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Faculty of Science and Technology,
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Combined computed tomography services for in- and outpatients in a medical care center: process efficiency

A case study

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M.Sc. Thesis October 2017

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Abstract

Background: Normally, in- and outpatient care in Germany is strictly divided between hospitals, and general physicians and specialty clinics, respectively. However, in a medical care center (MCC) these two patient types can be combined, which results in an unusual patient combination for German health care providers. As the number of medical care centers is growing, the importance for good and efficient processes is also rising to ensure health care for everyone who needs it. In this paper the focus lies on the in-and outpatient processes of computed tomography (CT) because it is an important diagnosis tool for both, inpatients and outpatients. Therefore, the efficiency of the processes is going to be assessed by identifying possible problems with the combination of the two patient types at the CT and simulating the CT-scan times.

Method: To understand and analyze the processes of the CT, observational research was conducted and existing flow-charts were studied and revised. After that the most process- impairing problems were identified through interviews with the people working directly with the CT. To give priority to the most important problems for a solution finding process, a ranking of the problems was done through multi-criteria decision analysis. To substantiate the importance of good solutions simulations of the scan schedules and times that are needed for in- and outpatients were made.

Results: The process analysis shows potential for improvement and difficulties especially in the inpatient process. The identified problems confirm this. The problems arise around process issues such as (i) bad distribution of information, (ii) difficult registration regulation of inpatients as well as (iii) patient characteristics such as difficulties with placing catheters (“bad veins”). The multi-criteria decision analysis shows that the “top 3” problems arise around inpatients. The simulation shows a shortage of time to scan inpatients.

Conclusion: The process efficiency of the Medical Care Center for Radiology by Prof. Dr. Uhlenbrock & Partner in Dortmund Hörde is not perfect and has high potential to be improved. Especially by refining the inpatient process time can be saved that is needed to scan all patients.

Keywords

Medical Care Center – Inpatients – Outpatients – Interviews - Multi-Criteria Decision Analysis – Simulation – Process Efficiency

1 Introduction

Computed tomography (CT) is a device used in diagnosing both chronic and acute diseases, by making images of different layers of the body through X-rays. In the past, CT was barely used, but nowadays diagnosis without CT is nearly unthinkable. Therefore, every hospital in major cities is equipped with at least one CT-scanner and special radiology clinics also provide patients with access to CT. With this, an optimal level of CT-scanners is guaranteed and the time to CT-scanner is minimized [1].

In Germany, per 1Million inhabitants 35.5 CT-scanners can be found which makes Germany the country with the fifth highest margin of CT-scanners in Europe in 2014. With these scanners a total of 114.4 scans per 1,000 inhabitants are done each year. Of these 114.4 scans 68.2 are for outpatients and 46.3 are for inpatients. In 2007 all performances from the radiology sector were worth €3.4Billion, of which 20% was assigned to CT [2].

Computed tomography is not only used in hospitals for diagnosing inpatients but also in special radiology clinics which are responsible for the care of outpatients. This is due to the fact that in Germany health care delivery is divided between in- and outpatients. Outpatients receive care through general physicians or as in the case of CT through specialty clinics. Inpatients receive CT-scans through the hospital they are assigned to. However, a Medical Care Center (MCC, or *Medizinisches Versorgungszentrum* in German) can, if it is linked to a hospital, care for both and thus combine the different types of patients [3, 4]. Other forms of combined in-, and outpatient services are mostly restricted to the care for emergency patients. A MCC is one of only three possibilities to combine all types of health care for in-, and outpatients which makes this combination uncommon for German health care. MCCs are the most common option of in- and outpatient combination and it is growing more and more popular, but still stays rather uncommon [4].

According to German law (§ 95 SGB V) the definition of a Medical Care Centre is: An interdisciplinary, medically supervised institution, which ensures and provides medical care through a structured collaboration of at least two physicians from different areas of expertise [5]. Founders of MCCs can be self-employed physicians (SEP) and hospitals but also providers of non-medical dialysis services. Around 40% of all MCC are in the hand of SEP, 38% are linked to hospitals and the remaining 20% are in the hand of the third carrier [5, 6]. Therefore, 38% of all MCCs deliver combined in- and outpatient care which means that this combination is not even present in the majority of MCCs. As an example of urology surgeries (but also various other situations) shows, uncommon situations or surgeries are prone to have more complications due to the lack of comparisons and routine [7], it is possible that MCCs are also more likely to have problems with the uncommon combination of patient types.

As costs and patient numbers rise the need for good quality care and health care processes grow and as all other parties involved in health care delivery, MCCs are obligated to fulfill this need.

The difficulty here lies in the uncommon combination of patients which has to be taken into account [4, 8]. Therefore, this study looks into one MCC to analyze the processes and asses the process efficiency (see 7.1) of health care delivery for in- and outpatients CT-services. The MCC where this case study will be conducted is the Medizinisches Versorgungszentrum for Radiology by Prof. Dr. Uhlenbrock & Partner in Dortmund Hörde. This MCC treats 137,422 patients a year of which 10,920 get a CT-scan, which makes it one of the biggest radiology centers in that area [9].

To assess the efficiency of the CT-processes different questions are aimed to answer. First, how is the process organized and how is the combination of in- and outpatients anticipated? Second, are there problems/bottlenecks with this process that impair the efficiency and what is the source of these problems/bottlenecks? This paper aims to identify problems that occur due to the combination of in- and outpatients at a computed tomography scanner, and to assess the effects of these problems on the process efficiency.

