed from task to task without possibility to go back. State machine workflows are more complex and sophisticated compared to sequential workflows, as for them it is possible to move more freely between the sequence steps both forwards and backwards, executing the tasks between these state transitions. Rules-driven workflows are a more advanced type of sequential workflow. As its name suggests, different rules which are modeled by using "if", "then" and "else" expressions determine the progress. (Smartsheet 2019.)

2.3 Workflow improvement methods

Many theories and methods exist for improving business processes. Their basic ideologies consider the company's experience, requirements, and input to create the most important workflows. (Smartsheet 2019.)

Six Sigma aims to decrease process variation and improve process control by standardizing the workflow process. As a result, number of defects can be reduced significantly. The name Six Sigma comes from its quality performance metrics which means 3.4 defects per million opportunities. Six sigma emphasizes statistical methods. By using Six Sigma tools, organizations can better understand fluctuations in processes, which allows them to identify the cause of the problem. Six Sigma professionals do not totally agree on the tool set but in general they use various quantitative and qualitative tools and techniques to achieve improvements in processes. Such tools are for example, control charts, process mapping and statistical process control (SPC). (American Society for Quality 2022c; Näslund 2008)

The most well-known Six Sigma methodology is the DMAIC cycle (Define, measure, analyze, improve, control). These process steps guide the process from identifying the problem to the implementation of solutions. (American Society for Quality 2022c.)

Näslund (2008) lists eight characteristics for six sigma's success:

- bottom-line results expected and delivered
- senior management leadership
- a disciplined approach (i.e., DMAIC)
- rapid (3-6 month) project completion
- clearly defined measures of success
- infrastructure roles for six sigma practitioners and leadership
- focus on customers and processes
- a sound statistical approach to improvement

According to Näslund (2008) some argue that Six Sigma projects are just continuous improvement efforts which are narrowly defined, while the proponents state that other quality initiatives are typically unable to cover more than a few of the eight characteristics listed above. (Näslund 2008).

Lean aims to enhance process efficiency by continuously searching for opportunities for improvement and ways to achieve more with less wasted resources. It is a systematic approach in which all members of the organization aim to reduce and remove non-value-adding activities and waste in all areas of the value stream. According to Womack and Jones (1994) "Lean aims to achieve the targets by eliminating unnecessary steps, aligning all steps in an activity in a continuous flow, recombining labor into cross-functional teams dedicated to that activity, and continually striving for improvement." Lean can be applied on multiple levels from a single activity or process to an entire organization or enterprise (American Society of Quality 2022b; Womack & Jones 1994.) There are seven or eight types of waste defined in lean manufacturing:

- Defects
- Overproduction
- Waiting
- Non-utilized talent

- Transportation
- Inventory
- Motion
- Extra-processing

The last one is debated by quality professionals if it should be included in the listing or not. (American Society of Quality 2022b.)

Total Quality Management (TQM) includes "understanding and implementation of quality management principles and concepts in every aspect of business activities" and requires that these principles "must be applied at every level, every stage and in every department of the organization". In addition, these principles are applied outside the organization to further improve also the supply chain management and relationships with the suppliers. (Dahlgaard, Khanji & Kristensen 1997, 8.) The American Society Quality (2002) summarizes TQM as "a management system for a customer-focused organization that involves all employees in continual improvement." The eight main elements of TQM are:

- Customer focus
- Total employee commitment
- Process approach
- Integrated system
- Strategic and systematic approach
- Continual improvement
- Fact-based decision-making
- Communications

Many organizations define these elements as their primary operating principles and core values (American Society for Quality 2022d.)

Business Process Reengineering (BPR) starts from the idea that in order to stay competitive companies should simultaneously be able to provide the best products but also provide

solutions to varying customer requirements. In addition, companies should be able to move fast and adapt to quickly changing market requirements. To do this in a larger scale means that companies are forced to seek for breakthroughs to achieve significant improvements by putting focus on strategy, technology, or automation for a short period of time. There are several definitions for BPR, but the main goal is always to redesign business process and achieve major breakthroughs. Whereas TQM concentrates on small and continuous improvements BPR focuses on making big changes and causing dramatic discontinuity. (Yin 2010.) Instead of just automating existing processes, the first thing to do should be eliminating current processes which do not add value (Hammer 1990). Information technology is often included as part of the solution but also the organization has to be ready for the change. According to Ying (2010) the main elements which are stressed in BPR are "focus on business process, questioning of the status quo, specific objectives, breakthrough achievement, and significant cultural change." (Yin 2010.)

Theory of Constraints (TOC) is based on an idea that every system has constrains or bottlenecks which slow down the system (Ikeziri et al. 2018). Cox (2012) determines constraint as "the factor that ultimately limits the performance of a system or organization" and resource bottleneck is determined as "any resource whose capacity is less than or equal to the demand placed on it for the specified time horizon" (Cox et al. 2012, p.9). TOC focuses on identifying and managing these constraints and bottlenecks and evaluating fixes to the workflows. Therefore, TOC is a tool for process development and quality management when it is used in production (Kumar, Maiti & Gunasekaran 2018).

Another part of TOC is thinking process. According to Mabin, Forgeson and Green (2001) the thinking process tools can be used on deciding "what to change, what to change to, and how to cause that change". The current factors which prevent the system from achieving its goals are the main focus of the processes. The process starts by identifying the system's symptoms which show that the system is not performing as well as it should or could. In order to find and analyze the root causes of these symptoms, TOC thinking process tools can be utilized. They can also be applied when determining possible solutions in order to fix these problems, and how to implement and operate these solutions. In this approach, TOC is used as a change management method, which maps change management from the perspective of the present issues, assuring that any modification will result in improvement by focusing it on the system's weakest areas. (Mabin, Forgeson & Green 2001.)

3 Workflows in healthcare sector

Workflows in healthcare are inferior to clinical processes such as diagnostic processes (Bucur et al. 2016). Designing workflows in healthcare sector requires understanding of the general principles of healthcare processes as well as common workflows which are used in the specific healthcare field. This chapter breaks healthcare workflows in three levels according to classification of Sheehan and Bakken (2012) and introduces some common workflows on each organizational level including systems which can support these workflows. Then previously used approaches to conclude workflow analysis in healthcare are presented offer solutions to be used as part of the workflow design process. In addition, basic principles of change management in healthcare sector are discussed.

3.1 Individual level workflows in healthcare

Individual level workflow can be considered as the individual's observable or cognitive workflow related to performing a task. These may differ from one another. For example, during a patient visit a clinician's one observable workflow might be a list of problems that the clinician asks the patient. The corresponding cognitive workflow in the clinician's mind could be for example "Listen for signs of any acute problems and take care of those first. If there are no symptoms indicating those, then focus on potential chronic problems." In addition, there is the workflow that is facilitated when clinician follows the rules and protocols established by the organization. These may be digital or paper forms or software. In that case workflow is related to how the information is presented and laid out. The acceptability and utilization of workflow automation depends on whether the software's workflow corresponds to the individual's cognitive and observable workflows. (Karsh 2009.)

When designing individual level workflows and automation in healthcare it is these forms and software and the interactions between them and the user that need to be designed. Some of the most commonly used systems (Table 1) related to individual level workflows in healthcare and especially in eyecare are for example Electronic medical records (EMR),

Clinical decision support systems (CDSS), Picture archiving and communication systems (PACS), and the software used by some examination devices.

Examination devices

Examination devices and their software are classified medical devices which are strictly regulated. Medical devices in general are healthcare equipment and supplies, instruments, and other similar supplies that the manufacturer intends to be used in the diagnosis, prevention, monitoring, treatment or mitigation of human disease. (Tukes 2022)

Electronic medical records (EMR) and Electronic health records (EHR)

EMR and EHR are both electronic records for storing patients' medical information. The difference is that EMR is used by one organization and EHR compiles multiple EMRs from various healthcare organizations into "a single comprehensive longitudinal or lifetime record for an individual patient." Only authorized clinicians and staff are allowed to create, manage, and consult the information in both EMR and EHR. (Gogia et al. 2019, 36-38.) EMR systems have widely replaced the old paper files and records. This ensures better availability and easier access to patient information at the point of care. Effective workflow management and efficient communications systems are critical for utilizing the full potential of EMR systems in all organizational levels (HIPAA Journal 2022.)

Picture archiving and communication systems (PACS)

PACS is used for archiving medical imaging information in a web-based storage. This enables storing and reviewing all the images in a digital form from one place instead of accessing them separately from the examination devices and their local storages. (Arora & Mehta 2014)

Clinical dashboards

Dashboards utilize data visualization to support viewing, examining and thus understanding the data on processes and process outcomes. Clinical dashboards are a specific type of dashboard used in healthcare which can be used for gathering disease specific information and metrics about the patient to assist diagnosis. Some clinical dashboards can also provide feedback to individual healthcare professionals on their performance compared to targets or standards. The aim in both cases is to support decision making and improving patient care while streamlining the individual workflow. (Randell et al. 2020)

Clinical decision support systems (CDSS)

Clinical decision support systems have become an important part of personalizing care and supporting clinical processes (Bucur et al. 2016). The diagnostic process is considered as challenging as making the correct diagnosis and therefore it has become a requirement to support also the process, not just the decision making itself (Musen, Middleton & Greenes. 2013). CDSS tools are based on clinical models which are developed from clinical knowledge. While these models and clinical knowledge are developed in clinical research domain the important aspect from the overall workflow and workflow design perspective is how these tools are implemented. Bucur et al. (2016) point out that it is important to adapt decision making support to match the clinical workflow in order to support the clinical processes properly. Providing clinical workflow support enables delivering recommendations when and where it is needed. (Bucur et al. 2016.) Healthcare professionals face a significant challenge due to the rapid pace of change in both therapeutic options and knowledge. This same challenge applies for clinical decision support systems to keep up with the development and not to become obsolete. Because changes to clinical processes and decision support may affect the workflows it is important that WfMS used in healthcare offer enough flexibility. (Bucur et al. 2016, Smartsheet 2019.)

Table 1 Common individual level workflows in healthcare and systems related to them

System	Workflow
Examination devices	- Entering patient demography or selecting patient from a worklist - Performing an examination - Saving the examination data - Sending examination data to other systems
Electronic medical records	- Searching for the patient's medical history - Viewing the patient's medical history - Adding information to the patient's medical history
Picture archiving and communication systems	- Searching for the patient's medical images - Viewing medical images - Adding data to the database
Clinical Dashboards	- Decision making
Clinical decision support systems	- Automatic event-based analysis and possible suggestion for action - Manual requests for computerized analysis and possible suggestion for action

3.2 Organizational workflows in healthcare

Depending on the organizational structure there may be one or more levels of workflows, which can be categorized under "organizational workflows" (Sheehan et al. 2012). For example, independent private optician stores usually consist of only one organizational level. Whereas some hospitals or hospital chains have multi-level organizations consisting of several units, clinics and departments. Therefore, the same workflow can be seen as an organizational or inter-organizational workflow depending on the point of view. A workflow between two optician stores is inter-organizational for a point of view of a single store but organizational from the point of view of the whole company.

When taking a clinic as an example of an organization, the organization level workflows mean the flow of information related to the patient's healthcare in the clinic and the dependencies of the tasks carried out. More generally it can be said that the organizational workflow is the flow of work and information in the organization between the professionals and patients as well. (Karsh 2009; Sheehan et al. 2012). Internal consultations, 2nd opinions or referrals are example of organizational workflows in eyecare field (Topcon University 2022b.) Commonly used systems related to organizational level workflows in healthcare are WfMS, EMR, PACS, Practice management systems and Telehealth systems (Table 2).

Practice management systems (PMS)

Practice management systems are medical software which manage a medical practice's daily operations including keeping records of patient demographics, scheduling appointments, invoicing, and reporting (American Medical Association 2023).

Workflow management systems (WfMS)

On this level WfMS can be used to manage and control the organizational workflows.

Electronic medical records (EMR)

Storing patient's medical information in EMR enables sharing the information inside the organization (Gogia et al. 2019, 36-38).

Picture archiving and communication systems (PACS)

Organizations can store imaging data so that it can be easily accessed in the points of care which are parts of the organizational workflow (Arora et al. 2014).

Telehealth systems

Telehealth refers to the technologies, platforms and services which enable health care professionals to provide quality care at a distance. While telemedicine means the practice of medicine using telehealth technologies to deliver care at a distance. Telehealth services can be further classified into synchronous and asynchronous telehealth services. In synchronous telehealth services for example a consultation takes place in real-time enabling bi-directional communication. Whereas in asynchronous telehealth services different actor don't need to be present at the same time. For example, acquisition of medical data and transmitting and analyzing data can happen in separate time frames. (Topcon University 2022c.)

Table 2 Common organizational level workflows in healthcare and systems related to them

System	Workflow
Patient management system	- Storing booking information - Storing patient demography
Workflow management system	- Controlling the workflow in the organization - Notifying the next professional in the sequence - Internal consultation - Internal 2nd opinion - Internal referral
Electronic medical record / Electronic health record	- Storing medical / health information - Internal consultation - Internal 2nd opinion - Internal referral
Picture archiving and communication systems	- Storing medical images and reports produced by examination devices
Telehealth system	- Enabling professionals to provide quality care at a distance

3.3 Inter-organizational workflows in healthcare

Inter-organizational workflows include processes which occur between at least two organizations. For example, hospitals send medication prescriptions to pharmacies which

then turn the prescription into a medication given for the patient. (Karsh 2009.) As mentioned in chapter 3.2 some workflows can be seen as organizational or inter-organizational depending on the point of view. For example, consultations, 2nd opinion or referral workflows can be handled internally in one organization or externally in co-operation with another organization. (Gogia et al. 2019, 36)

Commonly used systems related to inter-organizational level workflows in healthcare (Table 3) are for example EMR, EHR, PACS, WfMS, Reading centers, and Shared care systems.

Electronic medical record (EMR) and Electronic health records (EHR)

EHR compiles information from multiple EMRs from various healthcare organizations and therefore is used as a part of inter-organizational workflows. As mentioned in chapter 3.2 storing patient's medical information in EMR enables sharing the information inside one organization but if a healthcare organization consist of multiple units, then EMR is used also between these units. In these cases, the workflows between the units can be seen as inter-organizational workflows. (Gogia et al. 2019, 36-38).

Picture archiving and communication systems (PACS)

Organizations can use PACS to share imaging data so that it can be accessed by other organizations which are part of the inter-organizational workflow. (Arora et al. 2014).

Workflow management systems (WfMS)

Just like with other workflow levels WfMS can be used to manage workflows between organizations in some cases.

Reading center

In a scenario called store-and-forward medical information such as CT scans are stored in EHR, EMR or PACS and sent to a reading center in which certified specialists analyze the information. Some companies offer their services in a form of reading centers to other healthcare organizations, but some organizations also have their own reading centers. (Gogia et al. 2019, 36-38; Topcon University 2022c).

Telehealth

Just like with organization level workflows telehealth can also be used between organizations to support shared care models (Topcon University 2022c.) Shared care or

collaborative care is cooperation of hospitals, general practitioners, specialists and other healthcare professionals. It is a patient-oriented way to provide the care the patient needs. (Shaw et al. 2019.) In shared care models the work is distributed and communicated between different healthcare providers. Telehealth platforms have become a modern way to distribute the care remotely across distances. (Gogia et al. 2019, 36-38, 93-95.)

Table 3 Common inter-organizational level workflows in healthcare and systems related to them

System	Workflow
Electronic Medical Record / Electronic Health Record	- External consultation - External 2nd opinion - External referral - Storing medical /health information
Picture Archiving and Communication Systems	- Storing medical images and reports produced by examination devices
Workflow Management System	- External consultation - External 2nd opinion - External referral
Reading center	- External consultation - External 2nd opinion - External referral
Telehealth	- External consultation - External 2nd opinion - External referral

3.4 Workflow analysis approaches in healthcare

There are different fields of science which provide their research and own approaches for analyzing workflows. These approaches can also be utilized in healthcare.

Petri nets

In the fields of Information systems and Computer Science (CS) the approach for workflow analysis is based on the theory of Petri nets. (Sheehan et al 2012.) Petri nets is a process modelling technique which has mathematical foundation. This allows using various analysis

techniques to Petri net models. Another advantage is that in addition to formal notation Petri nets offers graphical notation, which makes it accessible for non-experts. Several software tools support Petri nets and it has many similarities with other modelling languages used by business process modelling tools. (van der Aalst & Stahl 2011, p 65). The approach requires system use data and which is typically acquired from WfMS (Sheehan et al 2012).

Process mining

Process mining is an example of a method which is based on Petri nets (Sheehan et al 2012). It is a technique to identify, analyze, and monitor processes based on event logs. Event logs should include at least a unique identifier for each process instance, a description of the event and a timestamp. Event log works as an input for process mining, and it is used to answer process related questions. The results are models which describe the processes of the organization. According to van der Aalst, the inventor of process mining, "The goal of process mining is to use event data to extract process-related information, e.g., to automatically discover a process model by observing events recorded by some enterprise system." (van der Aalst 2016, 25.) Compared to subjective results of traditional workshops and interview techniques, process mining can give an objective picture of the ideal process. (van der Aalst 2016, 25; Hirsjärvi, Remes & Sajavaara 1997, 201-203.)

Process mining is a useful method for evaluating tools after they have been implemented. The evaluation can consider how the tool is used or how the tool could be improved so that they better support the intended work. In practice this means analyzing the workflow at the organizational level. The method can be used to identify and model the most used or alternative routes for completing tasks. However, the analysis does not include the context in which the tasks are performed. (Sheehan et al 2012).

Contextual design (CD)

Contextual design is another approach used in IS and CS fields to understand workflows (Sheehan et al 2012). It is a user-centered design method in which information is collected from users in their own environment. This collected information is applied to the product being designed. Product in this case refers to any system a team is developing. (Holtzblatt et al. 2016.) Contextual design analyzes workflow at the organizational and individual levels. The benefit of this approach is that it uses a specific methodology, known as contextual inquiry, which provides relevant focal points to the design. (Sheehan et al 2012). The method

was originally invented in 1998 and the updated Contextual Design V2.0 was released in 2013. The update brings the methodology to the era of smart phones where work and personal life overlap. It combines the traditional CD techniques and the new techniques called Experience models to fulfilling core human motives while supporting activities. Contextual design is taught in many universities, and it is widely popular amongst UX designers. (Holtzblatt et al. 2016.)

Activity theory (AT)

Computer-Supported Cooperative Work (CSCW) is a field that aims to understand collaborative group work activities. Activity theory (AT) and coordination theory (CT) are both theoretical models which have been utilized in the CSCW field to describe these collaborative workflows inside groups. (Sheehan et al 2012.) Activity theory is a psychological theory which was developed in the Soviet Union and extended by Scandinavian researchers in the mid 1980's. It is a research framework for studying human-computer interaction (HCI) and concerned with understanding the relation between consciousness and activities. Its focus is on understanding everyday practices in the real world. The goal is to understand the mental capabilities of an individual. However, the theory sees that it is insufficient to analyze isolated individuals. Instead, it analyzes "the cultural and technical aspects of human actions". (Nardi 1995.) Activity analysis and development (ActAD) and Activity checklist are frameworks of methodologies based on Activity theory (Sheehan et al 2012).

The ActAD framework consists of four steps. First step is to describe the activity network. Second step is to establish goals for developing a new tool after evaluating how work activities have changed over time. Then existing goal-conflicts are identified in the third stage, and a model of the activity network's future vision is produced in the fourth. Workshops with users are used for concluding each phase. (Korpela, Mursu & Soriyan 2002.)

The Activity checklist consists of four categories which aim to make the developers to focus on the hierarchical structure of activities, context, the internal cognitive components, and external actions related to activities. In addition, it describes the expected changes in the actions related to using the new technology. The activity checklist can be used as a tool in

direct observations of work practices in a consistent way or to construct recommendations for interviewing potential users (Sheehan et al 2012).