This paper aims to contribute the following:

- Structured analysis of CT-processes in a Medical Care Center
- Identification of possible problems with combination of in-and outpatients at the CT
- Prioritization of problems on the basis of multiple criteria
- Simulation of CT-scan times to asses efficiency

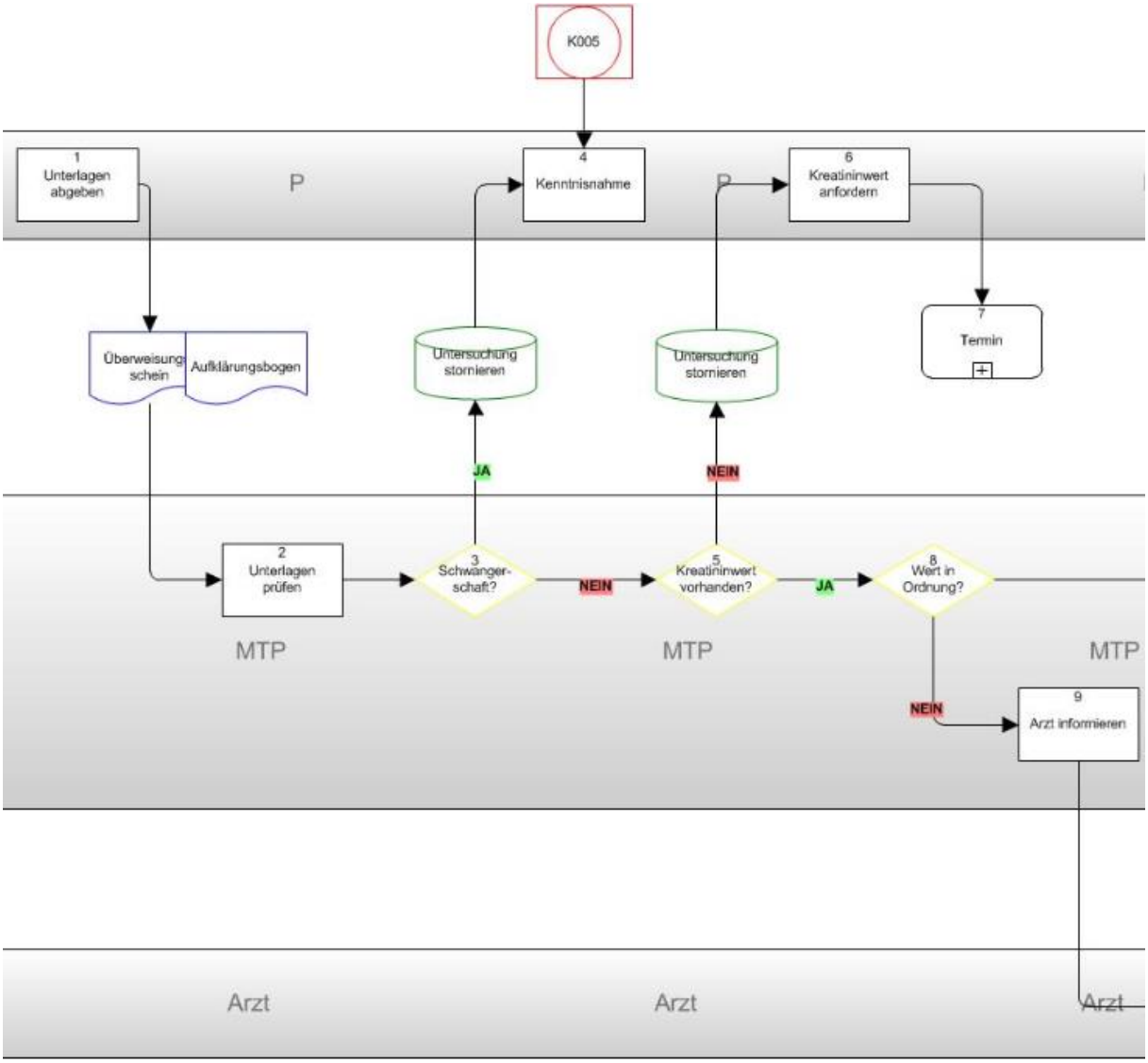
2 Method

2.1 The Process

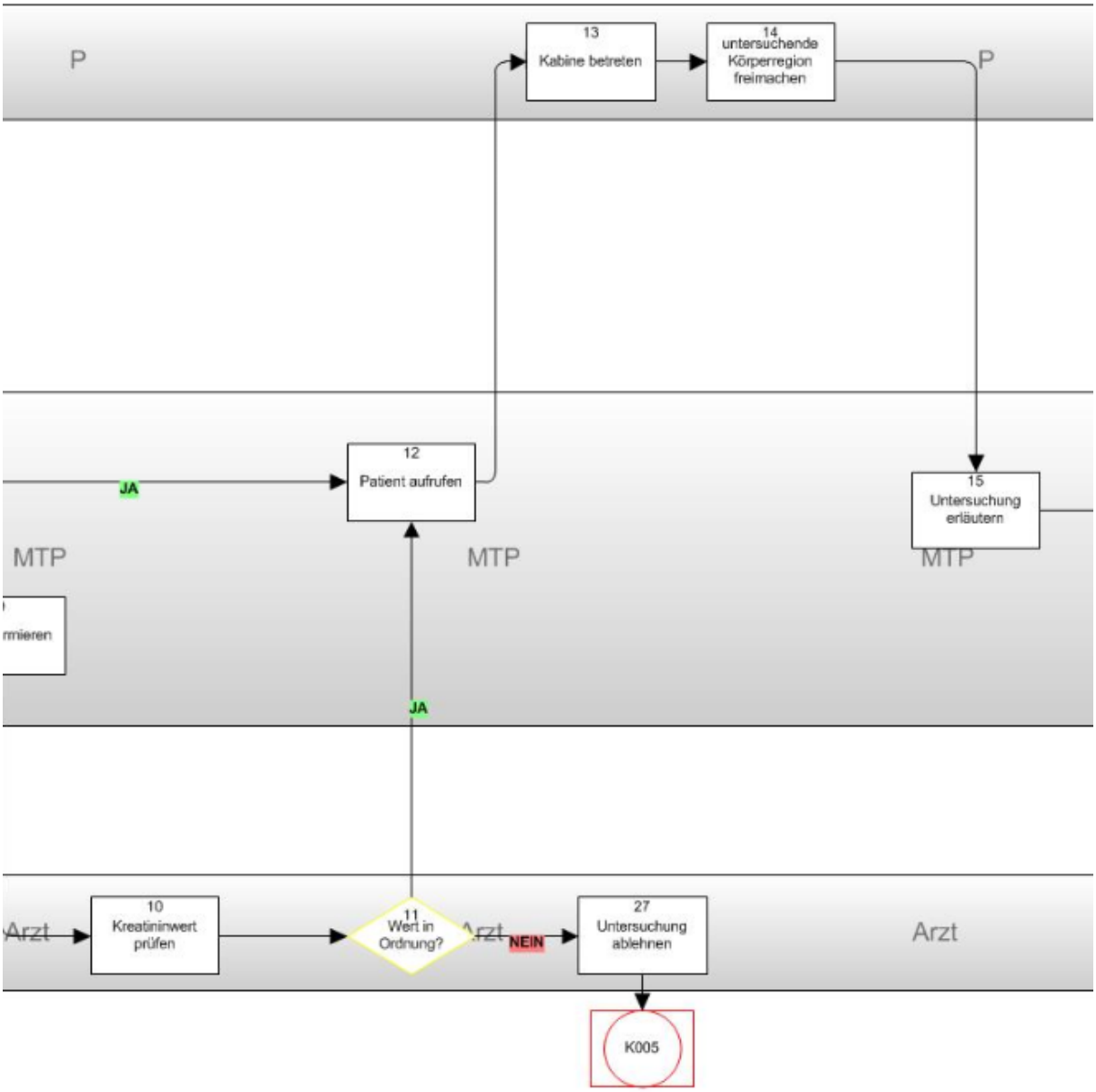
To analyze the quality of a process it is crucial to understand the process. The MCC has been busy with organizing all processes and making flow-charts, so that employees could look these up. They wanted to show everyone how the processes were planned to be and with this everyone had the opportunity to check whether the steps were performed right or not.

One of these flow-charts contained the whole processes for radiology procedures, thus CT, Magnet Resonance Imaging (MRI) and X-ray. They bundled this in one flow-chart, because the processes were generally the same despite the different technology used.

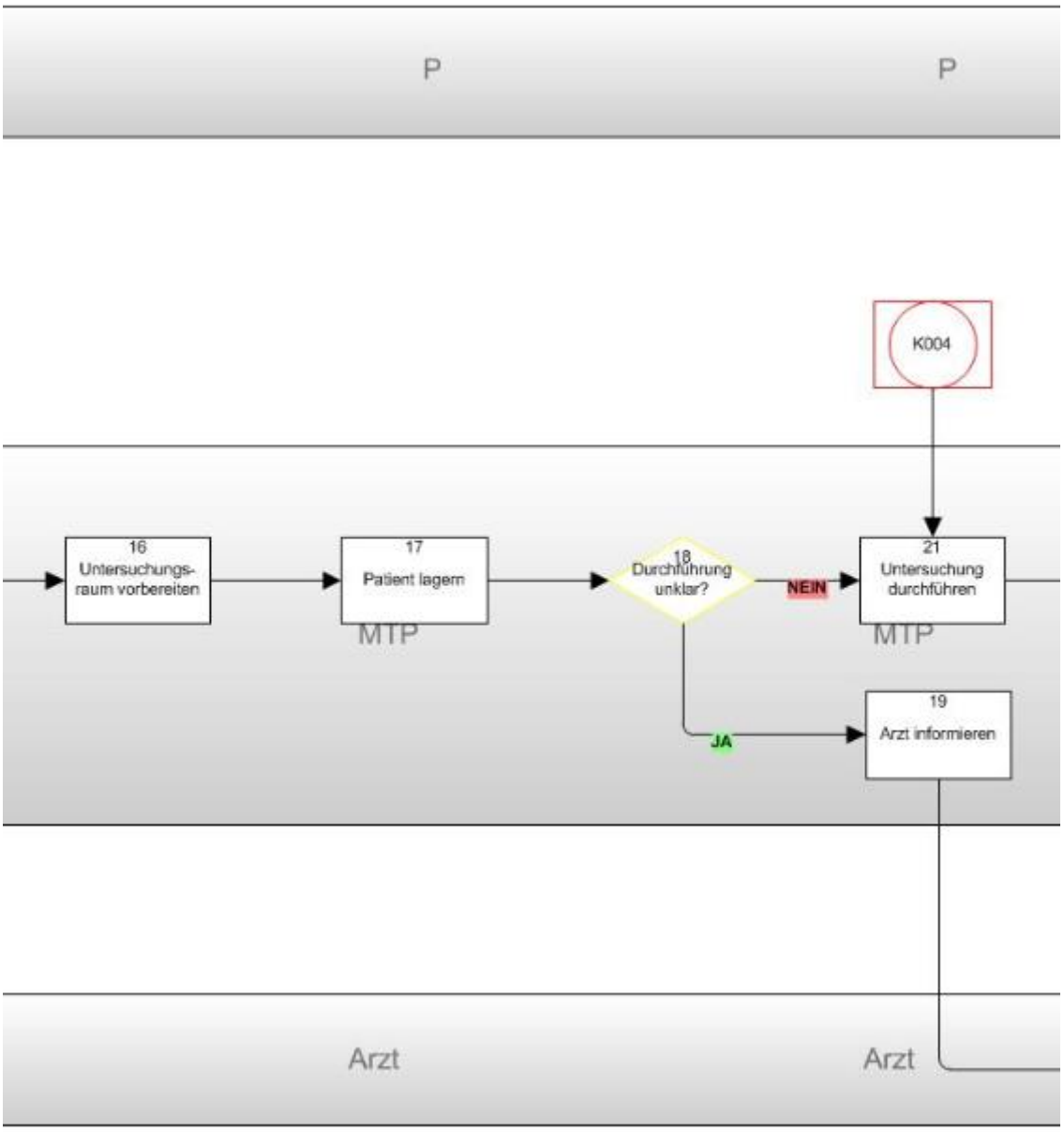
To understand the CT-process this flow-chart was studied. Unfortunately, it only contained the process for outpatients, and thus was lacking information about inpatient processes. To find out more about how inpatients were handled and to see the outpatient-processes in reality, a two-week observational research was conducted. For this, the researcher followed the CT-personnel (everyone who works directly with the CT) over a period of two weeks on every working day from 8am to 4pm. Special focus was put on how the care for both patient types was organized, e.g. which steps had to be taken and which parties were involved, and how the actual work differed from the planned processes from the flow-chart (also, the most important work criteria were observed, see part 2.2). Through this, the everyday work with different patients could be observed and the reality could be compared to the theory. Additionally, the process for inpatients was observed closely to understand how this was planned and how this differed from the outpatient-process. Due to the complexity of the flow-chart provided by the MCC (see Figure 1-4) another flow-chart was made that shows the most crucial steps in the outpatient-process.



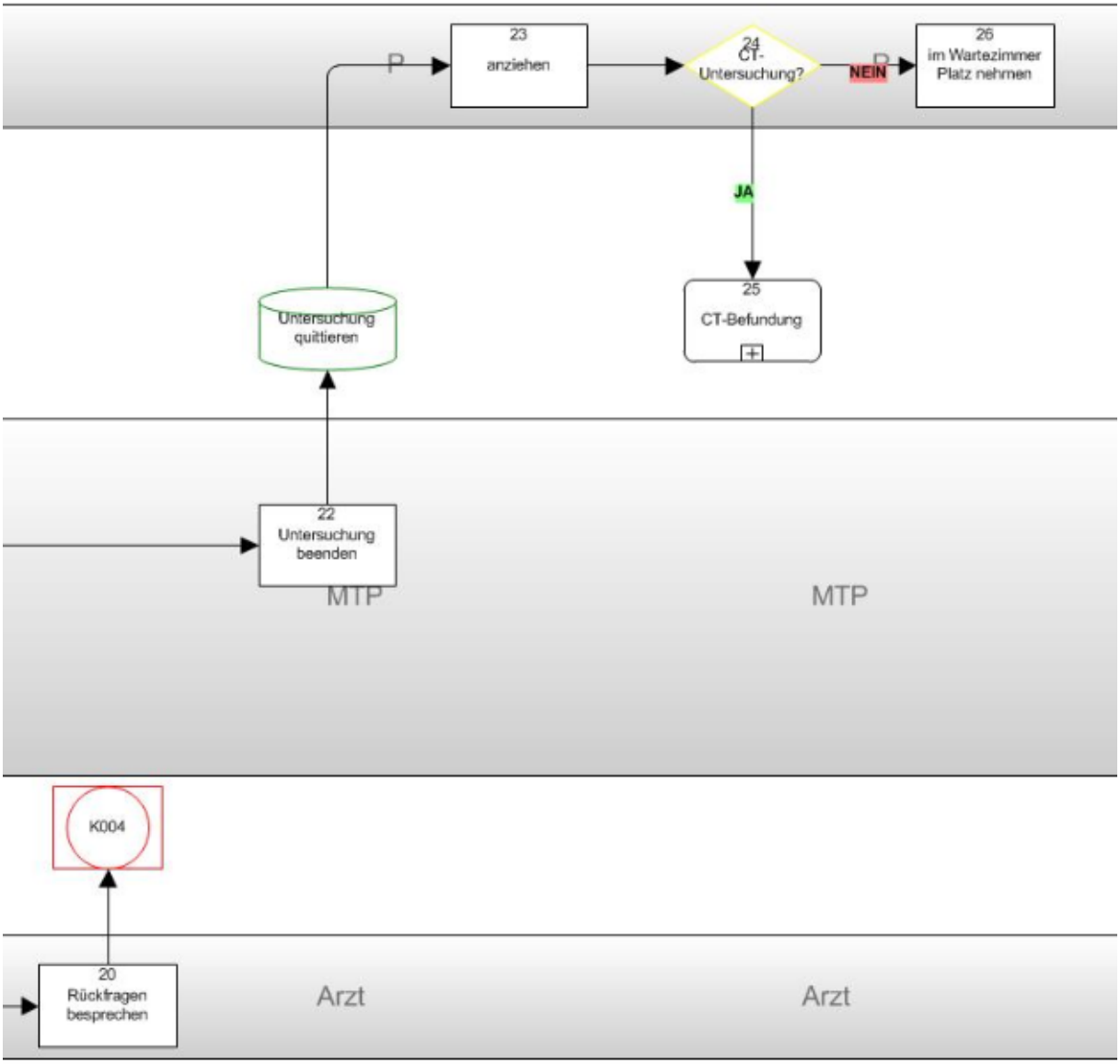
- Figure 1. Radiology Process Flow-Chart of Medical Care Center Part 1