Coordination theory (CT)

Coordination Theory provides an approach to analyzing group work to find alternative approaches involving computer support. The theory studies the dependencies and of the tasks between the group members and the mechanisms used for coordinating these tasks. According to the theory identifying and analyzing these dependencies can lead to new alternative coordination mechanisms and processes. The original theory provides a definition for coordination, a theoretical framework for analyzing coordination in complex processes, and typology of related coordination mechanisms and dependencies. Since 1994 the theory has been developed and for example the typology has been updated. Developing a complete model of a process includes modeling all of three main aspects which are coordination, decision making, and communications. (Zhang & Galletta 2006, 120-122.) The theory has been used for examining organizational and inter-organizational workflows for example by tagging and tracing documents in a hospital setting (Sheehan et al 2012).

Cognitive Task Analysis (CTA)

Cognitive science a multidisciplinary field which studies human thought processes. These processes include knowledge attainment, memory and problem solving. Using a variety of techniques based on cognitive theory, cognitive task analysis (CTA) studies human task performance. (Sheehan et al 2012.) Cognitive Task Analysis includes a group of methods based on cognitive theory which can be used to examine human tasks. Two commonly used approaches to carry CTA are Think-Aloud protocol (TA) and Cognitive Walkthrough (CW).

A systems analyst does a CW by assessing the system without the user. The aim is to mimic a real user's cognitive processes while they perform tasks. Its objective is to identify the sequences, which may include the cognitive or perceptual and physical actions necessary to achieve objectives. Instead, in TA the users of the system are present and required to describe their mental processes while they complete tasks. The user's mental model of the task is reflected in the verbalizations that were recorded. This information can be used to create design requirements to support individual workflows. (Jaspers 2009; Sheehan et al 2012.)

Distributed cognition (Dcog)

Distributed cognition is a theoretical framework which describes and uses activity system as a unit of analysis. The research aims to understand human performance and cognition of a specified group instead of an individual. Activity system includes “a group of human actors, their tools and environment, and is organized by a particular history of goal-directed action and interaction.” (Hazlehurst, Gorman & McMullen 2007.) Zhang (2007) has described a conceptual framework called UFuRT (user, functional, representational and task analysis) which is based on Dcog and can be used to describe workflow when designing information systems. UFuRT has four phases and completing them results in identifying the system requirements. (Zhang & Butler 2007.) UFuRT can be used to examine workflow at all levels. Especially it is suitable for inter-organizational and organizational workflows (Sheehan et al 2012.)

Organizational routines

Organizational science or organizational studies is another field that offers a methodology for understanding workflow (Sheehan et al 2012). It is a multidisciplinary field interested in “a collective activity, and how it relates to organization, organizing, and management” (University of Verona 2022). Organizational routines is a model used by organizational science that can be applied to study workflows in various settings. The model is suitable for analyzing organizational and inter-organizational workflows (Sheehan et al 2012). Feldman conceptualizes organizational routines as “generative systems with internal structures and dynamics.” The aim of the study is to influence change and direct the re-design process by clarifying internal structures within organization. From the routines two main component called ostensive aspects and performative aspects can be characterized. Ostensive aspects refer to patterns and routines which may come for example in a form of a guide. Whereas performative aspects are the specific actions that individuals perform as part of the routine in particular circumstances. These routines manifest in physical artifacts such as workflow systems or documents explaining how the procedure is carried out.

Feldman proposes three ways organizational routines can be utilized as a unit of analysis. These approaches are:

- treating routines as black boxes
- examining one aspect of a routine; and
- considering interactions between various aspects of a routine

Analyzing organizational routines offers possibility to learn about the organization including its power structure and political aspect. Understanding these is important to successfully influence change and useful for designing and implementing processes. (Feldman & Pentland 2005.)

3.5 Making changes to healthcare workflows

As several approaches to analyze and describe workflows exists choosing the most suitable approach should be based on selection criteria. From customer's workflow point of view, the information system should fit the workflows of each organizational level. Therefore, in order to ensure a successful implementation of a new information system the new workflows related to the system should always be adjusted to fit the purpose of these organizational levels. (Holden et al. 2009.)

According to Sheehan the selection of workflow analysis method depends also on the project objectives, larger organizational objectives, and project restrictions such as access to a certain environment and data, type of work, workers or population engaged (Sheehan et al 2012). Therefore, the selection criteria depend highly on the type of the improvement project. One example of a project type is a product development project which looks at workflows inside a product. For this project type workflow design methods which emphasize product development such as Contextual design are suitable (Holtzblatt et al. 2016). Another type could be an analysis project in a healthcare provider organization which seeks to find any target of improvement. In these projects the organization looks for any development possibilities from wide perspective. For these projects more comprehensive methods such as Six Sigma would be suitable (American Society for Quality 2022c). However, when a company which produces information systems wants to develop their workflow design process, they are choosing an approach to be used as part of their delivery process instead of product development or a single customer organization or project. Deriving from Sheehan's (2012) selection criteria the selection of approach then depends on the targeted process maturity goals, restrictions, and the company's business strategy. The restrictions can include for example the current limitations in the company's products such as what kind of data they provide for workflow optimization or general restrictions such as available resources.

In addition, when choosing a workflow analysis method there are also other things to be considered when creating a process which will affect workflows in healthcare sector. It has been proved that efficient workflow management reduces medical errors, supports following the industry regulations, and improves the quality of patient care. The reasons for any workflow changes should always be communicated to employees and managers to get everyone involved in the workflow to understand and adopt the change because sometimes even minor small changes to the workflow may have significant impacts on individual employees. If they have not understood the reason for the changes, they may look for possible workarounds and continue to work in the old way, which causes losses to the benefits that the organization was expecting. Therefore, it is important to monitor the results of the changes to determine if the desired effects are achieved. This can be backed by conducting internal audits. (HIPAA Journal 2022.)

4 Research methodology

This chapter first presents the research methodology and methods used in the empirical part of this thesis. Then the whole research process is summarized in the last subchapter.

4.1 Process development lifecycle

In a general level the empirical part followed the process development lifecycle model by Wysocki (2004). Wysocki's model was selected because project management office is the operative function responsible for the new process in THS. According to Wysocki, improving processes in project management requires a formal and planned approach because informality in process development has several downsides. Project manager may for example think their projects are so different that ideas suggested by their colleagues may not be applicable. Some project managers may also be hesitant for taking ideas from other project managers because they consider this as a sign of incompetence or weakness. (Wysocki 2004, p 13).

Wysocki's model is a formal approach to improving process which consists of four major steps (Figure 4).

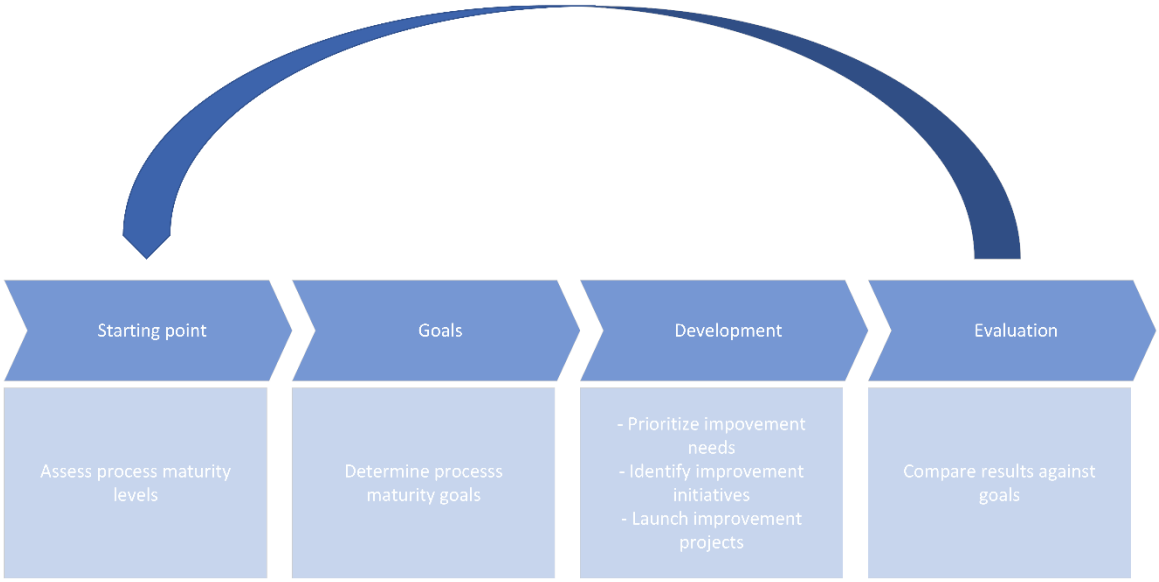

Figure 4 Process improvement lifecycle (Amended from Wysocki 2004, p 14)

Assessing process maturity levels is the starting point of developing a process. When the starting point is clear the goals for the development cycle should be set before starting the actual development. If the process is new, as in this case study, the maturity goal for the first cycle should be set to designing the first version of the process. According to Wysocki it should be made clear to the organization that further development cycles are most likely needed. (Wysocki 2004, p 13)

The current workflow design practices in THS were examined by conducting a case study. The result of the study was the assessment of process maturity levels which served as a starting point for the development lifecycle and enabled determining the process maturity goals. The analysis results together with the work done in the theoretical part of the thesis were utilized in development of the process solution. The workflow improvement methods and previously used approaches to workflow analysis were evaluated and the most suitable approaches for workflow analysis were included to the solution model. Literature analysis was utilized also by amending solutions to the solution model. The structure for the new process was taken from the current Delivery process in THS.

The exception to Wysocki's model is that launching improvement projects was not considered as parts of this thesis. Instead, a suggestion for the process solution was first built and then validated by organizing a workshop for the case company's employees. The refined

processes description for the new workflow design process was then presented as the main result of this thesis. Improvement projects required to implement the process are presented in the conclusions of this thesis.

4.2 Case study

The process maturity levels were assessed by conducting a case study in Topcon Healthcare Solution. As a starting point for the case study basic information about the case company was collected. Then an interview study was conducted and analyzed.

4.2.1 Collecting research data by interviews

Collecting data was carried out by conducting a semi-structured interview study on selected THS employees. Semi-structured interview is a suitable method to study less-known phenomena and to collect information about specific topics. There is no universal definition for semi-structured interviews but in level of formality it falls between structured and open interviews. The semi-structured interview does not strictly follow a list of pre-decided questions but instead it may have pre-decided themes for the interview or a list of questions which is used to support the interview. This approach provides freedom for the interviewees to express their views on the selected topics. (KvaliMOTV 2022a; KvaliMOTV 2022c).

In this case study six employees were selected (Appendix 1) for the interviews to represent different teams and different roles inside the teams. The interviews were carried out in October 2022. The goal in the interviews was to describe the current workflow design practices including their pros, cons, and improvement ideas. A list of interview questions (Appendix 2) was prepared to support the interviews, but the overall interview was carried out as a free conversation. All questions were not asked from all the interviewees and the interviewees were allowed to talk about other topics as well. Some interviews took place in the THS office in Helsinki while others were arranged remotely using Microsoft Teams. All interviews were recorded. The language of the interview was Finnish for those four interviewees who spoke native Finnish. In the two other interviews English was used. After each interview a transcription and a summary of the interview was created using the recording.

4.2.2 Analyzing the interviews

After all the interviews were completed and transcriptions were created the result were analyzed by using inductive content analysis to describe the phenomena (Hirsjärvi et al. 1997, 200-208; Metsämuuronen 2005, 213–214). The approach was chosen because the analysis does not depend solely on the existing literature. The development of content categories starts from the data itself and therefore it does not require an established theory or account as the starting point. According to Vears and Gillam, inductive content analysis is particularly appropriate when the aim is to describe and understand the phenomenon under investigation to get a practical answer or apply the findings to develop practice guidelines or policies. (Vears & Gillam 2022.)

The analysis was carried out using the following steps:

1) Reading and familiarizing the data
2) First round of coding: identifying big-picture meaning units
3) Second-round coding: developing subcategories and fine-grained codes
4) Refining the fine-grained subcategories
5) Synthesis and interpretation

(Vears et al. 2022.)

Initial coding schema

The big-picture meaning units were derived from the list of interview questions with additional units created for those unit which did not fall into these categories. These formed the following initial coding scheme:

A. Current workflow design practices/process

B. Key stakeholders

C. What has worked well

D. Problems

E. Requirements/suggestions for the new workflow design process

F. Change management on customer site

Subcategories and refined coding schema

On the second round of coding all big-picture categories were processed one by one to develop sub-categories. All sections included in the category in progress were processed line-by-line. Each one of these sections were coded in a more fine-grained manner.

After the second round of coding the sub-categories were compared against each other and refined as an iterative process in which some sub-categories were grouped and some ungrouped. Changes were also made to the big-picture meaning units which then formed the final content categories. The result of these coding rounds was the refined coding schema (Figure 5). The full schema is presented in Appendix 3.

A. Current workflow design practices

1 Sales phase

1.1 Understanding of customer needs

1.2 Analyzing customer's current environment and workflow

1.3 Planning how our products fits the customer's overall workflow

1.4 Upcoming product capabilities may be included according to the product roadmap

2 Knowledge transfer from Sales to Project team

2.1 Side product of technical support given in Sales phase

2.2 Delivery data sheet

2.3 Handover from Sales

2.4 Internal project kick-off meeting

Figure 5 Sample from the refined coding scheme

Synthesis and interpretation

The last step of the inductive content analysis was to synthesize the categories to create a narrative that provides an overall explanation of the phenomenon. This narrative presented in chapter 5.2 serves as assessment of the process maturity level describing the current workflow design practices in THS including well-working practices, problems as well as

requirements for the new process and suggestions to solve the current issues. Based on this interpretation the process maturity goals for this development cycle were determined and describes in chapter 5.2.

4.3 Developing the process solution

Connecting requirements to solutions

Developing the process solution started by building the Solutions model (Appendix 4). It was created to gather all the requirements and possible solutions to them based on the interviews, literature and some author's own suggestions. Building the model included the following steps:

1) Creating a list of initial development requirements
2) Gathering possible solutions based on interviews
3) Evaluating the importance of the requirements
4) Evaluating which solutions were out of scope
5) Excluding requirements for which the importance was 0
6) Excluding rows in which solution was out of scope
7) Including solutions from literature
8) Adding a column for related Delivery Process phases

List of initial development requirements was created by taking first all the items directly from in content category E (Requirement) in the refined coding scheme (Appendix 3). Then all items in content category D (Problems) were converted into requirements and added to the list. The list was sorted and refined by combining similar requirements.

Solutions were gathered from content categories A (Current practices), C (Well-working practices), and F (Suggested solution from THS employees) and supplemented with suggestions by the author (code in the table = S). In addition, suitable solutions from gathered from descriptive literature review to a specific column

The importance of each requirement for the first version of the new Workflow design process was evaluated in a scale (Table 4) from 0 to 3.

Table 4 Meanings of the importance value

Importance value	Meaning
3	high importance
2	medium importance
1	low importance
0	out of scope

The applicability of each solution was then evaluated again critically. Some solutions were considered out of scope for example because they would be hard to implement or not suitable for the first version of the process.

Requirements considered to be out of scope and their rows were separated to the Out-of-scope table (Appendix 5). If a requirement had importance of 1, 2 or 3 but included out-of-scope solutions the row was divided and the part including out-of-scope solutions was moved to the Out-of-scope table. Explanation about out-of-scope decision was added to the table.

Workflow improvement methods presented in chapter 2.3 and approaches to workflow analysis presented in chapter 3.4 were evaluated to select the most suitable approach for THS. From these approaches the most suitable solution for analyzing customer workflows for THS is a combination of Cognitive task analysis (CTA) and Organizational routines. CTA methods such as Think-Aloud protocol are closest to the current well-working practices of analyzing customer workflows in THS. Because CTA methods are most suitable for analyzing individual level workflows the analysis should be complemented by using Organization routines model to analyze also organizational and inter-organizational level workflows. The chosen methods were added to the Literature solutions column of the Solution model.

Finally, all rows in the Solutions model were examined and those Delivery process phases which best correspond to the requirement and solutions were added to a new column. The rows were then sorted again to organize the table.

Process solution

Building the new workflow process itself started by utilizing the Solution model. The process diagram for presenting the Suggested solution was built by using Miro. First the structure was planned and all solutions from the final version of the Solution model (Appendix 4) were placed in the diagram to the corresponding Delivery process phase. The diagram was then supplemented to create a complete process.

Workshop to present, refine and validate the Suggested solution was organized on the 21st of December 2022. The participants included the interviewed THS employees and the vice president of THS Operations. The workshop was divided in two parts. In the first part the suggested solution was presented starting from the structure of the process diagram and then continuing with the content. Participants were instructed to take notes on topics which caught their attention or if they had suggestions for refining the process. In the second part the suggested solution was refined and validated starting again from the structure and then moving to the content. Refinements to the process diagram were made according to the open conversation until it the process was considered valid. Process description for the new Workflow design process was written after the workshop to finalize the documentation of the solution.

4.4 Research process as a whole

As a summary of the whole research process, table 5 describes in more detail the phases of the research process as well as the research material, analysis methods and outputs of each phase.

Table 5 Research process as a whole

Research process phase	Research material	Analysis methods	Outputs
Familiarizing with the research topic	- Key concepts - Workflow improvement methods - Previously used approaches to and workflow analysis in healthcare	- Descriptive literature review	- Theoretical framework for the study - Potential approaches to be utilized in building the new process
Familiarizing with the case company	- Training material produced by the case company - Process descriptions - Other internal material and conversations		- Basic understanding of the case company - Information related to the case company's delivery process
Employee interviews	- 6 recorded interviews - 54 pages of transcribed text material	- Inductive content analysis	- Assessment of current workflow design process maturity levels in the case company - Process maturity goals
Developing the process solution	- All research material	- Tabulation - Workshop	- Solution model - Suggested process solution - Change requirements to the suggestion -Validation of the solution - Process description for the new process

5 Empirical results

In this chapter basic information of the case company is first presented as a starting point of the case study. Then the results of the interview analysis are presented as a narrative which provides an overall explanation of the current workflow design practices in THS Operations and Sales including related process development needs and improvement ideas. Process maturity goals and general development requirements describe the selected focus points for the current process improvement lifecycle. Solutions model then lists the included process requirements and connects them to selected solutions from interview analysis and literature. The Suggested process solution in chapter 5.5 is the draft version of new process which was presented in the validation workshop. Validation of the suggested solution describes the results of the validation workshop as changes made to the Suggested solution. The final version of the process is then presented as process description in chapter 5.7. The versions presented in chapters 5.5 and 5.7 are close to one another but including both the draft and the final version in the report was considered to improve visibility of the study.

5.1 Starting point for the case study

This chapter presents the case company including its background, products, customers, operating ecosystem, business strategy and the current Delivery process according to internal material produced by the company.

5.1.1 Company overview

Topcon is a 90-year-old corporation which bought a Finnish start-up company Kide systems in 2018 to do software development. Kide systems, founded in 2015, has quickly grown from a small Finnish start-up to a medium size international IT company as part of Topcon corporation. Today known as Topcon Healthcare Solutions (THS) the company and its local distributors manage an increasing number of delivery projects in eyecare field to deliver software products and solutions to existing and new customers. As the business grows also the processes need to evolve. (Laurila 2023.)

5.1.2 THS products

Topcon Healthcare Solutions has three main software products called Harmony Referral System (later Harmony RS), RDx and SightPilot. All three are regulated medical devices and they can be considered as Workflow management systems (WfMS) which support and streamline customer organization's workflow execution. The new Workflow design process concerns the delivery of these products to the customer (Laurila 2023.)

Harmony RS

Harmony Referral System is the main product of THS in the European and global markets. Harmony RS is highly configurable and a technically complex data management and collaboration platform which has several features and capabilities (Figure 6). These include centralized data management, clinical data management, patient management, clinical analysis tools, business intelligence, telehealth, shared care, and integration platform.

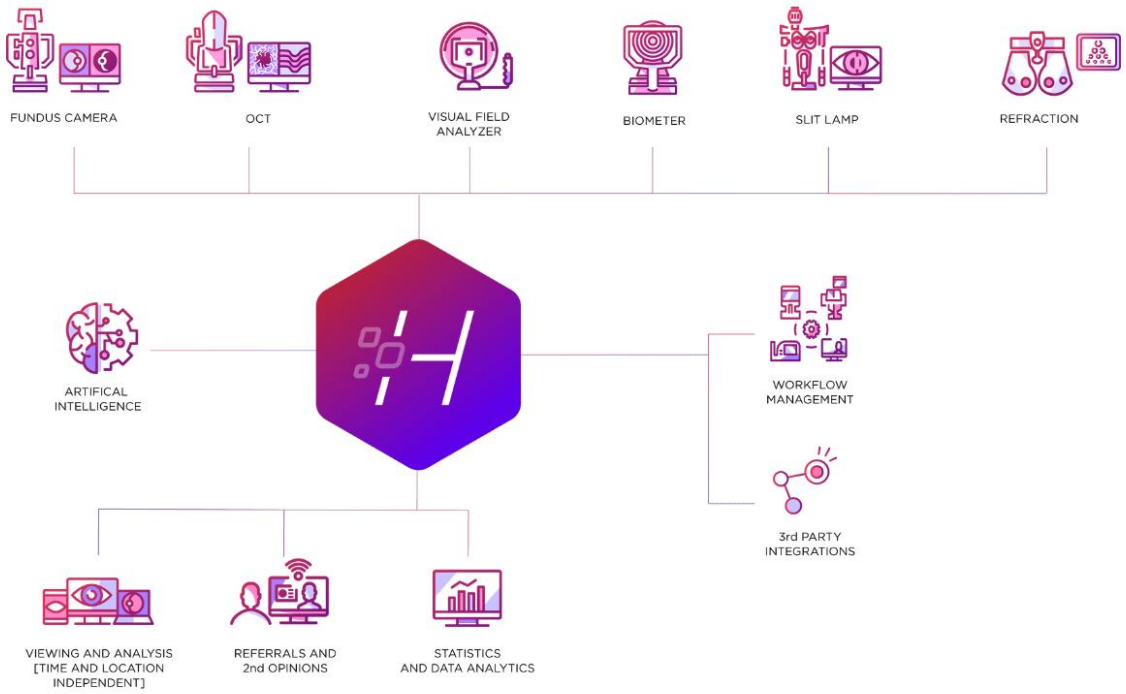

Figure 6 Harmony RS System Chart (Topcon 2022a).

One of Harmony RS's main characteristics is high connectivity. Its software ecosystem enables integration to practically any 3rd party eyecare device or software. This capability enables Harmony RS to transfer data between different devices and systems for example patient demography and worklists between the medical devices and Electronic medical

records (EMR) software. Examination data from integrated devices can be transferred to Harmony RS's Picture archiving and communication system (PACS). Harmony RS has the capability to manage and view this data in a single web application instead of having to use separate device or vendor specific applications some of which can be run only from the devices themselves or their dedicated workstations usually located next to the imaging device. This makes Harmony RS a telehealth portal which allows users such as ophthalmologists to access patient data practically from anywhere with internet connection. Additionally, the user can run 3rd party applications such as Artificial Intelligence (AI) tools directly on the Harmony RS platform. These AI tools can for example evaluate risks for certain eye diseases and therefore the information can be used for clinical decision making. (Topcon University 2022a; Topcon University 2022b.)

As a communication platform Harmony RS provides a reporting tool which allows users to fill in examination or request reports and send them to other defined users or user groups. This enables organizational and inter-organizational communication workflows which can be used for consultation, 2nd opinion or referral. These communication workflows together with the PACS are the key elements for connecting the services of different healthcare providers and combining otherwise disconnected and separate treatment paths into one shared care entity. The reports themselves support individual workflows. (Topcon University 2022a; Topcon University 2022b.)

RDx

RDx stands for Remote Diagnostics and is the hub of Topcon's Healthcare Suite. It is a synchronous telehealth platform which eye care professionals use to perform comprehensive eye exams for their patients remotely and in real-time. (Topcon University 2022c.) RDx can connect all Topcon refraction devices for remote control, and it is also able to connect to a wide range of non-Topcon pre-test equipment. In addition, RDx can be used together with Harmony RS by launching Harmony RS directly from RDx. This enables remote refractionists' to access patient's clinical data and images in a centralized storage remotely during the remote refraction. The remote refraction itself is done by using a digital phoropter which is operated though RDx. The refractionists can then use pre-programmed courses or control the workflow fully manually. (Topcon University 2022d.) This way RDx supports the individual workflow but offers also full flexibility for the user to determine the workflow when adjustments to standard workflows are needed. All in all, RDx supports the workflow

in individual, organizational and inter-organizational levels. From organizational point of view the swim lanes (Figure 7) are used for allocating work and to provide an overview of the whole process for individual users.

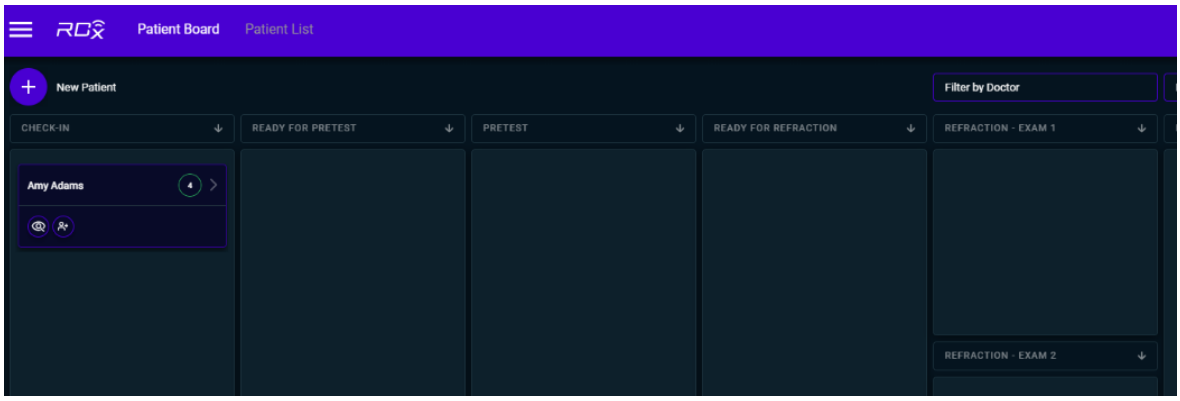

Figure 7 Swim lanes in RDx's Patient Board (Topcon University 2022d)

In case an external refractionist or ophthalmologist is used for remote examinations, the system can be seen to support inter-organizational workflows while it supports also the organizational workflow.

SightPilot

Topcon Chronos (Figure 8) combines binocular autorefraction, keratometry, subjective refraction and visual acuity assessment in a single device. Chronos is sold together with a software called SightPilot which is used to control Chronos via tablet or PC. (Topcon University 2022e.) While Topcon Head Quarters is the legal manufacturer of Chronos, THS is responsible for SightPilot. THS is also developing SighPilot+ which would make the software capable of controlling not only Chronos but also Topcon's automatic phoropter.

SightPilot's interface guides the user through the refraction, providing on-screen questions and directives based on patients' responses at each step. This allows for delegation of refraction which optimizes the clinical workflow. SightPilot is designed for straightforward patients, and it filters out patients that require more complex tests or a specialist customized refraction. (Topcon University 2022e.)

Figure 8 Topcon Chronos (Topcon University 2022e)

From workflow perspective SightPilot support individual and organizational workflows. While the system offers a standard workflow to follow, it also allows the user flexibility to customize the test protocol to suit the clinic's workflow and preferences and fully manual control when needed. If needed the data created be SighPilot can be exported to RDx and used as pretest data for the remote refractionist to finish the subjective refraction (Topcon University 2022d).

5.1.3 THS's customers

THS has several customer groups in the eyecare industry such as optician stores, optician store chains, eye clinics and hospitals. Services and product are provided for both public and private healthcare providers. Each customer group has their own characteristic needs, but the needs may also vary depending on the existing solutions they use as well as local legislation and ways of working. The differences between customer groups are visible especially in organizations' size and structure which both affect the workflows. In hospitals organizational workflow distributes tasks between individuals whereas in a small private optician stores one individual may be responsible of all the tasks in the workflow. In case a customer organization consists of several locations e.g., optician store chains then these stores may have inter-organizational workflows such as consultation or remote clinicians forming a virtual clinic serving multiple stores remotely. (Laurila 2023.)

5.1.4 Eyecare ecosystem

The eyecare ecosystem consists of several actors. They can be grouped into the following categories:

- healthcare providers
- healthcare financers
- healthcare infrastructure and technology providers
- research institutions
- regulatory institution
- pharma and lens manufacturers

In this listing THS belongs to healthcare infrastructure and technology providers. The relationships between the categories are visualized in Figure 9.

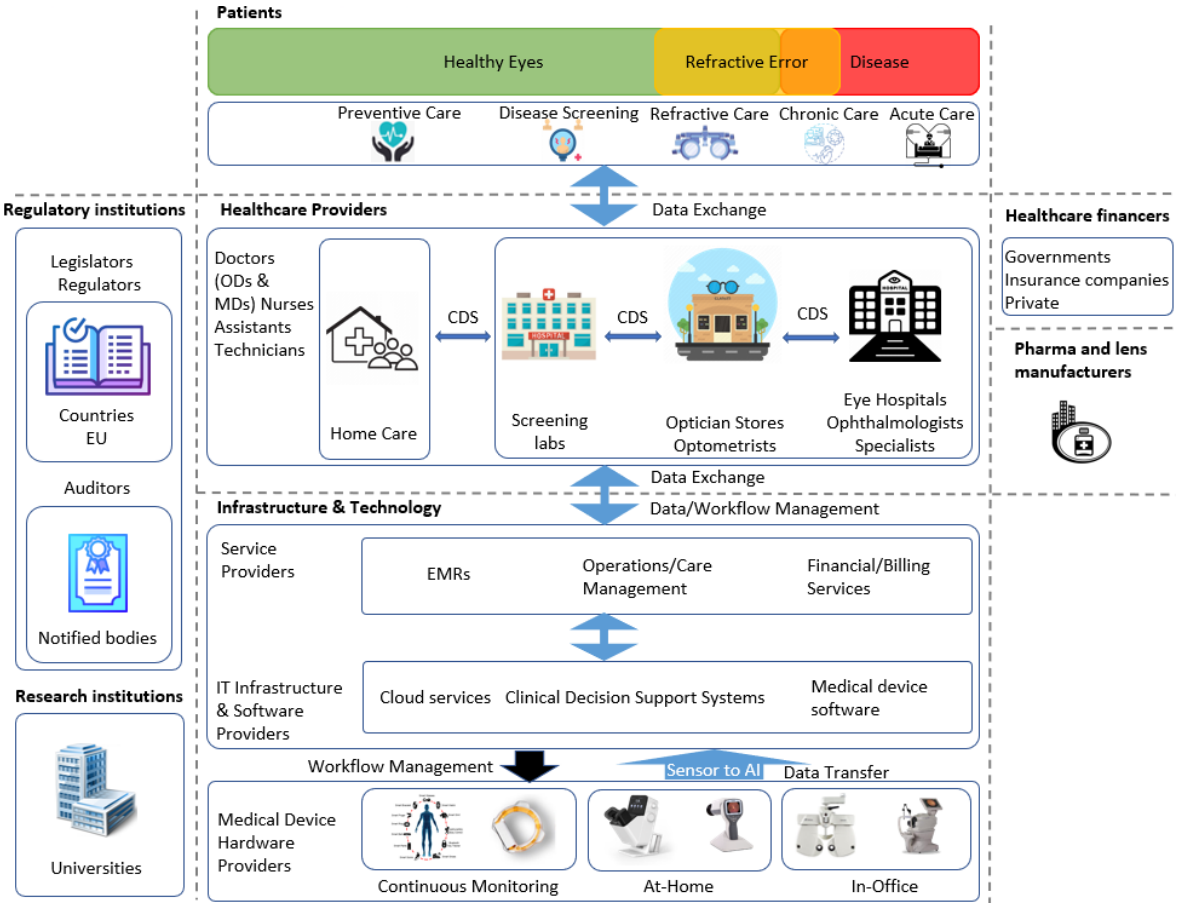

Figure 9 Eyecare ecosystem (amended from Wuotila 2022)

Healthcare providers are THS's main customer group and other groups are often indirectly or directly involved in THS delivery projects through THS customers. As THS solutions support integration to 3rd party applications, software and examination devices, the healthcare infrastructure and technology providers are often key stakeholders in THS's delivery projects. Customers have also workflows related to for example invoicing, billing, prescription of lenses and medication which may include information that sets requirements indirectly for the workflows managed by THS solutions. Regulatory institutions affect the workflows for example by determining which professions are allowed to perform certain tasks in the workflow. Research institutions provide new information which causes changes to the recommendations related to clinical treatment and may therefore affect workflows. (Wuotila 2022.)

5.1.5 Business strategy of THS

THS has five main focus areas in its strategy. They are:

1) Shared care
2) Clinical dashboards
3) Clinical efficiency
4) Marketplace
5) Data strategy

Especially the first four areas have a clear connection to workflows. Shared care model requires well-planned inter-organizational workflows to ensure seamless information and patient flow between organizations. Clinical dashboards offer support for decision making as a part of individual workflows. Clinical efficiency is a key measurement measuring the efficiency of clinical processes and therefore the workflows because all healthcare workflows are inferior to clinical processes. Marketplace strategy turns THS products into a platform, which enables 3rd party software products such as AI tools to be used automatically or manually as part of the workflows. (Wuotila 2022.)

5.1.6 Delivery process in THS Operations

THS Delivery process (Figure 10) includes a set of activities where the project team, sales team and support team work together to ensure a successful and high-quality project delivery. This process is a subject of interest in this case study because it describes the standard delivery of THS's products to the customers. Because THS does not have a separate process for workflow design understanding the Delivery process and its phases provides the closest framework for the current workflow design practices and requirements. This chapter is written based on the Standard Operating Procedure which describes the Delivery process. The sited revision was approved by THS's management in September 2022.

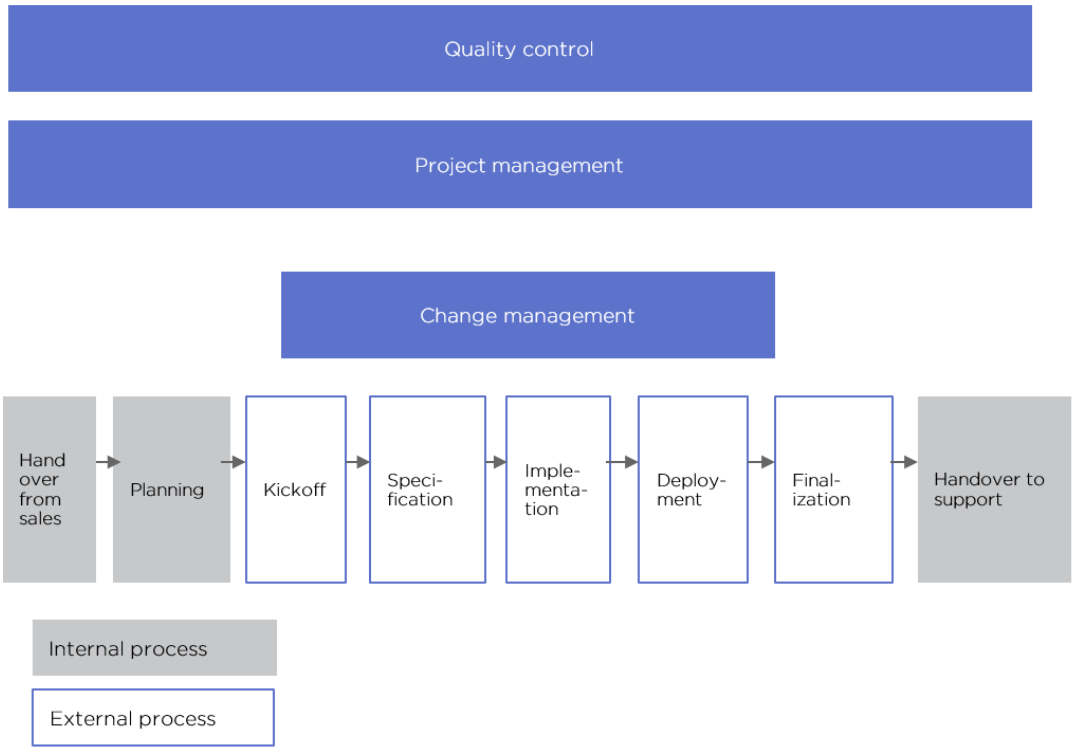

Figure 10 Delivery process in Topcon Healthcare Solutions (Topcon Healthcare Solutions 2022)

The process starts by handover from the sales phase. The sales team communicates the delivery scope and proposed time schedule to the project team. In the handover meeting the sales team transfers the responsibility of the project to the project team. As a milestone the

project team receives a sales handover document and a delivery data sheet containing all the details that have been agreed with the customer during the sales phase.

In the planning phase, an initial project plan is created based on the sales handover and delivery data sheet. Internal kick-off meeting to go through the plan and internal approval are the miles stones of this phase.

In the kickoff phase, the project group holds their initial meeting. Details of the project plan are discussed with the customer. The project's objectives including purpose, scope, limitations, and schedule are defined. THS and the customer commit to the agreed objectives and ways of working. After this phase, any changes to the project plan are handled according to the project change management process that has been agreed with the customer. Customer's acceptance to the project plan and the kick-off meeting are the milestone of this phase.

The specification phase defines the details for the project's technical implementation and identifies the changes the project requires in the end user workflows. The customer's key personnel are familiarized with the system that will be delivered and any missing functionality is pinpointed. The 3rd party interfaces and operational models in use are defined with the third parties that are involved in the project. Also, the user trainings are planned in this phase. Any product change or new product requirement is handled separately from the delivery scope. As a milestone the requirement specifications are documented in the first version of the Solution Description. In addition, any changes to the original scope are evaluated and the plans updated accordingly.

In the implementation phase all tasks in the project plan are carried out to produce the project's technical solution and achieve its objectives. As milestones the test and production environments are created, and device integration packages are implemented. Also, the project's Server Installation Report is completed and approved.

During the deployment the customer's examination devices are connected to the production environment and the connections are validated. Users are trained on the correct use of the system. If included in the delivery scope, the customer's previous data archives are migrated according to the migration plan. The system is taken into production use and its performance is monitored. The milestones include connection of the examination devices, organizing user training and providing User Acceptance Test report for the customer. In addition, the

project's Integration Report is filled and approved. At the end of the phase, the customer can start using the system in the production environment.

In the finalization phase after the project's objectives have been achieved and the customer has accepted the delivered solution, the project manager and the customer agree that project can be closed. This starts the Early Life Support period. During this period the project team will remain available to assist the customer in any issues that might arise immediately after the deployment. Finally, the project organization is disbanded, and the project is closed. The milestones include achieving and concluding the project objectives and that the customer has approved the delivered system by completing the project's User Acceptance Test (UAT) report and the project manager has received the acceptance from the customer.

After closing the project, the responsibility for the customer is transferred to the support team in a handover meeting. Milestones include that handover document has been created and the support team has reviewed the project's Solution Description document. In addition, it is expected that a lessons learned meeting has been held and the meeting notes have been shared with the participants.

5.2 Assessment of process maturity levels

The six content categories follow the main themes of the interview. The interviewees described the current workflow design practices (content category A) including what has worked well (content category C) and which problems they see or have encountered related to the current workflow design practices in THS (category D). In addition, they highlighted important stakeholders in the process (content category B). While listing issues and challenges the interviewees were also able to provide requirements (content category D) and suggestions for the new workflow design process (content category E) as a solution to the problems and requirements. Some of the listed problems address more general issues in the whole Delivery process or Sales process but are still indirectly connected to the current workflow design practices or the problem could be solved as a side product of the new workflow design process.