- Figure 2. Radiology Process Flow-Chart of Medical Care Center Part 2



- Figure 3. Radiology Process Flow-Chart of Medical Care Center Part 3



- Figure 4. Radiology Process Flow-Chart of Medical Care Center Part 4

2.2 Problem Analysis

2.2.1 Identification

It was found out that the theoretical and actual process sometimes differ and that problems do occur (see part 3.1). Therefore, it was decided to analyze which problems are present. Semi-structured interviews were carried out that aimed to identify possible problems and to gain detailed background information about the problems and the effects of those.

As only a small group of people could work with the CT and of those only three people worked there on a regular basis, it was decided to interview these three employees. They were the

most proficient concerning all matters of the CT and also had the most experience with problems and how to handle them (in the following text it will be referred to them as “main CT-personnel”). The interviews were carried out during working hours and thus were limited to around 15 minutes. When information was found to be missing after the interviews, additional questions were asked later to obtain more knowledge. However, the additional questions were not taken into account for the analysis, as they were asked afterwards and for clarification.

The analysis of the interviews was carried out according to DeCuir-Gunby et al. [10]. The interviews were transcribed in the original language (German) and can be found under Appendix 7.2.1-3. Then a codebook was developed that focused on identifying problems of process and planning, differences of the patient types and the effects of the problems. The codebook can be found under Appendix 7.2.4. This was done manually and no software was used, because it was only a small number of interviews.

It was chosen to use coding to analyze the interviews because “[c]oding is a heuristic […] and exploratory problem-solving technique […]” [11] that gives one the opportunity to compare interviews on the same basis and to find similarities and discrepancies [11].

The number of problems that were identified and chosen to be further analyzed was limited to five, to set a maximum of different problems and to ensure that a solution finding process could focus on the “main” problems.

2.2.2 Ranking

Through the problem identification, several problems were identified and five main problems were selected based on the most often professed opinion by the interviewees about which problems cause the biggest impairments (see part 3.2.1 for the results). This selection was done to focus on the most important problems for solution finding. Furthermore, it was chosen to also give a ranking to the problems so that a priority list for solution finding could be developed. With this the possible solutions for the most impairing problems could be developed first before focusing on less impairing problems.

The decision making process for the ranking should cover all important factors and criteria so that a one dimensional viewpoint is precluded. A lot of the existing decision making approaches only focus on one criterion and therefore are firmly one dimensional and may miss important points that could have led to a better and more fitting solution. Multi-criteria decision analysis (MCDA) approaches, however, focus on, sometimes conflicting, multiple criteria as the name suggests [12, 13]. In theory one-criterion methods deliver optimal solutions whereas multi-criteria methods give satisfactory solutions based on a compromise. Meanwhile, in reality this compromise means that more parties are satisfied and even slightly conflicting opinions are taken into account [14]. As a MCDA method M-MACBETH was chosen.

MACBETH was developed by Bana e Costa et al. and is an additive value function that weights different options on basis of different criteria and the scores on these criteria. It belongs to the MAUT methods. MACBETH only requires qualitative judgment about differences to quantify the relative attractiveness of the options [15]. Bana e Costa and other researchers applied MACBETH successfully in various different fields [15-18]. For example, Clivillé et al. [17] used MACBETH as a global framework for multi-criteria industrial performance expressions. With this they proved the relevance of this approach and were able to evaluate the knowledge required to perform this method.

Before getting the final results five steps need to be performed to prepare the MCDA [19]:

1. **Defining the decision problem:** What is the relative impact of the identified problems on the efficiency of the health care process?

2. **Selecting and structuring criteria:** As mentioned in 2.1, during the observational research criteria crucial to an efficient working process were identified. Table 1 shows the criteria identified during that period with descriptions. Through a focus group an order of the criteria was worked out. The stakeholders in the focus group were a quality manager, a physician, a patient and a member of the main CT-personnel. They were asked to first give their own preferences according to the order of the criteria. Later they were asked to come to a consent about the order. The result of this focus group can be looked up under 3.2.2.

- Table 1. Criteria and criteria description

Criteria	Description
Mental Impact	Impact of problems on mentality, e.g. distress and anger, of CT-personnel
Extra Time	Extra time caused by problem. Other tasks can be performed but the time planning is messed up
Extra Work	Extra steps/ actions that need to be performed due to problem that would normally not need to be done, e.g. phone calls
Extra Material	Extra material that needs to be used additionally to planned use, e.g. extra catheters
Complexity Solution Finding	Chance that the problem can be solved easily and effectively (“low hanging fruit”)

3. **Measuring performance:** The performance of the alternative problems on the criteria was summarized in a performance matrix. The performance scores were qualitative and were ascertained by asking the main CT-personnel. Data about performance scores by the MCC was not reliable due to a defect in the software and data collection would have cost a lot of time which would have resulted in a lack of time to finish all aims of this paper. Also, the criterion of mental impact can only be measured subjectively and therefore is difficult and therefore is impossible to be given a quantitative judgment when the study population has a maximum of six people that can work with the CT. Fortunately, MACBETH is capable of handling qualitative performance judgments which was proven by Bana e Costa et al. [15]. For example, the main CT-personnel was asked: To what extent does the problem causes extra time? They could answer with no (0), low (25), medium (50), high (75) and very high (100). As in this case the biggest problem was the "best", maximization of the criteria was the aim.

4. **Scoring alternatives:** MACBETH does scoring through direct rating by a visual analogue scale, where in this case no (0) was the lowest value and very high (100) was the highest value with a lineal graph in-between.

5. **Weighting criteria:** The previously mentioned focus group was also asked to perform step four by giving their preferences for changes within criteria. For example, they could say that complexity of solution finding was much more important than extra work but only a little more important than extra time.

2.2.3 Simulation

Efficiency is defined as a level of performance of a process that uses the lowest amount of inputs to create the greatest amount of outputs. The focus group decided that the most important criterion should be time when estimating the impact of the problems on the efficiency of the process (see part 3.2.2 for results). Therefore, input in this case would be time and output treated patients. The more patient can be scanned the more efficient the process is. However, the problems pose a threat to the efficiency of the process. This impact is in fact experienced by the CT-personnel and other professions that work directly with the CT-scanner in their daily work. However, people working in the management do not see this impact. As they make decisions concerning the process efficiency it is important to show them the importance of good solutions for the problems. This could lead to time saved and thus a more efficient process. Therefore, it was decided to create a simulation model of the time needed for in- and outpatient CT-scans. The simulation was made using Microsoft Excel and based on mean data of the needed time with standard deviation (Law & Kelton).

Most of the data needed for the simulation was not available from MCC databases (the defect previously mentioned), and thus CT-personnel was asked to give an educated guess about times of different types of scans. It was chosen to use estimate data given by CT-personnel and not collecting data. This was done due to the high extent of time that would otherwise be needed to collect reliable data which would extent the given time of the research. As the main CT-personnel is the most experienced with the CT, it was decided that the given data would be sufficient. However, three different simulations, an optimistic, a realistic and a pessimistic one, were made to deal with the variance in the data given by CT-personnel. The different simulations are only distinguishable in the used mean and standard deviation of the times for the four patient groups (see table 2). The four groups are outpatients with and without contrast agent and inpatients with and without contrast agent that get a CT-scan. This was chosen because scan time differences are the best distinguishable between these groups.

- Table 2. Mean scan times (standard deviation) in minutes per patient group per simulation

Patient Type	**Optimistic**	**Realistic**	**Pessimistic**
Outpatient without Contrast Agent	5:00 (1:00)	5:30 (1:00)	6:00 (1:00)
Outpatient with Contrast Agent	10:00 (3:00)	10:00 (4:00)	10:00 (5:00)
Inpatient without Contrast Agent	7:00 (2:00)	7:30 (3:00)	8:00 (4:00)
Inpatient with Contrast Agent	12:00 (4:00)	13:00 (5:00)	14:00 (6:00)

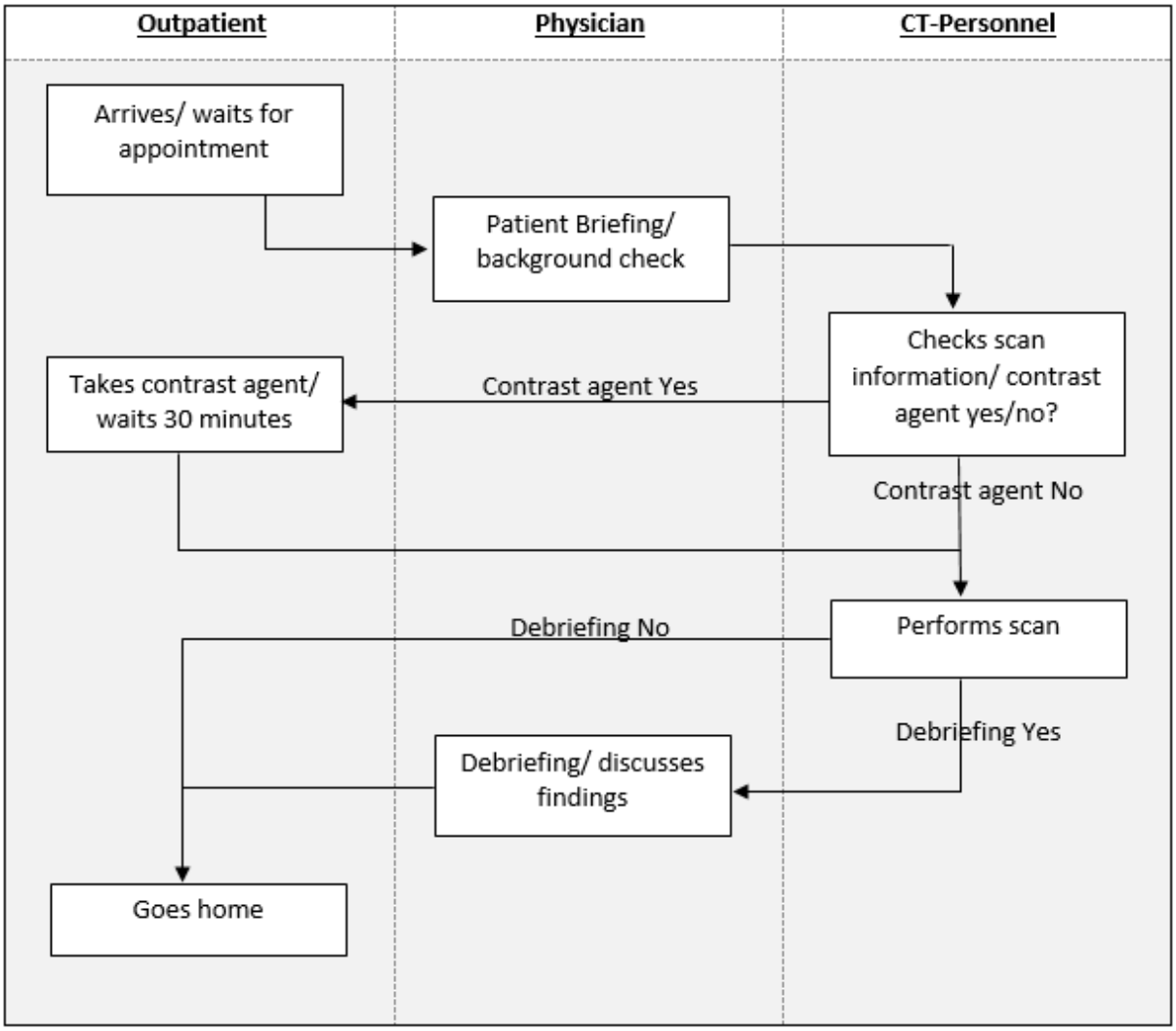
The differences in the three simulations can be described as the less favorable a simulation the higher the mean times and the bigger the standard deviation. Thus, with an estimate time of 5-6 minutes for outpatient scans without contrast agent, the optimistic simulation used 5 minutes whereas the pessimistic simulation used 6 minutes. The simulations were made for a period of 260 days (five workdays per 52 weeks). The weekends were excluded because there are no outpatient services during that time. No warm-up period was implemented because information is directly collected and e.g. queues are not included. It was decided that the data would have a normal distribution. This could be assumed based on the data given by the CT-personnel.