As expected, the current design practices vary between projects and depend also on the customer. In general workflow design is done alongside other phases reaching from Presales

to Implementation phase in the Delivery process. One interesting finding was that the Delivery process itself is not followed completely in practice. Some of these differences were seen positively (content category C) and working well while others were raised as issues (content category D).

The workflow design starts in presales phase. Sales collects understanding of customer needs. They analyze customer's current environment and workflow and plan how the company's products fit the customer's overall workflow. The level of analysis depends on the salesperson but also on the customer's interest in investing time and resources in Presales phase.

The interviews reveal that non-existing features and functionalities are sold to the customer intentionally and sometimes accidentally. There are two reasons for doing this intentionally. Either the features or functionalities are in the product roadmap and expected to be available for the project or they are considered as minor nuances.

> *I hate selling things we don't have. But if a customer asks for it and somebody tells me we can do that in the next version, I'm going to tell the customer we can't do that now, but we're going to be able to do that in the next version. – Sales Manager*

"Nuances", as Sales manager put it, are for example new device or EMR integrations which have not been done before but are expected to be manageable in the projects. This can be seen as necessity because the company promises vendor neutral connectivity. According to the Sales manager the accidental cases are a result of inadequate technical support in presales phase and lack of consistent processes. However, the project team experiences all these cases as selling something the company doesn't have regardless of the reason behind it.

While vendor neutral promise is relatively well understood reason the issue is that underestimating the workload of a development task as a "minor nuance" consumes resources in the project teams. The project team must design and create customized and complicated solutions sometimes including the workflow. Practically this means product development work which should be handled by the Product management and product development teams. This causes a risk for delays in other tasks in the project because of task dependencies or availability of certain team members. Inadequate time resource can reflect to other projects. This includes capability to offer technical support for Sales. Avoiding including product development tasks intentionally in projects would save technical resources

in Operations. This saved resource could be allocated to supporting Sales, resulting in decreasing amount of accidental overselling cases freeing more technical resources in Operations.

Officially the Delivery process includes separate “Specification” and “Implementation” phases but in practice these two phases are combined as an iterative design phase. During these iterations workflows are designed alongside technical specification and implementation which is done piece by piece with the customer and the 3rd parties. Each integration is specified and planned according to the technical limitations and customer requirements, which defines the related workflows. According to the Solution architect and Support specialist this has usually been working well in practice.

> *The information is so specific. And because we are in the beginning of our career with the devices and our products, gathering information is the only way we can get the foundation from which we can see where the workflow planning should be started. What kind of devices are included? What information they produce. Are licenses required? What do they cost? Who pays? And so on.*
> *– Solution architect*

The problem is that sometimes this information comes too late.

> *In some cases when we move forward with the project, complex things come up at later stages. That makes us feel “OK, maybe we didn't put enough effort in the specification phase.” – Sr. Project Manager*

This highlights the problems caused by lack of consistency in documentation and following the Delivery process as well as missing Workflow design process in both Presales phase and the delivery projects. The inconsistencies and lack of processes lead to inefficient communication. According to the Project manager sales cases are not defined well enough before quotations are signed, and projects are handed over to the project teams.

> *In my opinion unfinished sales cases are handed over to the project teams. Sales cases are established as projects because the quotation is signed but it is unclear what exactly has been sold and what is the real customer need.*
> *– Project manager*

In addition, the Handover from Sales meeting is often just a quick unplanned meeting instead of being a well-planned and documented knowledge transfer session. Sometimes these meeting are skipped, and information is transferred to the project team using only the

Delivery datasheet excel. Even though the excel is generally seen as a positive and important tool it has two main short comings. Firstly, because the Presales phase can sometimes take years it is not guaranteed that all information is up to date. The second problem is that the excel sheet presents only a static description of the included system components and their integrations. It does not describe the current system and its workflows or how the new system will be used by the customer even though some workflows may be mentioned in high-level. Describing the current and planned workflows throughout the whole process starting from Presales phase until the end of the project was seen as a solution to tackle these communication issues while it would provide several other improvements including better customer understanding, increasing sales opportunities and less project and workflow design failures.

We should definitely have a process for mapping the workflow and documenting it in the sales phase. – Project manager

After Handover from sales the project is planned in high-level before the Kick-off meeting with the customer which is then followed by meetings with the 3rd parties and design iterations. Several issues related to these phases and causes for them were mentioned in the interviews. These are often problems in external communication listed in subcategory D12. Lack of project requirement documentation or workflow descriptions and low capability to demonstrate before building make it difficult to communicate especially with non-technical customer representatives. The specifications and understanding of technical limitations in different systems requires colleting technical details but is highly depending on the customer that the information is correct and adequate. Varying terminology is also a challenge which may cause misunderstandings.

Even though the iterative design has usually worked well the interviewees have also experienced issues and failures which led to failed or non-optimal workflow design. These reasons are also results of many of the topics already mentioned for example as communications issues and including non-existing product functionalities. For example, “Developing of the needed functionality is delayed or removed from product roadmap” is a result of including non-existing functionalities to the project scope according to the roadmap. Many of the other reasons mentioned relate to not including all end user groups in the workflow designing or lack of workflow documentation and demonstration. The issue with

iterative design is that some requirements are found too late because gathering the information was inadequate and left for the project phase.

> *Workflows have been planned but not comprehensively taken into account in the projects. They are not in a central role. It is often just expected that the product fits every customer's workflow without planning. – Project manager*

The lack of workflow planning, and missing workflow descriptions goes back to the product itself and accidental overselling. Because the most common architecturally supported workflows are not described Sales has to ask for architectural support from the team in Helsinki. Due to lack of resources this support is not often available in a reasonable timeframe. Sales has to be self-sufficient in managing the situation. This poses a risk of unintentionally selling something which requires a functionality that is missing from the product.

> *We've got the building blocks. We just need to align them in the right way. At the moment, the way our building is built is like an inverse pyramid. If I have five people in the basement, the pyramid is more solid. But at the moment it is for the most part 1-2. – Sales Manager*

Results of failed or non-optimal workflow design usually manifest for the end users. Some user groups may not be satisfied to the workflow, or some useful features are not utilized at all. If possible, some users or user groups may keep using the old system and workflows. The reason for dissatisfaction can be over-complicated workflows or workarounds because the product does not support the simple solution which was sold.

> *The high-level workflow which was agreed with the customer during sales phase turned out to be impossible to produce in a simple way because our product did not support the required system architecture. To achieve the required end-result of the planned high-level workflow we had to design and implement a much more complicated workflow which included a lot of manual work. This caused problems already in the design phase because customer representatives struggled to understand the workflow. – Solution architect*

In these cases, additional requirements may also arise after the test period. To meet the customer requirements and to keep the customer satisfied this may require promises to deliver additional features which require product development. This ad hoc product development consumes resources in the project team and the required product development and may cause mandatory changes to the product road map. Changes to the roadmap cause

other issues as mentioned before but also take resources from product development in general towards large customer segments. Other possible issues of non-optimal workflows are performance issues in production. This is more related to technical implementation of complex solutions. The worst-case scenario for failures in workflow design is that customer cancel's the procurement completely or partially.

Overall customer understanding and communication were seen as the main targets for improvements. The interviews included conversations about concentrating especially on this part when creating the first version of the new workflow design. Suggestions for process (content category F) includes suggestions for new sub-processes, resources, communication improvements as well as new practices and activities to presales or delivery process to meet the requirements and solving the problems.

The most important requirement was gathering comprehensive customer understanding early in the project or preferably in presales phase. This is not just the foundation of the project, but it also enables long-term comprehensive planning and taking into account upscaling of the system and customer's potential growth.

> *We should be able to offer comprehensive long-term planning as a side service before starting our projects. This pre-project could even result in a conclusion that other procurements or development projects are recommended before delivering our products. – Project manager*

As a solution a consistent current workflow analysis was proposed to take place in Presales phase or early in the project depending on the customers interest to invest before procurement. Alternatively, this workflow analysis could also be a part of an even wider comprehensive preliminary investigation which is conducted for additional fee before starting any projects. In addition to workflow analysis this preliminary investigation would include analyzing customer needs outside THS products and creating a comprehensive long-term plan. Both options would cover many of the problems categorized as missing processes.

When designing new workflows, the planning should always start from the architecture.

> *If you do start with workflow and don't take into account the architecture, you will oftentimes offer the customer something that's not possible.*
> *– Sales Manager*

Especially with inter-organizational workflows architecture is the key that determines which workflows are possible to implement. This is related to data ownership, visibility of patient data to different organizations and how the product can be configured accordingly. Productization of workflows by creating workflow templates for most common architecturally supported workflow and offering them for customers instead of always starting from scratch was suggested as a solution. The selected template(s) would be included in Handover from Sales and used throughout the project and finally handed over to the support. This would decrease the need for technical support in presales, product development for projects and improve internal and external communication.

Third requirement mentioned and emphasized by most interviewees was to decrease the amount tailoring. Especially the possibility to separate development tasks from project scope to a separate line and including product management to these tasks was mentioned.

> *We need to nail down what's going to be required and is any product development required to fulfill complex needs. -- The answer might be we can't do that. But that doesn't mean the project gets cancelled or shelved. It just means we've nailed down before we've even got into a process of building a project and sending a quotation and disappointing the customer because what they want is actually two years away. – Sales Manager*

These two combined are also connected to the requirement of ensuring solutions are easy to maintain and support. Other requirements relate to improving communication and participation of different stakeholders and getting training material from AI vendors. Content category B lists these stakeholders.

While customer understanding and communication were seen problematic the iterative design itself had been working well in practice (content category C). Visualizations of workflow designs were seen as important communication tool and they had been working well when applied. Some projects have had an internal project team member with clinical user experience participating in workflow design and end user training. This was seen as a highly valuable resource. In some projects also the customer understanding had been significantly improved when current workflows were analyzed on customer site in real environment with the end users.

> *The best way is to go to the real customer environment and walk through the workflow in practice with the employees. Not PowerPoint or some*

cleaned version of the imagined workflow but real situation from which you get the real workflow. – Project manager

For customizing the report templates which end users use as part of their individual level workflow, one international customer had provided requirements to make country-specific customizations to ease users' adaptation to the new system and workflows.

A certain item in the report may be placed differently, e.g., on top of each other instead of next to each other. Another item may have been removed completely when it is not used in a certain country at all. Or some section has been added when it is important in one country there but not elsewhere.
– Support specialist

Sometimes there are also report customization requirements because of country-specific standards and regulations. All requirements including those related to local laws, regulations or customer's own quality system come directly from the customer.

When asked specifically about working with AI vendors and AI workflows as part of the iterations, the interviews revealed that this stakeholder group is not acknowledged during the projects currently. AI workflows are simply switched on according to the project scope. How customer utilizes AI is currently not considered during the delivery process. This decision should be made in presales as part of the system level planning. Currently it is on the vendor's and customer's responsibility to plan the workflows for utilizing the information that AI analysis provides them. Dedicated internal AI account manager was requested as a resource during the interviews to take care of providing the project team all necessary material including up-to-date customer training material and AI report temples from the chosen AI vendor. AI workflows could be utilized for optimizing workflows better if included in the overall workflow designing.

To sum up, the iterative design works well but it is the more comprehensive preparation to the iteration phase which requires resources and consistent processes to understand the system level requirements. Subcategory F1 lists suggestions for new sub-processes including their phases to improve the preparation. In addition, F1 mentions the suggested additions to the iterative technical design. Suggestions for related resources and communication improvement as well as practices and activities to be included in the current processes are listed under subcategories F2, F3 and F4. One of the highlighted reasons why the preparation

for workflow design has been inadequate is the lack of professional workflows design skills in projects teams.

> *Putting workflow design in a centric role of the projects requires special skills, which haven't had in our teams. – Project manager*

While creating workflows, it is also important take into account what happens afterwards. Current practices for supporting customer's change management are listed in subcategory A12. User training is provided, and customer's project team member has to perform User acceptance test after the deployment phase. Early-life-support is also given for 14 days after Go-live. However, workflow feedback is not gathered from end users and results of changes to the original workflow are not measured by THS. Gathering end user feedback during the project could help optimizing the workflow designs.

Measuring the changes was not categorized as a problem but providing these measurements could help customer in change management by convincing the end users about the system's benefits. That in turn would increase customer satisfaction. From Support team's perspective the most important requirement is that solutions are easy to support and maintain.

> *In the implementation, it should also be noted that the solution is easy to support for the Support team. Old and specific environments are challenging for us if the know-how no longer exists in the company, or it is outdated. Documentation is always essential, but especially if there is anything unusual or special. – Service manager*

To meet this requirement documentation has to be adequate. Here describing the workflow helps understanding the whole system. Unifying the workflow designs with workflow templates and minimizing using hoc solutions in projects also decrease the risks caused by inadequate project documentation listed as problems in subcategory D7.

5.3 Process maturity goals and method selection criteria

Because THS does not have a Workflow design process the current maturity level is considered zero. For the first version of the new process the maturity goals are:

- The process is documented and approved
- The process supports Delivery process and enables following it in real-life

- The process enables systematic analysis of customer's current workflows
- Improvements in internal communication and workflow documentation enable efficient knowledge transfer from sales to project team
- Improvements in external communication ease communication with customer and 3rd parties
- All end user groups are acknowledged in workflow design

Concluding a workflow analysis and utilizing its findings efficiently should have high priority in the new process. The earlier the analysis can be timed the earlier the information it provides can be utilized to increase understanding of customer needs. If concluded already in Presales phase, it can provide possibilities for additional sales which further justifies using the resources. The selected the workflow analysis approach should:

- Include all organizational levels which the information system supports
- Meet the workflow design process maturity goals
- Be in line with the company's business strategy
- Not depend on known restrictions in the company's products or resources

5.4 Solution model

The list of the accepted development requirements presented in the first column of the Solution model (Appendix 4) includes 37 requirements. Out of these requirements 17 such as "Gathering comprehensive customer understanding" (Figure 11) were estimated to have high importance (3) for the first version of the new process. 15 requirements such as "Handover from sales meeting is planned properly" had medium importance (2) while 5 requirements such as "Ensuring users start using the new workflows instead of the old ones" were considered to have low importance mostly because they were not included in the emphasis of the first version of the process even though they may be important requirements otherwise.

Requirement	Importance for process version 1.0	Solutions based on interviews	Solutions from literature	Process phase
Gathering comprehensive customer understanding	3	F1.1 Consistent current workflow analysis in presales phase F2.1 General overview for the customer about the software F2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist) F4.1 Workflow designer for project teams	Cognitive task analysis Organizational routines Identifying organizational levels for workflows Analyzing workflows in all organizational levels	Presales
Workflow analysis	3	F1.1 Consistent current workflow analysis in presales phase	Cognitive task analysis Organizational routines Analyzing workflows in all organizational levels	Presales

Figure 11 Sample from the beginning of the Solution model

Solutions to the requirements are presented in the third column of the model. Most of the process requirements were fulfilled by solutions taken directly from the refined coding schema of the interview analysis. Only a few solutions in this column had to be created by the author based on general understanding of the phenomena and the interpretation of current workflow design practices. Many of these solutions such as “Consistent current workflow analysis” were seen as a solution or at least partial solution to more than one requirement and therefore appear in the model more than once. “Consistent current workflow analysis” is also an example of a solution which is a sub-process and therefore includes a set of activities (Figure 12). Some of these activities such as “Documenting the workflow analysis on a template” appear also independently in the Solution model when the activity itself is a solution to the requirement rather than the whole sub-process.

1.1 Consistent current workflow analysis in presales phase

1.1.1 Preparing the customer for analysis process

1.1.2 Analyzing the current workflows on-site in at least two locations

1.1.3 Analyzing the current workflows for all end user groups

1.1.4 Documenting the workflow analysis on a template

1.1.5 Identifying all branches of workflows in different systems

1.1.6 Validating the analysis with all participants

Figure 12 A sub-process solution as presented in the Refined coding schema (Appendix 3)

Solutions from literature column includes Cognitive task analysis and Organizational routines as the selected approaches to workflow analysis. In addition, the column includes other important guidelines from literature such as “Describing workflows in all organizational levels” to ensure consistency and quality of the process.

From process phase column it can be calculated that 32 out of 37 requirements have solutions which correspond to Presales phase. There are 15 requirements in which Presales is the only corresponding process phase. This emphasis is aligned with the general development requirement of improving customer understanding which has higher impact when understanding is collected early in the process. Even though the other 17 requirements corresponding to Presales phase may have higher correlation to other process phases, the fact that almost 90% of them correspond to Presales highlights that information created in the early process is a prerequisite for fulfilling most of the other requirements as well. For example, Communication and documentation improvements such as “Using workflow templates” improve the process but most of the input to the templates comes from understanding the customer needs.

Specification phase is corresponding to 13 requirement which is the second highest value. Here many of the solutions relate again to customer understanding but many are also practical advises for communication improvements such as “Starting an iterative design cycle by visualizing the initial design and using that as a starting point for further conversations and iterations”. This is an example of a solution which helps communicating

design alternatives created during specification phase but also an example of a solution which is linked to customer understanding collected and documented in Presales phase.

5.5 Suggested process solution

The phases (Figure 13) in the suggested process solution are based on the structure of THS's Delivery process. Presales phase is added to the beginning of the diagram because workflow design starts there. Customer understanding was chosen as one focus point in the first version of the new process. Planning and Kick-off phases are considered to belong to the same phase because in practice they are overlapping. Specification and Implementation phases form an iterative design phase in which the phases are repeated until the result is accepted. Handover to support was not included in the process diagram because workflow design process does not reach there. Workflow descriptions are simply included in the Solution description which is part of the project documentation in the handover.

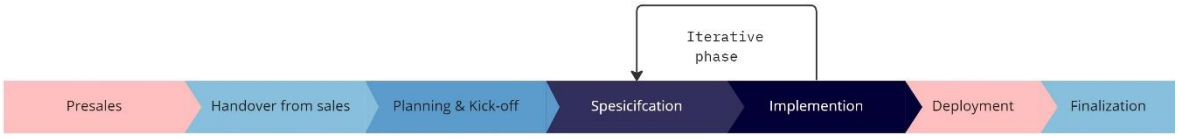

Figure 13 Phases of the Workflow design process

For each phase there are six rows. The first three rows represent the objectives, activities and deliverables which are common to the Workflow design process and the Delivery process These are considered more general parts of the whole process. The last three rows represent the objectives, activities and deliverables specifically related to workflow design. The full process diagram is presented in Appendix 6.

Presales

The general objective in the Presales phase is gathering comprehensive customer understanding. From workflow design perspective the objectives are getting clear requirements from customer and ensuring adequate gathering of information to start the delivery project. The activities in this phase follow the suggestion of the interviewed Sales manager. Tasks for the consistent current workflow analysis are collected from all

interviews. All activities and participants are described in table 6. In the table, all Workflow design activities are included as tasks under two of the common activities.

The most suitable solution for analyzing customer workflows for THS is a combination of Cognitive task analysis (CTA) and Organizational routines. CTA methods such as Think-Aloud protocol are closest to the current well-working practices of analyzing customer workflows in THS. Because CTA methods are more suitable for analyzing individual workflows the analysis should be complemented by using Organization routines model to analyze also organizational and inter-organizational workflows.

Table 6 Suggested tasks and activities in Presales phase

Activities	Participants
General overview for the customer about the software	Sales, customer
Detailed meeting to understand the scope and customer needs	Sales, solution architect, product specialist, customer,
Writing down the basic project scope and separating development tasks from scope	Sales, solution architect
Consistent current workflow analysis - Preparing the customer for analysis process - Identifying organizational levels for workflows - Analyzing the current workflows on-site in at least two locations -Analyzing workflows in all organizational levels - Identifying all workflow branches in different systems - Documenting the workflow analysis on a template - Validating the analysis with all participants	Clinical solution specialist
Communicating scope and development tasks to customer and highlighting complex areas -Offering workflows based on templates -Determining possible workflows and timeframe	Sales, customer
Requirements meeting on highlighted complex areas	Sales, solution architect, product specialist, customer
Signing a quotation/contract	Sales
Planning the handover from Sales	Sales

As general deliverables these tasks produce recordings of important meetings, Sales handover document, Up-to-date Delivery datasheet, and a signed quotation and contract. As workflow deliverables the detailed description of current workflows and description of planned workflows are produces. Also, the validation meeting for the workflow analysis with the participants is recorded.