With the simulations the mean outpatient interim time (see 7.1), mean inpatient time (see 7.1) and mean utility, all with minimum, maximum and standard deviation, could be calculated.

3 Results

3.1 The Process

The flow-chart provided by the MCC is very complex and contains all steps from receiving the wish for an appointment to document distribution and all possible exclusion criteria. This flow-chart can be found under Appendix 7.1. For a better overview about the process directly linked to the CT a simplified flow-chart (Figure 5.) was made for the purpose of this paper. It contains only the most crucial steps about the outpatient CT-process.



- Figure 5. Simplified Outpatient-process Flow-chart

First the patient arrives at the MCC at a pre-arranged time and waits for his appointment to start. The pre-arranged time differs between treatments, because when the patient needs to take e.g. a contrast agent he has to arrive one hour to 30 minutes earlier than other patients. Most of the patients arrive at the pre-arranged time or even a little earlier, however, sometimes patients are late which causes delay in the schedule. Approximately one in 10 patients is late.

After that the patient is called up by a physician to come to a consulting room for a briefing during which he checks the patient's background, such as allergies, disease or pregnancy, and explains the following scan. Following this the last specifications for the scan are entered into the system.

When the briefing is over and all information is entered, the system shows that the patient is ready to scan. When the CT-personnel sees this, they check the scan information and also if the patient needs coral contrast agent or not. If the patient is to receive an oral contrast agent, the CT-personnel hands it out to the patient and describes how to take it. The patient takes the contrast agent as described and waits around 30 minutes.

When the patient is fully prepared the scan can take place. CT-personnel calls up the patient, the patient then undresses the affected body region in a separate room and enters the scanner room after the room is prepared. Preparation of the scanner room means disinfecting all surfaces and laying a paper layer on the scanner platform. This takes around one minute. The CT-personnel then ensures that the patient is lying down in the correct manner and starts the scan. If uncertainties occur, a radiologist is called for help, but this is only seldom the case (1-2% of all scans) as there is always an experienced CT-personnel member present.