Handover from sales

In Handover from sales phase both the general and workflow objectives are successful knowledge transfer. All activities are included in the handover meeting organized by Sales as part of the Delivery process. Going through the workflow descriptions is added as a new activity. All activities and participants are described in table 7.

Table 7 Suggested tasks and activities in Handover from sales phase

Activities	Participants
Going through Delivery data sheet	Project team, Sales
Going through Sales handover document	Project team, Sales
Going through description of current workflow	Project team, Sales
Going through description of planned workflow	Project team, Sales

The deliverables here are the recording of the meeting and project manager's acceptance for the handover. Project manager has the right to reject the handover if preparation is inadequate.

Planning & Kick-off

The general objective in the Presales phase is contacting the main stakeholders. From workflow design perspective the objective is to identify all the stakeholders related to workflow design. According to the Delivery process project manager makes the initial project plan. Internal kick-off meeting is held to get internal approval followed by kick-off meeting with the customer. After that planning and kick-offs are done with different external stakeholders depending on their availability and reachability. In the delivery process this was considered under Specification phase but in the Suggested solution these are included in the Planning & Kick-offs to emphasize the importance contacting the 3rd parties as early as possible and treating end-users as the most important stakeholder for workflow design. Customer should also name workflow owner who makes the final decision about the workflows. All activities and participants are described in table 8.

Table 8 Suggested tasks and activities in Planning & Kick-off phase

Activities	Participants
Internal Kick-off meeting	Project team = Project manager, Solutions architect, Integration specialist, AI account manager, Clinical solution specialist
Kick-off meeting with customer	Project team, customer
Naming representatives from all user groups	Customer
Naming customer's workflow owner	Customer
Contacting 3rd parties	Project manager, 3rd parties
Establishing workgroups	Project manager, customer, 3rd parties
Asking for AI training material	Project manager, AI account manager

As general deliverables these activities produce schedule for technical iterative design cycles and established workgroups for the project. As workflow deliverable the list of individual stakeholders for workflow design is produced.

Specification

The general objective in the Specification phase is to define the technical details needed to implement the solutions. To achieve this objective several iterations between Specification and Implementation phase are usually needed according to the interviews. The number of iterations is expected to reduce as a result of improvements in the earlier phases including the analysis of the current workflow in Presales. From workflow design perspective the objectives are onboarding all stakeholders and including all user groups to workflow design activities. This supports the general objectives in Specification and Implementation phases. The activities in this phase are combination of the current well-working practices and suggestions mentioned in the interviews. These include communication improvements such as using workflow descriptions and other visualization of designs. In addition, aligning of decision support and clinical processes is mentioned in the literature. This activity concerns for example consultation workflows and configuring AI tool automation so that the AI analysis is placed in the right phase of the clinical process. All activities and participants are described in table 9.

Table 9 Suggested tasks and activities in Specification phase

Activities	Participants
Iterative technical design piece by piece	Project team, customer, 3rd party (person who understands the system, person who does the integration)
Workflow descriptions are used for communication	Project team
Adjusting workflows to fit the purpose of all organizational levels	Clinical solution specialist, workflow owner, user representatives
Aligning decision support with clinical processes	Clinical solution specialist, workflow owner, user representatives
Customizing report templates - according to previously used reports - according to workflow analysis	Support specialist, customer
Utilizing visualizations of designs in communication	Project team
Internal and external meetings to optimize workflows	Need based participation
Updating description of planned workflow	Clinical solution specialist

As general deliverables these activities produce schedule for technical definitions and limitations for integrations and corresponding workflows. First version of Solution description is also drafted. As workflow deliverables updated descriptions of the planned workflows are produced.

Implementation

In Implementation phase the general objective is to implement solutions which are easy to maintain and support. From workflow design perspective the objective is to implement the most suitable workflows for all user groups. The activities in this phase follow the Delivery process. Workflow survey for the end users is the only new activity in this phase. This could be conducted for example by allowing user group representatives to test the workflows in test environment and then collecting their feedback to validate the implemented workflows. All activities and participants are described in table 10

Table 10. Suggested tasks and activities in Implementation phase.

Activities	Participants
Technical implementation	Solution architect, integration specialist, 3rd parties
Configuring the workflows	Project team
Testing the workflows	Project team
Workflow survey for the end users	Clinical solution specialist

As general deliverable these activities produce an updated version of Solution description. As workflow deliverables the planned workflows are now implemented and descriptions of them are updated. If another design iteration is needed this phase produces input for the next specification phase instead.

Deployment

The general objective in the Deployment phase is training the users on how to use the new system. From workflow design perspective the objective is to train the workflows. The activities in this phase include providing user trainings and documentation tasks. Showing the final workflow description to all end users is part of the user training but highlighted here as a workflow design activity to emphasize the importance of providing the end users also the big picture and not just their own specific part of the workflow. All activities s and participants are described in table 11.

Table 11. Suggested tasks and activities in Deployment phase

Activities	Participants
Providing user trainings	Clinical solution specialist, integration specialist
Showing final workflow description to all end-users	Clinical solution specialist

The deliverables here are the training event itself and training material.

Finalization

The general objective in the Finalization phase is supporting customer in change management. From workflow design perspective the objective is simply finalizing the documentation. The activities in this phase follow the Delivery process. The only new activity is to add the final workflow description to the Solution description. More activities could be added to support customer's change management, but these were considered to be out of scope for the first version of the process as they also need more preparation and planning. All activities and participants are described in table 12.

Table 12. Suggested tasks and activities in Finalization phase

Activities	Participants
User acceptance test	Clinical solution specialist, customer's workflow owner
Early-life-support	Project team, 3rd parties
Adding final workflow description to the Solution description	Clinical solution specialist

The deliverables here are User acceptance test report and Solution description including the workflow description.

5.6 Validation of the suggested solution

Structure of the suggestion

First three rows were renamed so that the names describe their purpose better. Columns were changed so that Planning & Kick-off phase was divided to correspond the Delivery process. For the same reason participants preferred to keep Specification and Implementation phases separately as suggested. After the changes participants considered the structure understandable and logical as it follows the phases in the existing Delivery process.

Content of the suggestion

For Presales phase "Lead qualification and providing an indictive quote" and "Confirming the findings internally" were added as activities. Participants for different activities were also refined. This includes participating Sales in workflow analysis and replacing product specialist and solution architect as providers of technical sales support. A new role called sales support engineer has been planned to be established to provide this support flexibly in short notice when required.

Handover to support was discussed and minor change was made for the formatting of handover acceptance.

Dividing Planning & Kick-off phase to separate columns caused also their content to be divided and therefore supplementation and some other changes was required. This included clarifying objectives and activities related to stakeholders. "Internal approval for project plan" was added to as a general deliverable to the planning phase.

One participant pointed out that design iterations may spin-off new development tasks. This topic was discussed but changes were not made to the suggested process solution since change requests are handled according to change management process.

Description of the Deployment phase got criticism because only trainings were mentioned in the objectives, activities, and deliverables. Deploying the system and end-to-end workflows were added as objectives as well as corresponding activities and deliverables were created.

Finalization phase was accepted as suggested. At the end of the workshop the attendees accepted the refined process as a whole.

The workflow analysis methods were also accepted after refining the tasks and task order. Organizational routines was considered to be more useful if used before Think-Aloud protocol. This way it can provide information which can be used to prepare for the analysis of individual workflows including identifying different user groups. Think-Aloud protocol then also confirms the findings of organizational routines and specifies the workflows.

5.7 Process description for the new process

Workflow design process describes how THS designs customer workflows which will be deployed as part of the delivery of THS products. The process will be used in large-scale enterprise customer projects and projects which may have a larger impact to the business success. During the process the project team, sales team, and support team work together on a set of activities. The purpose is to collect comprehensive understanding of customer's needs from workflow perspective and then use that information to design and deploy workflows that support the customer's clinical processes and fit the multiple levels of organization.

The full process diagram for the final version of the process is presented in Figure 14. The process starts in Presales and then follows the phases determined in THS's Delivery process reaching until the Finalization phase of the project.

Each process phase has its own objectives, activities and deliverables. Some of them are common for the Delivery process and Workflow design process while others belong solely

to the Workflow design process. To highlight this the common areas of the two processes are described in the first three rows of the process diagram as

- Delivery process objectives
- Delivery process activities and
- Delivery process deliverables

which are then followed by Workflow design specific areas described similarly in three rows as

- Workflow design objectives
- Workflow design activities
- Workflow design deliverables

	Presales	Handover from Sales	Planning	Kick-off	Specification	Implementation	Deployment	Finalization
Delivery process objectives	• Gathering comprehensive customer understanding	• Successful knowledge transfer	• Contacting internal stakeholders	• Contacting customer and all 3rd party stakeholders	• Defining technical details	• Implementing solutions which are easy to maintain and support	• Training users to use the new system • Deploying the system	• Supporting customer in change management
Delivery process activities	➢ General overview for the customer about the software ➢ Lead qualification and providing an indictive quote ➢ Meeting to understand scope and customer needs ➢ Writing down basic project scope and separating development tasks ➢ Analyzing current workflows ➢ Confirming the findings internally ➢ Communicating scope and development tasks to customer ➢ Requirements meeting on highlighted complex areas ➢ Signing quotation and contract ➢ Planning the handover from sales	➢ Going through delivery data sheet ➢ Going through Sales handover document	➢ Internal Kick-off meeting ➢ Planning the project	➢ Kick-off meeting with customer ➢ Contacting 3rd parties ➢ Establishing workgroups	➢ Iterative technical design piece by piece ➢ Workflow descriptions are used for communication ➢ Drafting Solution description	➢ Technical implementation	➢ Providing trainings ➢ Go-live	➢ User acceptance test ➢ Early-life-support
Delivery process deliverables	✓ Recordings of important meetings ✓ Sales handover document ✓ Up-to-date Delivery datasheet ✓ Signed quotation and contract	✓ Recording of the meeting ✓ Handover is accepted with qualification	✓ Internal approval for project plan	✓ Schedule for technical iterative design cycles ✓ Workgroups	✓ Technical definitions and limitations for integrations ✓ Technical definitions and limitations for workflows ✓ 1st version of Solution description	✓ Updated Solution description	✓ Trainings & training material ✓ Production environment is ready	✓ User acceptance test report
Workflow design objectives	• Getting clear requirements from customer • Ensuring adequate gathering of information	• Successful knowledge transfer	• Confirming competence to deliver selected AI products	• Identifying customer and 3rd party stakeholders	• Onboarding all stakeholders • Including all user groups in workflow design	• Implementing the most suitable workflows for all user groups	• Training the workflows • Deploying end-to-end workflow	• Finalizing workflow documentation
Workflow design activitives	➢ Preparing the customer for the analysis process ➢ Identifying organizational levels for workflows ➢ Identifying all workflow branches in different systems ➢ Analyzing the current workflows on-site in two locations ➢ Documenting the analysis on a template ➢ Validating the analysis with all participants ➢ Offering new workflows based on templates ➢ Determining possible workflows and timeframe	➢ Going through description of current workflow ➢ Going through description of planned workflows	➢ Asking for AI training material	➢ Naming representatives from all user groups ➢ Naming customer's workflow owner	➢ Adjusting workflows to fit the purpose of all organization levels ➢ Aligning decision support with clinical processes ➢ Customizing report templates ➢ Utilizing visualizations of designs in communication ➢ Internal and external meetings to optimize workflows ➢ Updating description of planned workflows	➢ Configuring the workflows ➢ Testing the workflows ➢ Conducting workflow survey for users	➢ Deploying the end-to-end workflows in production ➢ Showing final workflow description to all users	➢ Adding final workflow description to Solution description
Workflow design deliverables	✓ Recording of validation meeting ✓ Detailed description of current workflows ✓ Description of planned workflows	✓ Handover is accepted with qualification	✓ Competence to deliver the AI products	✓ List of individual stakeholders	✓ Updated description of planned workflows	✓ Implemented and validated workflows ✓ Description of implemented workflows	✓ Trainings and training material ✓ Workflows are deployed in production	✓ Workflow description as part of Solution description

Figure 14 Process diagram of the final Workflow design process

Presales

The general objective in the presales phase is gathering comprehensive customer understanding. From workflow design perspective the objectives are getting clear requirements from customer and ensuring adequate gathering of information to start the delivery project. The activities and participants are described in table 13. In the table, all Workflow design activities are included as tasks under two of the common activities.

The method for analyzing the current workflows should be a combination of Organizational routines and Think-Aloud protocol. Organization routines model is first used to analyze the organizational and inter-organizational level workflows. The two main component of the routines, ostensive aspects and performative aspects, are examined to prepare for analyzing individual workflows. This includes identifying organizational levels and identifying all workflow branches in different systems. Think-Aloud protocol is then used for analyzing individual level workflows of different user groups on customer site. This details the description on current workflows and confirms the findings in organizational routines.

Table 13. Tasks and activities in Presales phase

Activities	Participants
General overview for the customer about the software.	Sales, customer
Lead qualification and providing an indictive quote.	Sales, customer
Detailed meeting to understand the scope and customer needs	Sales, customer, sales support engineer
Writing down the basic project scope and separating development tasks from scope	Sales, sales support engineer
Analyzing current workflows - Preparing the customer for analysis process - Identifying organizational levels for workflows - Identifying all workflow branches in different systems - Analyzing the current workflows on-site in two locations - Documenting the workflow analysis on a template - Validating the analysis with all participants	Clinical solution specialist, Sales
Confirming the findings internally	Clinical solution specialist, Sales
Communicating scope and development tasks to customer and highlighting complex areas -Offering workflows based on templates -Determining possible workflows and timeframe	Sales, customer
Requirements meeting on highlighted complex areas	Sales, customer, sales support engineer
Signing a quotation/contract	Sales
Planning the handover from Sales	Sales

As general deliverables these tasks produce recordings of important meetings Sales handover document, up-to-date Delivery datasheet, and a signed quotation and contract. As workflow deliverables the detailed description of current workflows and description of planned workflows are produced. Also, the validation meeting for the workflow analysis with the participants is recorded.

Handover from sales

In Handover from sales phase both the general and workflow objectives are successful knowledge transfer. All activities are included in the handover meeting organized by Sales. All activities and participants are described in table 14.

Table 14. Tasks and activities in Handover from sales phase

Activities	Participants
Going through Delivery data sheet	Project team, Sales
Going through Sales handover document	Project team, Sales
Going through description of current workflow	Project team, Sales
Going through description of planned workflow	Project team, Sales

The deliverables here are the recording of the meeting and acceptance of the handover with qualification. Project manager has the right to reject the handover if preparation is inadequate.

Planning

In general, the planning phase concerns mainly the Delivery process as its main activity is making the initial project plan and accepting it internally. The general objective in the planning phase is contacting internal stakeholders. From workflow design perspective the only objective is to confirm the project team has competence to deliver the selected 3rd party AI products. All activities and participants are described in table 15.

Table 15. Tasks and activities in Planning phase

Activities	Participants
Internal Kick-off meeting	Project team = project manager, solutions architect, integration specialist, AI account manager, clinical solution specialist
Asking for AI training material	Project manager, AI account manager

As general deliverable these activities produce internal approval for the project plan. As workflow deliverable the team has competence to deliver the selected AI products.

Kick-off

The general objective in the Kick-of phase is contacting the customer representative and all 3rd party stakeholders. From workflow design perspective the objective is to identify all individual stakeholders related to workflow design. In this phase the customer should name representatives for all end user groups as well as a workflow owner who makes the final decision about the workflows. These representatives are treated as the most important stakeholder for workflow design. All activities and participants are described in table 16.

Table 16. Tasks and activities in Kick-off phase

Activities	Participants
Kick-off meeting with customer	Project team, customer
Naming representatives from all user groups	Customer
Naming customer's workflow owner	Customer
Contacting 3rd parties	Project manager, 3rd parties
Establishing workgroups	Project manager, customer, 3rd parties

As general deliverables these activities produce schedule for technical iterative design cycles and established workgroups for the project. As workflow deliverable the list of individual stakeholders for workflow design is produced.

Specification

The general objective in the Specification phase is to define the technical details needed to implement the solutions. To achieve this objective several iterations between Specification and Implementation phase are usually needed. Results of the workflow analysis conducted in presales are an important input to reduce the number of iterations required. From workflow design perspective the objectives are onboarding all stakeholders and including all user groups in workflow design. This supports the general objectives in Specification and Implementation phase. Using workflow descriptions and other visualization of designs is important for effective communication. Aligning of decision support and clinical processes concerns for example consultation workflows and configuring AI tool automation so that the AI analysis is placed in the right phase of the clinical process. All activities and participants are described in table 17.

Table 17. Tasks and activities in Specification phase

Activities	Participants
Iterative technical design piece by piece	Project team, customer, 3rd party (person who understands the system, person who does the integration)
Workflow descriptions are used for communication	Project team
Customer demonstrates what kind of workflows they want	Customer
Aligning decision support with clinical processes	Clinical solution specialist, workflow owner, user representatives
Customizing report templates - according to previously used reports - according to workflow analysis	Support specialist, customer
Utilizing visualizations of designs in communication	Project team
Internal and external meetings to optimize workflows	Need based participation
Updating description of planned workflow	Clinical solution specialist

As general deliverables these activities determine the technical definitions and limitations for integrations and corresponding workflows. First version of Solution description is also drafted. As workflow deliverables updated descriptions of the planned workflows are produced.

Implementation

In Implementation phase the general objective is to implement solutions which are easy to maintain and support. From workflow design perspective the objective is to implement the most suitable workflows for all user groups. The activities in this phase belong mainly to the Delivery process. Workflow survey is used to collect feedback of the implemented workflows in test environment. All activities and participants are described in table 18.

Table 18. Tasks and activities in Implementation phase

Activities	Participants
Technical implementation	Solution architect, integration specialist, 3rd parties
Configuring the workflows	Project team
Testing the workflows	Project team
Workflow survey for the end users	Clinical solution specialist

As general deliverable these activities produce an updated version of Solution description. As workflow deliverables the planned workflows are now implemented and validated. The

workflow descriptions are also updated. If another design iteration is needed based on the feedback, this phase produces the input for the next Specification phase instead of validation.

Deployment

The general objective in the Deployment phase is training the users on how to use the new system and deploying the system. From workflow design perspective the objective is to train the workflows and deploy end-to-end workflows. The activities in this phase include the deploying the workflows and the system in production environment, providing user trainings. The final workflow description is shown to all end users as part of the user training to provide them also the big picture and not just their own specific part of the workflow. All activities and participants are described in table 19.

Table 19. Tasks and activities in Deployment phase

Activities	Participants
Providing user trainings	Clinical solution specialist, integration specialist
Showing final workflow description to all end users	Clinical solution specialist
Deploying end-to-end workflows	Integration specialist
Go-live	Integration specialist

The deliverables here are the training event itself and training material. Production environment is also ready for use and workflows are deployed in production.

Finalization

The general objective in the Finalization phase is supporting customer in change management. From workflow design perspective the objective is simply finalizing the documentation. The activities in this phase are mainly part of the Delivery process. All activities and participants are described in table 20.

Table 20. Tasks and activities in Finalization phase

Activities	Participants
User acceptance test	Clinical solution specialist, customer's workflow owner
Early-life-support	Project team, 3rd parties
Adding final workflow description to the Solution description	Clinical solution specialist

The deliverables here are User acceptance test report and Solution description including the workflow description.

6 Conclusions

In this chapter, the research questions of this thesis are answered, and the main results of the research are discussed. The conclusions also bring together thoughts related to the applicability, reliability, and limitations of the research. Finally, the further research topics that emerged during the research process will be highlighted.

6.1 Answering the research questions

This research had three research questions to be answered during the research.

Research question 1: How to design workflows in healthcare sector?

The theoretical framework presented in chapters 2 and 3 answers to this research question. The first thing to point out is that workflow has different definitions. Before deciding the workflow design method, it is important to clarify which definition is chosen. Workflows can be defined as specific types of processes controlled by Workflow Management Systems, which means workflows are automation (Dumas et al. 2005, 22-24; Stohr et al. 2001). Or they can be approached from wider perspective by determining that workflows are flows of work which comprise of inputs, transformation, and outputs (Karsh 2009). The latter definition enables including also cognitive workflows in addition to observable workflows, which is important in healthcare sector because even small changes may have a significant impact on individual employees and their workflows (HIPAA Journal 2022). Successful deployment of information systems in healthcare sector requires that the system fits within the multiple levels of the healthcare organization (Karsh 2009). Therefore, choosing methods for workflow design in healthcare depends on the project needs and goals while taking care that the selected methods are suitable to conclude the analysis on all identified organizational levels of workflows (Holden et al. 2009; Sheehan et al 2012). Because of the high number of existing workflow improvement and analysis methods some selection criteria are needed for the method selection. The criteria are different whether the methods are applied to for example developing a product, delivery process or identifying potential improvement projects in an organization.

Research question 2: Which process solutions fit the case company's needs to become the basis for the new workflow design process and what kind of process is to be built from this?

The case study in this thesis aimed to develop a workflow design process to improve the delivery projects of THS's platform solutions. According to THS employees and the interview analysis, the current Delivery process is not completely followed in practice during the delivery projects. Since the Delivery process is part of the company's quality system also the new Workflow design process has to be aligned with the description of the Delivery Process. Also, because the two processes are deeply connected failing in following either one of them makes it harder to follow also the other one. Therefore, the first version of the new process concentrates on solving the main issues related to workflow design practices which make following the Delivery process difficult. The process phases also follow the structure of the Delivery process, and the process description (Figure 14) highlights the common objectives, tasks, and deliverables of these two processes.

Based on the discussion in the interviews it came clear that the two main areas where improvements were required to enable following the Delivery process were improving customer understanding and communication. In practice this means that the first version of the process concentrates on analyzing the customers current workflows and involving end users as the most important stakeholders to the design process. Monitoring the results and other means of supporting the customer in change management after the deployment are also important but the decision was made to leave those aspect for future process development cycles to concentrate on the earlier phases of the project (HIPAA Journal 2022).

The process solution and included workflow analysis methods acknowledge the requirement to analyze and design workflows in all organizational levels (Karsch 2009; Sheehan et al. 2012). The three-level classification of Sheehan and Bakken was chosen to be used in the theoretical framework of this thesis for simplicity but when designing workflows in delivery projects the number of workflow levels should be considered separately in each project to match the project needs including structure of customer organization and customer's possible co-operation with other organizations. Depending on the type of organization in the eyecare ecosystem these organizations may consist of one or multiple units (Laurila 2023). In case of an organization consisting of a single unit, the unit level workflows can be included in organizational workflows. In those cases, using just three workflow levels for

workflow analysis is well justified. However, in case the customer organization consist of multiple units, the unit level workflows should be analyzed separately from organization level workflows for clarity.

In that case levels in which workflows occur are:

- individual level
- unit level
- organizational level and
- inter-organizational level

After the organizational structure for the project is defined the workflow analysis methods should be selected based on selection criteria. For the case company Organizational routines and Think-Aloud protocol were selected. The analysis and its results should be consistently documented and communicated though the process with different stakeholders and the implemented workflows should be tested by real end user by conducting a survey before deployment phase. Consistency is the key to successfully implement the new process in practice. Therefore, the following improvement projects need to be launched in THS:

- Creating workflow analysis template to conclude and document the workflow analysis and its results
- Creating workflow templates to productize the best available workflow alternatives
- Creating workflow description template to document and communicate workflow designs during the delivery projects
- Creating workflow survey template to test implemented workflows with end users

Research question 2: How the developed solution meets the company's requirements?

The case study formed the foundation for determining the current process maturity levels and maturity goals. This included collecting interview data form the case company's employees. The interview analysis found 6 big-picture meaning units directly from the interview data. These were:

- Current workflow design practices
- Key stakeholders
- Practices or activities which have worked well
- Problems related to current workflow design practices
- Requirements for the new workflow design process
- Suggestions for the new workflow design process

Only some basic principles were added to the solution model from the theoretical framework or suggested by the author when the selected solutions were gathered to the suggested process solution. Therefore, the problems and requirements as well as solutions to them came mainly from the employees themselves. This emphasis was made intentionally to involve the employees in development of the process to ensure it meet their need and therefore the company's needs. The suggested process solution was also presented in a workshop for the interviewed employees and a few other company representatives including the Vice President of THS Operations. In this workshop the attendees were allowed to freely express their opinions and suggest refinements to the process. At the end of the workshop the attendees agreed that the refined process meets the company's requirements to be implemented as the first version of the new process. Further development cycles are obviously needed to meet the requirement which were decided to be left out of scope for this process version. This matter was communicated to the attendees (Wysocki 2004, p 13). Requirements and solutions which were left out of scope for this process development cycle or the whole process are listed and explained in Appendix 5.

6.2 Evaluation of reliability and applicability

The planned research process and methodology aimed to ensure the reliability of the entire research throughout the entire process. Especially in planning and executing the interview study additional attention was put ensure the reliability of data collection and analysis. Before conducting the actual interviews, a test interview was organized in the case company's office to test the interview settings and the list of supportive questions. The participant of the test interview was a potential candidate for interviews but did not take part

in the official interviews. The pre-testing provided valuable information about the validity of the supportive questions and time reserved for the interviews. Semi-structured interview method made it possible to clarify unclear or wide research questions for the interviewees and the interviewees were able to express their experiences openly. In qualitative research, it is important for the validity of the research that the interviewees know about the topic on which the research is being conducted. This was considered when selecting the interviewees. The selected interviewees had participated in different phases of customer delivery projects or worked in customer support where potential problems in the process could also manifest. The selections were also made so that the group of interviewees comprehensively represented different teams. Although the number of interviews was small, the six interviews succeeded in providing a versatile picture of the current state of workflow design practices and related development challenges in the case company. Because the interviews were recorded it was possible to analyze them carefully. The synthesis and interpretation phases confirmed that the information collected from different interviews forms a logical entity.

Because the process solution was formed as a result of a case study and validated by the case company it can be said with confidence that the results are usable and applicable for the case company. The process solution is based the case company needs and the solution is described in a clear and understandable format. The required development projects to implement the process are listed and estimated to be easily executed. If implemented successfully the new process has potential to solve the issues it was designed to solve. This should result in better customer understanding in the early phases of the project and effective communication which together increase project success and customer satisfaction. When mutual understanding between the supplier, customer and 3rd parties is improved the number of surprises, change requests, wasted worktime and mistakes required to be fixed especially in the later phases of the project should decrease. This helps the project to stay in the planned scope and schedule and also supports following the Delivery process according to the company's quality system.

The research process was planned around the basic idea that it is not previously known which approach serves the case company's needs best. Instead of simply picking and applying a workflow improvement method such as Six Sigma, descriptive literature analysis was conducted to study different possibilities and developing a selection criterion which concerns deployments of information systems in healthcare field. The research process therefore

ensures the applicability of the selected workflow analysis methods as part of the Workflow design process in the case company but also widens to applicability to other similar companies which deliver information systems in healthcare sector.

Another argument that supports the applicability of this thesis outside the case company is that at the time of this study the case company had three different products from which only one had been delivered by the teams in Europe. However, the objective since the beginning of the research process was to develop a process solution which could be used to design workflows during delivery projects of any of THS's products or a combination of them, not just the product currently in the European markets. As these three products are all different and emphasis different organizational levels of workflows it is expected that the process developed in this thesis can be relatively easily modified to be utilized by other information system providers as well. The process description could serve as basis of workflow design process and be modified to fit the delivery process of other information systems providers in healthcare sector which provide highly configurable systems.

6.3 Limitations and further development

Workflow analysis methods

Literature is full of different methodologies, methods and approaches which could be utilized in workflow design. Therefore, it was not realistic to study and include all of them to the theoretical framework of this thesis. In addition, workflow analysis approach should be decided based on the project (Sheehan et al. 2012). However, it would not have been realistic for the case company to adopt multiple approaches in short timeframe in a professional way and include them to a process as a method toolbox from which the approach would then be selected for each customer project. In the interviews consistency of the process was also highlighted as a requirement for successful communication during the projects. For these reasons the decision was made to start with two approaches, Organizational routines and Think-Aloud protocol. Together they can cover all organizational levels of workflow. All workflow improvement methods in chapter 2.3 such as Lean, Six Sigma, BPR and Theory of Constraints were considered not applicable in the first version. Using these methods would target in more comprehensive process development for the customer organization from a wider perspective whereas THS can provide solutions only to the selected problems.

In addition to just analyzing the current customer workflows a “Comprehensive preliminary investigation for an additional fee” was suggested in the interviews. This would include analyzing customer needs also outside THS products and then creating a comprehensive long-term plan. This would mean providing consultation services by commercializing parts of the Workflow design process, which can be considered in the future as a development idea for the process. For this kind of service, the more comprehensive workflow improvement methods would be suitable. Whereas for the first version of the process it is more important to include mainly the workflow analysis methods to ensure full understanding of the customers current workflow and concentrating on delivering THS’s own platform products and 3rd party solutions which run the platform.

Technical implementation and optimization of workflow designs

In this thesis the decision was made to look workflows from wider perspective considering workflows to be more than just automation (Dumas et al. 2005, 22-24; Karsh 2009; Stohr et al. 2001). Taking this wider approach and focusing on workflows from the end users’ perspective means that this thesis did not provide solutions to workflow design from the point of view of technical implementation. The process does not for example include measuring and optimizing workflows by utilizing measuring tools or other potential technologies. This limitation was pointed out by one of the interviewed THS employees who mentioned the need to develop better workflow implementation tools and sub-processes for that. Other more technical analysis requirements related to the early phases of the Delivery process which were left out of scope included device analysis, evaluating customer specific system performance requirements and detailed plan for potential upscaling of the system.

User trainings and customer’s change management

Developing customer trainings and providing other means of change management support were both recognized as areas of improvements in the interviews. The suggestions to support customer’s change management included developing training certificates, offering trainings as invoiceable packages and providing statistics on system usage. Due to decision to concentrate on customer understanding and communication these suggestions were dropped out of the scope of the first version of the new process. However, these are good examples

potential solutions which are relatively easy to include for future development lifecycles of the process.

Account and workflow management after the Delivery projects

The process was designed to be implemented only in the delivery projects. Therefore, it does not solve the issue of what to do with the workflows for example when the customer's solution is upgraded in the future. These upgrades may open new possibilities for further workflow improvements and optimization which were not possible or even considered during the original delivery project. However, it has been recognized also in THS that these improvement possibilities are usually not utilized when the solution is upgraded because of the resources it requires from THS and the customer. The benefits are considered difficult to communicate to existing customers who are satisfied with their current workflows. Even though THS knows the customer would most likely benefit from a new feature it is hard to communicate if the exact use case or the exact problem it could solve is not known. Because the timeframe between the original project and the upgrade may be several years these workflow optimizations would require a new workflow analysis because the customer may have gone through significant changes to their organization, processes or workflows since the original delivery project. Another issue is the lack of centralized documentation of changes done to the solutions after the projects. The new Workflow design process includes adding the workflow description to Solution description at the end of the project. However, Solution description in THS is a project document which is not updated afterwards. These issues highlight the fact that workflow management is needed also after the project is closed and handed over to support.

7 Summary

The main objective in this diploma thesis was to develop a new process for Topcon Healthcare Solution. The rapid growth during the recent years had revealed process development needs in the company and its processes. One of these was that workflows were not treated as a central part of the Delivery process which led to complications and inefficiencies. The company’s current strategy to move towards providing comprehensive solutions instead of individual software also requires better workflow design because the number of available options for the customer is increasing. Communicating the different options and their effects with the customer is becoming more challenging, and decision making between different options requires a deeper understanding of the customer's real needs. The deployment may fundamentally change the workflows in the customer organization and affect individual employees. At the time of this research the designing of workflows was based on the assessment of professionals, but a systematic process was missing.

To research the topic and to develop a process solution the company decided to fund this diploma thesis project as an internal process development project. The research was conducted concentrating on THS Operations in Helsinki. The research started in August 2022 by researching the topic and collecting basic understanding of the topic. The result form the first main part of this thesis which is the theoretical framework build in September 2022. The framework answers for the first research question: How to design workflows in healthcare sector? The conclusions in this part highlight the importance of analyzing the workflows in all organizational levels and ensuring the workflow fit between the multiple levels of healthcare organization. Methods for this analysis and design work should be decided based on the needs and characteristics of the project. The criteria are therefore different also for different project types.

The second main part of the thesis was the case study. Collecting material for describing the starting point was done in September 2022. In this work the author was able to utilize his own experience as an employee of the case company to find the essential material. The interview study was then planned in early October. The interviews took place during the second half of the month. A lot of time and effort was spent on analyzing the material and

coding the data to content categories. These categories formed structured lists including current design practices, problems, requirements, and solutions to current challenges. This phase took longer than expected finishing in late November. The lists served as categorized collections of puzzle pieces which were used in assessing the current process maturity levels, building the solution model and finally the suggested process solution in late November and the first half of December. The theoretical framework was also utilized when determining the process maturity goals and to collecting solutions to the solution model.

The new workflow design process respects the phases of the case company's delivery process determined by its quality system and aims to support following it in practice which was one of the main challenges recognized in the case study. The first version of the process to be implemented in THS concentrates in the early phases of the process by improving customer understanding and communication. It is recognized that further development is required to improve the process in the following process development cycles.

The diploma thesis achieved its main objective with excellent results. The new process was validated by the case company in December 2022 and the required improvement projects to implement the process have been launched or planned to be launched during 2023.

References

American Medical Association. 2023. How to select a practice management system. [Online] Available at: https://www.ama-assn.org/practice-management/claims-processing/how-select-practice-management-system. [Accesed: 18th January 2023].

American Society for Quality. 2022a. Learn about quality. [Online] Available at: https://asq.org/quality-resources/learn-about-quality. [Accesed: 29th January 2023].

American Society for Quality. 2022b. What is lean?. [Online] Available at: https://asq.org/quality-resources/lean. [Accesed: 25th September 2022].

American Society for Quality. 2022c. What is lean six sigma?. [Online] Available at: https://asq.org/quality-resources/six-sigma.

American Society for Quality. 2022d. What is Total Quality Management (TQM)?. [Online] Available at: https://asq.org/quality-resources/total-quality-management. [Accesed: 23th September 2022].

Arora, D., & Mehta, Y. 2014. Use of picture archiving and communication system for imaging of radiological films in cardiac surgical intensive care unit. Journal of anaesthesiology, clinical pharmacology, 30(3), 447–448.

Bucur, A., van Leeuwen, J., Christodoulou, N., Sigdel, K., Argyri, K., Koumakis, L., Graf, N. and Stamatakos, G. 2016. Workflow-driven clinical decision support for personalized oncology. BMC Medical Informatics and Decision Making, 16(S2).

Cox, J. F. III, Boyd, L. H., Sullivan, T. T., Reid, R. A., & Cartier, B. 2012. The Theory of Constraints International Certification Organization Dictionary. 2nd ed. New York, NY: McGraw-Hill

Dahlgaard, J.J., Khanji, G.K. and Kristensen, K. 1997. Fundamentals of total quality management. London: Routledge.

Deokar, A. V., Kolfschoten, G. L., & de Vreede, G.-J. 2017. Prescriptive Workflow Design for Collaboration-intensive Processes using the Collaboration Engineering Approach. Global journal of flexible systems management, 9(4), 11–20.

Dumas, M., van der Aalst, W.M.P. & ter Hofstede A.H.M. 2005. Process-aware information systems: bridging people and software through process technology. Hobroken, Nj: John Wiley And Sons.

Feldman M.S. & Pentland, B.T. 2005. Organizational routines as a unit of analysis. Industrial and Corporate Change, 14(5), 793–815.

Gogia, S., Novaes, M., Basu, A., Gogia, K. & Gogie S. 2019. Fundamentals of telemedicine and telehealth. London, United Kingdom: Academic Press.

Hammer, M. 1990. Reengineering Work: Don't Automate, Obliterate, [Online] Harvard Business Review. Available at: https://hbr.org/1990/07/reengineering-work-dont-automate-obliterate.

Hazlehurst, B., Gorman, P. N., McMullen, C.K. 2007. Distributed cognition: An alternative model of cognition for medical informatics. International journal of medical informatics (Shannon, Ireland). [Online] 77 (4), 226–234.

HIPAA Journal. 2022. Healthcare Workflow Management. [Online] Available at: https://www.hipaajournal.com/healthcare-workflow-management/. [Accesed: 26th September 2022].

Hirsjärvi, S., Remes, P., Sajavaara, P. 1997. Tutki ja kirjoita. Helsinki: Kirjayhtymä yo

Holden, R. J. & Karsh, B.-T. (2009) A theoretical model of health information technology usage behaviour with implications for patient safety. Behaviour & information technology, [Online] 28 (1), 21–38

Holtzblatt, K. & Beyer, H. 2016. Contextual design: design for life. Second edition. Cambridge, MA: Elsevier.

Ikeziri, L.M., Souza, F.B. de, Gupta, M.C. and de Camargo Fiorini, P. 2018. Theory of constraints: review and bibliometric analysis. International Journal of Production Research, 57(15-16), 5068–5102. doi:10.1080/00207543.2018.1518602.

Jaspers, M. W. 2009. A comparison of usability methods for testing interactive health technologies: Methodological aspects and empirical evidence. International journal of medical informatics (Shannon, Ireland). [Online] 78 (5), 340–353.

Karsh, B.-T. 2009. Clinical Practice Improvement and Redesign: How Change in Workflow Can Be Supported by Clinical Decision Support. [Online] Available at: https://digital.ahrq.gov/sites/default/files/docs/biblio/09-0054-EF-Updated_0.pdf [Accesed: 26th September 2022].

Korpela, M., Mursu, A. and Soriyan, HA. 2002. Information Systems Development as an Activity. Computer supported cooperative work, [Online] 11 (1-2), 111–128.

Kumar, P., Maiti, J., & Gunasekaran, A. 2018. Impact of quality management systems on firm performance. The International journal of quality & reliability management. 35 (5), 1034–1059.

KvaliMOTV. 2022a. Strukturoitu ja puolistrukturoitu haastattelu. [Online] Available at: https://www.fsd.tuni.fi/menetelmaopetus/kvali/L6_3_3.html. [Accesed: 28th January 2023].

KvaliMOTV. 2022b. Tapaustutkimus. [Online] Available at: <https://www.fsd.tuni.fi/menetelmaopetus/kvali/L5_5.html>. [Accesed: 25th January 2023].

KvaliMOTV. 2022c. Teemahaastattelu. [Online] Available at: https://www.fsd.tuni.fi/menetelmaopetus/kvali/L6_3_2.html. [Accesed: 28th January 2023].

Laurila, E. 2023. Vice President of Operations in Topcon Healthcare Solutions EMEA. Email and Slack conversation to confirm the information in chapter 5.1, 26th January 2023.

Lääkäriliitto. 2021. Tutkimus lääkärien kokemuksista: Potilastietojärjestelmissä on edelleen kehitettävää. [Online] Available at: https://www.laakariliitto.fi/uutiset/ajankohtaista/tutkimus-laakarien-kokemuksista-potilastietojarjestelmissa-on-edelleen-kehitettavaa/. [Accessed 29th January 2023].

Mabin, V.J., Forgeson, S. and Green, L. 2001. Harnessing resistance: using the theory of constraints to assist change management. Journal of European Industrial Training, 25(2/3/4), 168–191.

Metsämuuronen, J. 2005. Tutkimuksen tekemisen perusteet ihmistieteissä. Jyväskylä. Gummerus.

Musen, M.A., Middleton, B. and Greenes, R.A. 2013. Clinical Decision-Support Systems. Biomedical Informatics. [Online] pp.643–674. doi:10.1007/978-1-4471-4474-8_22.

Nardi, B. A. 1995. Context and consciousness: Activity theory and human-computer interaction. Bonnie A. Nardi (ed.). Cambridge, Massachusetts: The MIT Press.

Näslund, D. 2008. Lean, six sigma and lean sigma: fads or real process improvement methods?. Business Process Management Journal, 14(3), 269–287. doi:10.1108/14637150810876634.

Randell, R., Alvarado, N., McVey, L., Ruddle, R. A., Doherty, P., Gale, C., Mamas, M., & Dowding, D. 2020. Requirements for a quality dashboard: Lessons from National Clinical Audits. AMIA Annual Symposium proceedings. AMIA Symposium, 2019, 735–744.

Salminen. 2011. Mikä kirjallisuuskatsaus?. Opetusjulkaisuja 62. Vaasan yliopisto. [Online] Available at: https://www.uwasa.fi/materiaali/pdf/isbn_978-952-476-349-3.pdf

Shaw, J., Sethi, S., Vaccaro, L., Beatty, L., Kirsten, L., Kissane, D., Kelly, B., Mitchell, G., Sherman, K., & Turner, J. 2019. Is care really shared? A systematic review of collaborative care (shared care) interventions for adult cancer patients with depression. BMC health services research. [Online] 19 (1), 120–120.

Sheehan, B. & Bakken, S. 2012. Approaches to workflow analysis in healthcare settings. NI 2012: 11th International Congress on Nursing Informatics, June 23-27, 2012, Montreal, Canada. [Online] p.371. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3799136/.

Sitra. 2022. Terveysdatan sujuva ja turvallinen käyttö. [Online] Available at: https://www.sitra.fi/julkaisut/terveysdatan-sujuva-ja-turvallinen-kaytto [Accessed 29th January 2023].

Smartsheet. 2019. Save Time by Taking the Time: Creating Workflows. [Online] Available at: https://www.smartsheet.com/save-time-taking-time-creating-workflows. [Accesed: 23rd August 2022].

Stohr E. A. & Zhao J. L. 2001. Workflow Automation: Overview and Research Issues. Information Systems Frontiers, 3(3), 281-296.

Terveyden ja hyvinvoinnin laitos. 2020. Kysely: Asiakas- ja potilastietojärjestelmät tukevat sairaanhoitajien työtä vain osittain. [Online] Available at: https://thl.fi/fi/-/kysely-asiakas-ja-

potilastietojarjestelmat-tukevat-sairaanhoitajien-tyota-vain-osittain [Accessed 29th January 2023].

Topcon Healthcare Solutions. 2022. Delivery Process - SOP00022EN Rev. 2.0 SIGNED, viewed 2nd October 2022, retrieved from SharePoint database.

Topcon University. 2022a. Harmony RS: Solution Overview (Sales). Topcon University. Available at: https://learning.topcon.com/#/online-courses/6a19827a-6187-457a-afdf-8e6563f9b1c1. [Accesses: 25th August 2022].

Topcon University. 2022b. Harmony RS: Using your Solution. Topcon University. Available at: https://learning.topcon.com/#/online-courses/589197ca-826b-4768-b9af-e4b9643e613d. [Accessed: 25th August 2022].

Topcon University. 2022c. RDx – Product Training. Topcon University. Available at:

https://learning.topcon.com/#/online-courses/489ceb10-8c99-4c62-a1b4-74df1e846ce0.

[Accessed: 26th August 2022].

Topcon University. 2022d. RDx – Using your software. Topcon University. Available at:

https://learning.topcon.com/#/online-courses/0503113f-3f5e-470d-9f65-beb8a44ba72b. [Accessed: 29th August 2022].

Topcon University. 2022e. Chronos - Using Your Device. Topcon University. Available at: https://learning.topcon.com/#/online-courses/6d458e43-164d-4852-ab39-eeea2dc29ce9.

[Accessed: 29th August 2022].

Turvallisuus- ja kemikaalivirasto (Tukes). 2022. Lääkinnälliset laitteet REACH- ja CLP-asetuksessa. [Online] Available at: https://tukes.fi/tietoa-tukesista/materiaalit/kemikaalit/laakinnalliset-laitteet-reach-ja-clp-asetuksessa. [Accessed 12th October 2022].

University of Verona. 2022. Organizational studies. [Online] Available at: https://www.dea.univr.it/?ent=arearic&id=76&tipo=gruppo&lang=en. [Accessed 11th October 2022].

van der Aalst, W. & Stahl, C. 2011. Modeling business processes: a petri net-oriented approach. Cambridge, Mass: MIT Press.

van der Aalst, W. 2016. Process Mining Data Science in Action. 2nd ed. 2016. [Online] Berlin, Heidelberg: Springer Berlin Heidelberg.

Vears, D.F. and Gillam, L. 2022. Inductive content analysis: A guide for beginning qualitative researchers. Focus on Health Professional Education: A Multi-Professional Journal, 23(1), pp.111–127.

Womack, J. and Jones, D. 1994. From lean production to the lean enterprise. Harvard Business Review, 72(29), 93-103.

Wuotila, V. 2022. Eye Care State-of-the-Union & Topcon's Position. [PowerPoint presentation]. THS EMEA Monthly Meeting. 19th August 2022.

Wysocki, R.K. 2004. Project management process improvement. Boston: Artech House.

Yin, G., 2010. BPR Application. Modern Applied Science, 4(4). doi:10.5539/mas.v4n4p96.

Zhang, P. & Galletta, D. F. 2006. Human-computer Interaction and Management Information Systems: Foundations: Foundations. [Online]. Armonk: Routledge.

Zhang J.J., Butler K.A. 2007. UFuRT: a work-centered framework and process for design and evaluation of information systems. HCI International 2007: The 12th International Conference on Human-Computer Interaction, July 22-27, 2006, Beijing, China. [Online] Available at: https://www.researchgate.net/publication/228993873_UFuRT_A_work-centered_framework_and_process_for_design_and_evaluation_of_information_systems. [Accesses: 28th September 2022].

Appendix 1. Interviewees and their selection criteria

Six interviewees were selected to represent different teams involved in THS Operations and Sales.

Team	Role
Project Management Office	Sr. Project manager, Team lead
Project Management Office	Project manager
Sales	Sales manager
Solutions Team	Solution architect
Customer Success	Service manager
Customer Success	Support specialist

Sales determines with the customer which THS products and services are taken to the delivery project. The contract between the customer and THS defines and limits the project scope and therefore affects the workflows which can be offered in the project scope.

Project management executes the delivery project. This includes specifying and configuring the selected workflows to the THS products. At the end of the project the solutions are delivered and to the customer and new workflows are trained to the end-users.

Solutions team is always included in the delivery projects. They are responsible for technical specification and implementation of solutions and integrations which manifest in end-user workflows.

Customer success team takes care of the customer after the delivery project has closed. With direct customers all service request and possible change request to the existing solutions go through them. This includes change request to the workflows. Team may also get service request from the project management team to implement some specific parts of the customer workflows during the delivery projects.

Appendix 2. Interview template

Interviewee's name:
Job Title:
Team:
Date of the interview:

General information given the interviewee before starting the interview:

In my thesis I am creating a new workflow design process for THS to design customer workflows in a consistent way during delivery projects. As a part of my thesis project, I am interviewing selected THS employees. The goal of the interviews and the analysis following them is to describe the current ways of working related to the topic and their pros and cons. The results will be used together with the descriptive literature review to select suitable methods to build the new process.

The interview is semi-structured, and it should proceed like a real conversation. A list of interview questions was prepared to support the interview and analyzing the results, but it is not expected that all participants are able to answer all the questions. The interviewees were selected to represent Sales and different teams in THS Operations, and they are interviewed separately. Semi-structured interview was chosen as a method to allow the employees to express their experience and opinions more freely compared to structured interviews or surveys. This is important to enable gaining deeper understanding of the current practices and development needs while minimizing the interviewer's own biases. Involving the employees to the process development also increases their commitment to the new process. Interviews will be recorded for analysis purposes. The recordings will be deleted after the thesis has been approved or latest by the 31st of May 2023.

Supportive questions:

1) How customer workflows have been designed in enterprise customer projects where you have been involved?

2) Who are the key external stakeholders for successful workflow design?

3) Which practices or activities have you found useful for understanding or analyzing customer workflows?

4) Which practices or activities have you found useful for designing customer workflows?

5) Which activities should be involved in the new workflow design process for enterprise customers in your opinion?

6) Have you encountered problems which you think originate to workflow design but became visible elsewhere? If yes, how do you think the problem could have been avoided?

7) How common it is that end-users use workarounds or continue to work in the same way as before after the workflow changes were applied? How could this be avoided?

8) When the changes to the customer workflows are applied, how are the results to determine if the changes are having the desired effect monitored?

Appendix 3. Refined coding schema

A. Current workflow design practices

1 Sales phase

1.1 Understanding of customer needs

1.2 Analyzing customer's current environment and workflow

1.3 Planning how our products fits the customer's overall workflow

1.4 Upcoming product capabilities may be included according to the product roadmap

2 Knowledge transfer from Sales to Project team

2.1 Side product of technical support given in Sales phase

2.2 Delivery data sheet

2.3 Handover from Sales

2.4 Internal project kick-off meeting

3 Project kick-off with the customer representative(s)

3.1 Business-oriented representative with high level workflow design

3.2 Sometimes key user(s)

4 Iterative technical design piece by piece with customer and 3rd parties

4.1 Meetings to gather business and technical requirements, limitations, and specifications

4.2 Customer, THS and 3rd parties suggest a piece of a workflow

4.3 THS and/or 3rd parties design and implement the part

4.4 Going through the results with the customer

4.5 Customer approves or suggests changes

5 Workflows are planned alongside the technical design

6 Design practices vary between projects and depend on customer

7 AI tools are enabled according to project scope

8 AI providers are responsible for AI related workflows

9 Customer and 3rd parties are responsible for presenting requirements related to their internal quality systems and local regulations regarding the workflow

10 Product management develops the product according to projects' needs

11 Visualizing and communicating workflow designs

11.1 Flowcharts

11.2 Report templates

12 Supporting change management

12.1 User training is given

12.2 Customer's project team member performs User acceptance test

12.3 Early-life-support is given for 14 days after Go-live

12.4 Results of changes to the original workflow are not measured by THS

B. Key stakeholders

1 Internal stakeholders

1.1 Clinical application/workflow/service design specialist

1.2 Integration specialist

1.3 Solution architect

1.4 Trainer

2 Customer's stakeholders

2.1 Representatives of each end-user groups

2.2 Workflow owner or other workflow decision maker

2.3 IT professional

2.4 Owner or Business representative

3 Stakeholders for all 3rd party integrations

3.1 Person who does the integration to our system

3.2 Person who understands the 3rd party system as a whole

C. Practices or activities which have worked well

1 Internal project team member with clinical user experience participates in workflow design and end user training

2 Iterative designing

3 Starting an iterative design cycle by visualizing the initial design and using that as a starting point for further conversations and iterations

3.1 Flowcharts

3.2 Architectural drawings

3.3 Screenshots

3.4 Written requirements in structured format

3.5 Report mock-ups from UI/UX team

4 Analyzing current workflows onsite

4.1 Analysis of real environment and workflows

4.2 Same analysis in at least two locations

4.3 Asking additional questions if differences are found

5 Customer demonstrates what kind of workflow they want

5.1 Visualizations

5.2 other demonstrations

6 Customizing report templates according to previously used reports

D. Problems related to current workflow design practices

1 Internal communication between Sales and Project team

1.1 Outdated or incomplete information in Delivery data sheet

1.2 Project kick-off is skipped or not planned properly

1.3 The current workflow is not described

1.4 The planned new workflow is not described

1.5 Varying terminology

1.6 Lack of consistency in general

2 External Communication

2.1 The current workflow is not described

2.2 The planned new workflow is not described early in the project

2.3 Documentation of requirements is not consistent or adequate

2.4 Not communicating clearly if a feature requires product development

2.5 Getting technical details from non-technical customer representatives

2.6 High dependency on correct and adequate information input from the customer

2.7 Low capability to demonstrate before building

3 Reasons for failed or non-optimal workflow designs

3.1 Customer representative does not understand the value of suggested workflow optimization

3.2 Not including all user groups to the workflow designing

3.3 Expecting the product/functionality to fit the workflow without planning

3.4 Low capability to demonstrate before building

3.5 Missing functionalities in the product

3.6 Developing a needed functionality is delayed or removed from product roadmap

3.7 Inadequate gathering of information in Sales phase

3.8 Communicating and documenting requirements fails

3.9 Some requirements are realized too late

3.10 The supported workflows are not defined and documented

4 Results of failed or non-optimal workflow design

4.1 Some user groups are not satisfied

4.2 Users do not utilize some useful features

4.3 Some users/user groups use keep using the old system if possible

4.4 Having to use complicated workflows or workarounds because the product does not support the simple solution which was sold

4.5 Additional requirements after test period

4.6 Promises to deliver additional features which require product development

4.7 Product development is required during projects

4.8 Customer cancels the procurement completely or partially

4.9 System's performance issues in production

5 Missing or inadequate resources

5.1 Technical support for sales

5.2 Professional workflows design skills in Project team

5.3 Dedicated AI account management

5.4 Technical resources for development work in projects

5.5 Product development for large customer segments

5.6 End-users don't devote enough time for training

6 Missing processes

6.1 Workflow analysis

6.2 Device analysis

6.3 Detailed plan and system requirements for potential upscaling

6.4 Using workflow templates

6.5 Implementation sub-processes

6.6 Gathering workflow feedback from end-users

6.7 Account management processes to document workflow changes

7 Risks of inadequate project documentation

7.1 Maintenance and support problems

7.2 Losing understanding of old and customized solutions

E. Requirements for the new workflow design process

1 Gathering comprehensive customer understanding

2 Starting workflow planning from architecture

3 Possibility to separate development tasks from project scope

4 Less tailoring during projects

5 3rd party stakeholders are included early in the project

6 Participating end-users as the most important stakeholder for workflow design

7 Improving communication

8 Getting clear requirements from the customer

9 Getting training material from AI vendors

10 Ensuring solutions are easy to maintain and support

F. Suggestions for the new workflow design process

1 New sub-process or process phases

1.1 Consistent current workflow analysis in presales phase

1.1.1 Preparing the customer for analysis process

1.1.2 Analyzing the current workflows on-site in at least two locations

1.1.3 Analyzing the current workflows for all end user groups

1.1.4 Documenting the workflow analysis on a template

1.1.5 Identifying all branches of workflows in different systems

1.1.6 Validating the analysis with all participants

1.2 Comprehensive preliminary investigation for an additional fee

1.2.1 Consistent current workflow analysis

1.2.2. Analyzing customer needs also outside THS products

1.2.3 Creating a comprehensive long-term plan

1.3 Using workflow templates in Sales

1.3.1 Productization of common workflows

1.3.2 Describing workflows with verified architectural support

1.4 Iterative technical design piece by piece with customer and 3rd parties

1.4.1 Customer needs and understanding of the current workflow as an input

1.4.2 Internal and external meetings to optimize workflows

1.4.3 Otherwise, process follows current iterative design practices

2 Presales practices and activities

2.1 General overview for the customer about the software

2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist)

2.3 Solution architect and Sales write down the basic project scope after the detailed meeting

2.4 Scope and development tasks are separated

2.5 Scope and development task are communicated to the customer

2.6 Complicated areas are highlighted

2.7 Requirements meeting for solution architect, product specialist, sales and customer

2.8 Determining which workflows are possible and timeframe

2.9 Mapping and documenting the current and planned workflows

2.10 Signing a quotation

2.11 Handover from Sales to Project team

3 Delivery process practices and activities

3.1 Naming a workflow owner in customer organization

3.2 Project schedule is an estimation until the scope is accepted

3.3 Iterative technical specification and workflow design

3.4 All end user groups are included in workflow design

3.5 Workflow survey about the suggested workflow for end users

3.6 The final workflow description is shown for all end users

4 Resources

4.1 Workflow designer is included in project teams

4.2 AI - account manager supports project teams

4.3 At least 2-3 open timeslots per week for technical Sales support (product specialist and solution architect)

4.4 Workflow analysis takes place as early as possible

4.5 Timing of workflow analysis depends on customer’s willing to invest resources in Sales phase

4.6 Workflow templates reduce the need for technical support in presales

4.7 Product management is included if scope includes something which haven’t been done before

5 Communication improvements

5.1 Creating Workflow descriptions of current and planned workflows

5.2 Workflow descriptions are understandable for end-users but detailed enough for technical team

5.3 Workflow descriptions are part of Handover from Sales

5.4 Final workflow description is given to the Support

5.5 Recording important meetings

Appendix 4. Solutions model

Requirement	Importance for process version 1.0	Solutions based on interviews	Solutions from literature	Process phase
Gathering comprehensive customer understanding	3	F1.1 Consistent current workflow analysis in presales phase F2.1 General overview for the customer about the software F2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist) F4.1 Workflow designer for project teams	Cognitive task analysis Organizational routines Identifying organizational levels for workflows Analyzing workflows in all organizational levels	Presales
Workflow analysis	3	F1.1 Consistent current workflow analysis in presales phase	Cognitive task analysis Organizational routines Analyzing workflows in all organizational levels	Presales
Device analysis	1	S Information created in Workflow analysis regarding the devices can be utilized as a partial solution.		Presales
Customers current workflow is described in detail in presales or early in the project	3	F1.1 Consistent current workflow analysis in presales phase F4.4 Workflow analysis takes place as early as possible F4.5 Timing of workflow analysis depends on customer's willing to invest resources in Sales phase	Cognitive task analysis Organizational routines Describing workflows in all organizational levels	Presales

Requirement	Importance for process version 1.0	Solutions based on interviews	Solutions from literature	Process phase
Using workflow templates	3	F1.3 Using workflow templates in Sales F4.3 At least 2-3 open timeslots per week for technical Sales support (product specialist and solution architect) F4.7 Product management is included if scope includes something which haven't been done before	Templates are based on organizational levels	Presales
Using consistent terminology	2	F1.1.4 Documenting the workflow analysis on a template F1.3 Using workflow templates in Sales		Presales
Documentation of requirements is consistent and adequate	2	F1.1 Consistent current workflow analysis in presales phase F1.3 Using workflow templates in Sales F2.3 Solution architect and Sales write down the basic project scope after the detailed meeting		Presales
Technical support is available for Sales	3	F 2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist) F2.3 Solution architect and Sales write down the basic project scope after the detailed meeting F 2.7 Requirements meeting for solution architect, product specialist, sales and customer F4.3 At least 2-3 open timeslots per week for technical Sales support (product specialist and solution architect) F4.6 Workflow templates reduce the need for technical support in presales F4.7 Product management is included if scope includes something which haven't been done before		Presales
Communicating clearly if a feature requires product development	3	F2.5 Scope and development task are communicated to the customer F2.6 Complicated areas are highlighted F2.7 Requirements meeting for solution architect, product specialist, sales and customer F2.8 Determining which workflows are possible and timeframe		Presales

Requirement	Importance for process version 1.0	Solutions based on interviews	Solutions from literature	Process phase
Ensuring missing product functionalities are not included in the projects	3	F1.1 Consistent current workflow analysis in presales phase F1.3 Using workflow templates in Sales F2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist) F2.3 Solution architect and Sales write down the basic project scope after the detailed meeting F2.4 Scope and development tasks are separated F2.5 Scope and development task are communicated to the customer F2.6 Complicated areas are highlighted F2.7 Requirements meeting for solution architect, product specialist, sales and customer F2.8 Determining which workflows are possible and timeframe		Presales
Possibility to separate development tasks from project scope	2	F2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist) F2.3 Solution architect and Sales write down the basic project scope after the detailed meeting F2.4 Scope and development tasks are separated		Presales
Ensuring the product supports all agreed outcomes with simple workflow solutions before signing the quotation	2	F1.1 Consistent current workflow analysis in presales phase F1.3 Using workflow templates in Sales F2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist) F2.6 Complicated areas are highlighted F2.8 Determining which workflows are possible and timeframe		Presales
Less tailoring during projects	1	F1.3 Using workflow templates in Sales F2.4 Scope and development tasks are separated		Presales

Requirement	Importance for process version 1.0	Solutions based on interviews	Solutions from literature	Process phase
Product development is not required from project teams	1	F2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist) F2.3 Solution architect and Sales write down the basic project scope after the detailed meeting F2.4 Scope and development tasks are separated F2.5 Scope and development task are communicated to the customer F2.6 Complicated areas are highlighted F2.7 Requirements meeting for solution architect, product specialist, sales and customer F2.8 Determining which workflows are possible and timeframe F2.9 Mapping and documenting the current and planned workflows F4.7 Product management is included if scope includes something which haven't been done before		Presales
The planned new workflow is described in presales	2	F1.3 Using workflow templates in Sales F2.9 Mapping and documenting the current and planned workflows	Describing workflows in all organizational levels	Presales
Ensuring adequate gathering of information in sales phase	3	C5 Customer demonstrates what kind of workflow they want F1.1 Consistent current workflow analysis in presales phase F2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist) F2.3 Solution architect and Sales write down the basic project scope after the detailed meeting F2.7 Requirements meeting for solution architect, product specialist, sales and customer F4.7 Product management is included if scope includes something which haven't been done before F5.1 Creating Workflow descriptions of current and planned workflows F5.2 Workflow descriptions are understandable for end-users but detailed enough for technical team F5.3 Workflow descriptions are part of Handover from Sales S Project manager has the right to reject Handover from Sales	Cognitive task analysis Organizational routines Analyzing workflows in all organizational levels	Presales, Handover from Sales

Requirement	Importance for process version 1.0	Solutions based on interviews	Solutions from literature	Process phase
Handover from sales meeting is planned properly	2	S Project manager has the right to reject Handover from Sales F2.10 Signing a quotation F5.3 Workflow descriptions are part of Handover from Sales		Presales, Handover from Sales
Ensuring up to date information in Delivery data sheet	3	S Project manager has the right to reject Handover from Sales		Presales, Handover from Sales
Not skipping Handover from sales meeting	2	S Project manager has the right to reject Handover from Sales		Handover from Sales
Getting training material from AI vendors	2	F4.2 AI - account manager supports project teams		Planning
Support from AI account management	2	F4.2 AI account manager supports project teams		Planning
3rd party stakeholders are included early in the project	3	F1.1 Consistent current workflow analysis in presales phase F1.1.5 Identifying all branches of workflows in different systems F1.4 Iterative technical design piece by piece with customer and 3rd parties F4.4 Workflow analysis takes place as early as possible		Presales, Planning, Specification
Participating end-users as the most important stakeholder for workflow design	3	F1.1.3 Analyzing the current workflows for all end user groups F1.1.5 Validating the analysis with all participants F3.4 All end user groups are included in workflow design F3.5 Workflow survey about the suggested workflow for end users F3.6 The final workflow description is shown for all end users		Presales, Specification, Implementation, Deployment
Consistent gathering of information before iterative design	2	C5 Customer demonstrates what kind of workflow they want F1.1 Consistent current workflow analysis in presales phase F4.5 Timing of workflow analysis depends on customer's willing to invest resources in Sales phase		Presales, Specification

Requirement	Importance for process version 1.0	Solutions based on interviews	Solutions from literature	Process phase
Getting clear requirements from the customer	3	C3 Starting an iterative design cycle by visualizing the initial design and using that as a starting point for further conversations and iterations C5 Customer demonstrates what kind of workflow they want C6 Customizing report templates according to previously used reports F1.1 Consistent current workflow analysis in presales phase F1.3 Using workflow templates in Sales F2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist) F2.7 Requirements meeting for solution architect, product specialist, sales and customer F2.8 Determining which workflows are possible and timeframe F2.9 Mapping and documenting the current and planned workflows F3.1 Naming a workflow owner in customer organization F5.1 Creating Workflow descriptions of current and planned workflows		Presales, Planning, Specification,
Improving capability to demonstrate before building	2	C3 Starting an iterative design cycle by visualizing the initial design and using that as a starting point for further conversations and iterations F1.3 Using workflow templates in Sales S Creating design mock-ups		Presales, Specification
Helping customer representatives to understand the value of suggested workflow optimizations	2	C3 Starting an iterative design cycle by visualizing the initial design and using that as a starting point for further conversations and iterations F1.3 Using workflow templates in Sales F1.4.2 Internal and external meetings to optimize workflows F3.1 Naming a workflow owner in customer organization F3.4 All end user groups are included in workflow design F3.5 Workflow survey about the suggested workflow for end users F4.1 Workflow designer for project teams F5.2 Workflow descriptions are understandable for end users but detailed enough for technical team	Aligning decision support with clinical processes	Presales, Planning, Specification, Implementation,

Requirement	Importance for process version 1.0	Solutions based on interviews	Solutions from literature	Process phase
Improving communication	3	C3 Starting an iterative design cycle by visualizing the initial design and using that as a starting point for further conversations and iterations C5 Customer demonstrates what kind of workflow they want F1.1 Consistent current workflow analysis in presales phase F1.3 Using workflow templates in Sales F2.2 Detailed meeting to understand the scope and customer needs (incl. customer, Sales, solution architect, product specialist) F2.3 Solution architect and Sales write down the basic project scope after the detailed meeting F5.1 Creating Workflow descriptions of current and planned workflows F5.2 Workflow descriptions are understandable for end users but detailed enough for technical team F5.3 Workflow descriptions are part of Handover from Sales F5.4 Final workflow description is given to the Support F5.5 Recording important meetings		Presales, Handover from Sales, Kick-off, Specification, Implementation, Deployment, Finalization
Helping customer representatives to understand the value of suggested workflow optimizations	2	C3 Starting an iterative design cycle by visualizing the initial design and using that as a starting point for further conversations and iterations F1.3 Using workflow templates in Sales F1.4.2 Internal and external meetings to optimize workflows F3.1 Naming a workflow owner in customer organization F3.4 All end user groups are included in workflow design F3.5 Workflow survey about the suggested workflow for end users F4.1 Workflow designer for project teams F5.2 Workflow descriptions are understandable for end users but detailed enough for technical team	Aligning decision support with clinical processes	Presales, Planning, Specification, Implementation,
Easing gathering technical details from non-technical customer representatives	1	C3 Starting an iterative design cycle by visualizing the initial design and using that as a starting point for further conversations and iterations C5 Customer demonstrates what kind of workflow they want F1.1 Consistent current workflow analysis in presales phase F5.2 Workflow descriptions are understandable for end-users but detailed enough for technical team		Presales, Specification

Requirement	Importance for process version 1.0	Solutions based on interviews	Solutions from literature	Process phase
Decreasing the dependency on correct and adequate information input from the customer	2	F1.1 Consistent current workflow analysis in presales phase F1.4 Iterative technical design piece by piece with customer and 3rd parties F4.1 Workflow designer for project teams	Cognitive task analysis Analyzing workflows in all organizational levels	Presales, Specification
Ensuring solutions are easy to maintain and support	2	F1.3 Using workflow templates in Sales F1.3.1 Productization of common workflows F1.3.2 Workflows with verified architectural support F2.4 Scope and development tasks are separated F4.7 Product management is included if scope includes something which haven't been done before F5.4 Final workflow description is given to the Support		Presales, Implementation
Gathering end-user feedback about workflow designs	3	F3.4 All end user groups are included in workflow design F3.5 Workflow survey about the suggested workflow for end users F3.6 The final workflow description is shown for all end users		Implementation
Ensuring users start using the new workflows instead of the old ones	1	A12.1 User training is given S Providing usage data to support customer's change management during the Early-life-support period.	Aligning decision support with clinical processes	Deployment, Finalization
Improving end user satisfaction in all user groups	3	C6 Customizing report templates according to previously used reports F1.1 Consistent current workflow analysis in presales phase F1.4.2 Internal and external meetings to optimize workflows F3.4 All end user groups are included in workflow design F3.5 Workflow survey about the suggested workflow for end users F3.6 The final workflow description is shown for all end users	Aligning decision support with clinical processes Adjusting workflows to fit the purpose of all organizational levels	Presales, Specification, Implementation, Deployment
Workflow design skills in project teams	3	F4.1 Workflow designer is included in the project team		All phases

Requirement	Importance for process version 1.0	Solutions based on interviews	Solutions from literature	Process phase
Mitigating risks of inadequate project documentation	3	F1.1.4 Documenting the workflow analysis on a template F1.3 Using workflow templates in Sales F4.7 Product management is included if scope includes something which haven't been done before F 5.1 Creating Workflow descriptions of current and planned workflows F5.2 Workflow descriptions are understandable for end-users but detailed enough for technical team F5.3 Workflow descriptions are part of Handover from Sales F5.4 Final workflow description is given to the Support		All phases

Appendix 5. Out-of-scope requirements and solutions

Requirement	Importance for process version 1.0	Solutions based on interviews	Explanation
Defining and documenting architecturally supported workflows	0		Requirement for implementing the Workflow design process.
All additional requirements after the test period are evaluated critically	0		All changes to the project plan are handled according to the project change management process
Change requests which require product development are separated from projects	0		All changes to the project plan are handled according to the project change management process
System performance requirements are evaluated	0	F1.2 A comprehensive preliminary investigation for an additional fee	Development idea for later versions of the Workflow design process
		New process is created for evaluating customer specific system performance requirements.	Systems team is responsible for creating the evaluation process
Product development for large customer segments	0		Product management is responsible for the process
Increasing end-users' devotion for user training	0	Providing certifications from completed user trainings	Development idea for later versions of the Workflow design process
Workflow analysis	3	F1.2 Comprehensive preliminary investigation for an additional fee	This solution is a development idea for later versions of the Workflow design process. Other solutions were selected for version 1.0.
Device analysis	0	Creating device analysis process	Solutions team is responsible for device integrations

Requirement	Importance for process version 1.0	Solutions based on interviews	Explanation
Detailed plan and system requirements for potential upscaling	0	F1.1 Consistent current workflow analysis in presales phase F1.3 Using workflow templates in Sales F1.2 Comprehensive preliminary investigation for an additional fee	Systems team is responsible for system requirements and maintenance
Using workflow templates	3	F1.3.1 Productization of common workflows F1.3.2 Describing workflows with verified architectural support	Using the workflow templates in general was included in the process. These solutions here are requirements for implementing the process.
Implementation sub-processes	0	S Creating better tools for configuring the products and testing the integrations	Technical implementation of workflows requires development outside Workflow design process
Account management processes to document workflow changes	0	S Information documented at the end of the project in Solution description is copied and used as a foundation for a new Account management document. This document is updated as a part of support and account management processes including system updates and all changes including changes to workflows	Customer success team is responsible for account management

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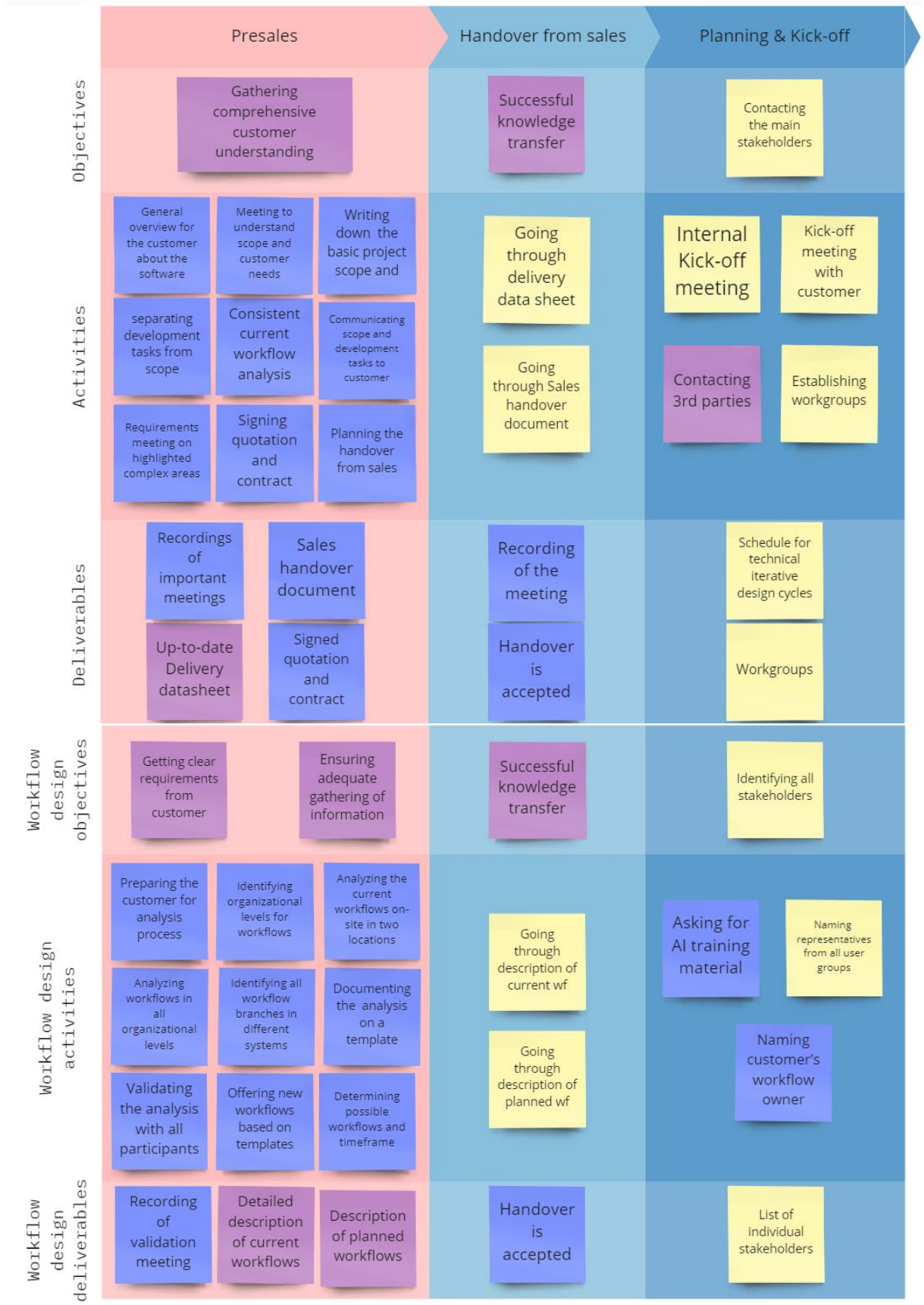
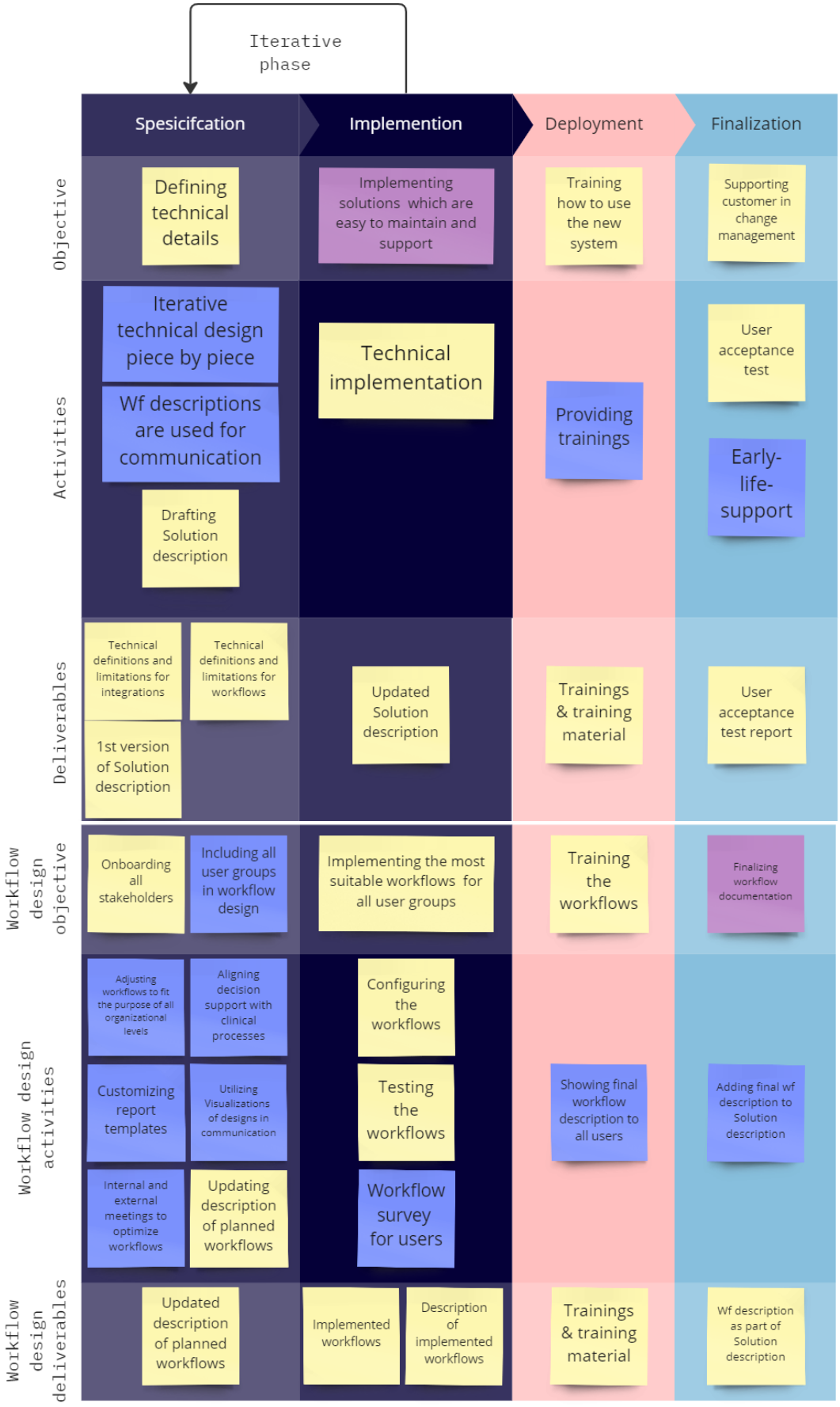
Appendix 6. Suggested process solution




Iterative phase
Spesicifcation
Implemention
Deployment
Finalization
Objective
Defining technical details
Implementing solutions which are easy to maintain and support
Training how to use the new system
Supporting customer in change management
Activities
Iterative technical design piece by piece
Wf descriptions are used for communication
Drafting Solution description
Technical implementation
Providing trainings
User acceptance test
Early-life-support
Deliverables
Technical definitions and limitations for integrations
Technical definitions and limitations for workflows
1st version of Solution description
Updated Solution description
Trainings & training material
User acceptance test report
Workflow design objective
Onboarding all stakeholders
Including all user groups in workflow design
Implementing the most suitable workflows for all user groups
Training the workflows
Finalizing workflow documentation
Workflow design activities
Adjusting workflows to fit the purpose of all organizational levels
Aligning decision support with clinical processes
Customizing report templates
Utilizing Visualizations of designs in communication
Internal and external meetings to optimize workflows
Updating description of planned workflows
Configuring the workflows
Testing the workflows
Workflow survey for users
Showing final workflow description to all users
Adding final wf description to Solution description
Workflow design deliverables
Updated description of planned workflows
Implemented workflows
Description of implemented workflows
Trainings & training material
Wf description as part of Solution description