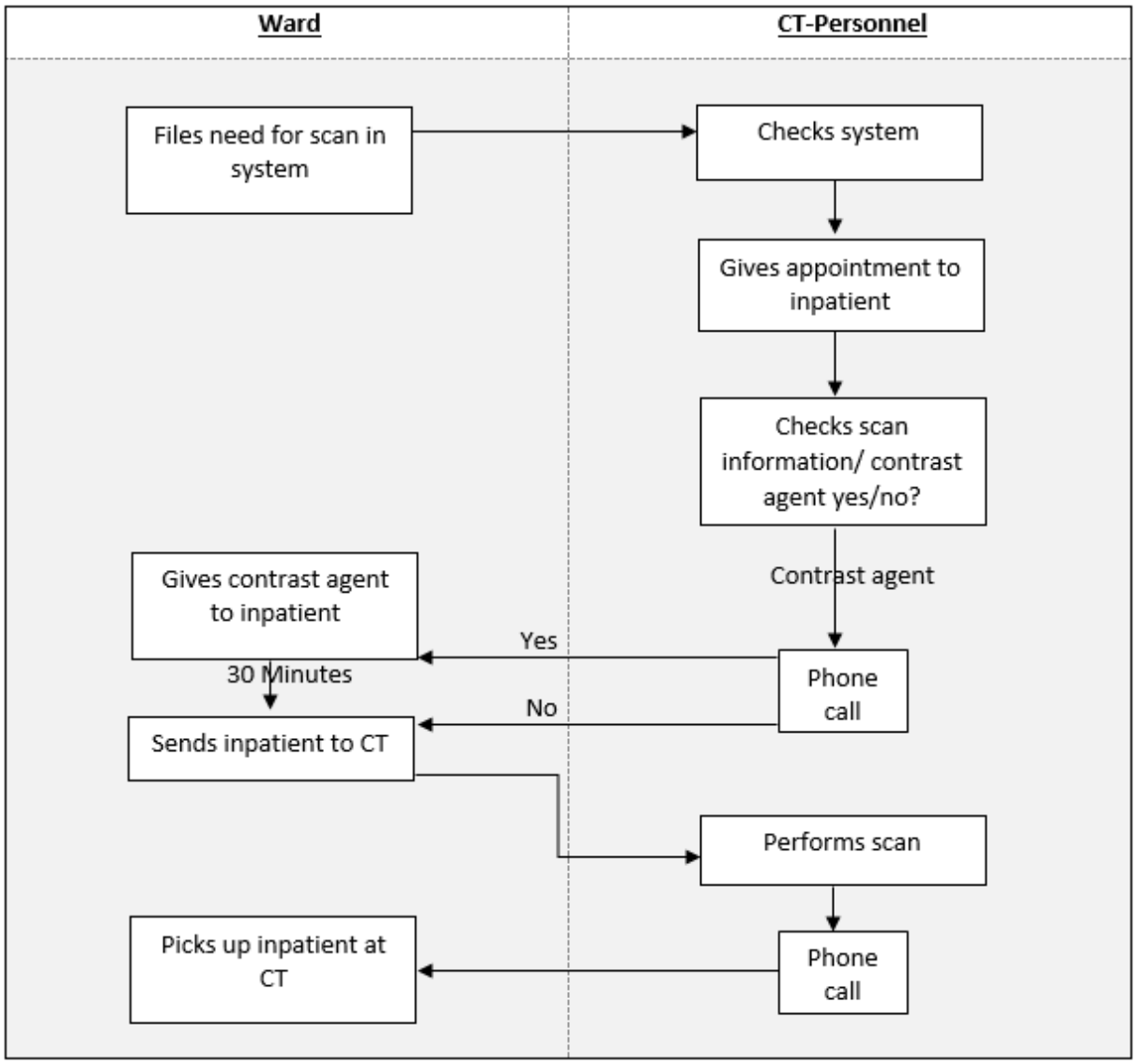
When the scan is finished the patient gets dressed again and is either asked to wait for a debriefing or can go home. Most of the patients can go home immediately because they will discuss the findings with their own physician. Patients who receive a debriefing (10-25%) have to wait until the physicians call them to the consulting room again where they will discuss the findings with a physician of the MCC.

In the observational research the basic process described in the flow-chart could be verified. However, there are some facts too complex or too contingent to state them in a flow-chart. First, emergency patients are unforeseen at the start of a day. Emergency patients enter the MCC whenever an accident occurs, which can be at every time of the day. These patients have, of course, priority, which causes delays for outpatients. The MCC tries to anticipate emergency patients in their planning by reserving time-slots, which helps CT-personnel to find space for emergency patients or take care of earlier delay. However, the number is still unforeseeable as on most days there a no emergencies whereas on other days up to five might occur.

The second issue which cannot be stated in a flow-chart is the human factor. It is possible that outpatients are too late, speak another language, have dementia or are hearing impaired. This can lead to a delay in the planning, preparation or actual scan process. Also CT-personnel can make mistakes through which delay can occur or patient need to be re-scanned. All this is only natural but of course needs to be handled carefully to minimize process-disturbance and adverse events.

The last issue not stated in the outpatient flow-chart is that additionally to 20–35 outpatients per day, around 5-10 inpatients need to be scanned. For this process no flow-chart is provided by the

MCC. However, to give an overview, an inpatient-process flow-chart (Figure 6.) was made, based on observations and personal communication.



- Figure 6. Inpatient-process Flow-chart

Whenever inpatients need a CT-scan this is registered (see 7.1) in the system by the ward. The CT-personnel needs to check their notifications regularly because inpatients can be registered on every moment of the day. It can be assumed that inpatients get registered more after ward-rounds, but it still happens on all times of the day because pre-examination needs to be done and ward-rounds also take a different amount of time on different times of the day.

When the notification has been seen the CT-personnel needs to give the inpatient a time slot (see 7.1) in the schedule. The schedule is build up from time slots which all have an assigned time of 15 minutes. There are four time slots between 13:30 and 14:30 that are reserved for inpatients. This time slot gives the CT-personnel a one-hour range for the inpatients, which makes it easier to plan them just like emergency patients. However, some inpatients get registered quite some time before

the time slot or after the time. Then the CT-personnel uses interim time between outpatients or overtime to treat them. Another difficulty is the unforeseeable number of inpatients. On some days there are only 5 when on other days there will be 10.

Before the scan the CT-personnel checks the scan information and calls the ward when a patient needs to take oral contrast agent. Even though it is protocol that this information is entered in the system, in reality it is often lacking. Up to 50% of all inpatient information is missing, which means that CT-personnel needs to call the ward to get that information.

After all information is available, the ward is called to send the patient down to the CT. This can sometimes lead to problems because the ward either needs to send a nurse with a patient, which is not always possible because all nurses are busy. Or the internal hospital transport needs to be called, which is also busy in a lot of cases. Around 30% of the inpatients get send to the CT later than planned. This results in the fact that CT-personnel needs to scan these inpatients not at the planned time but either sooner or later than what was scheduled.

When the inpatient is present the scan can be performed. This is also more difficult than with outpatients. Inpatient tend to be sicker and older and more immobile than outpatients. CT-personnel needs to place the patient on the CT-platform without the help of the patient. Therefore, starting a scan takes longer than it does with outpatients. After the scan the ward is called again to pick up the patient.

All these issues are solved by the CT-personnel through experience on a daily basis. This leads to stress but also keeps the MCC running. However, steady improvement is necessary to avoid stress and enlarge patient satisfaction.

It can be seen that there are differences in the processes between in- and outpatients, but also in the patient characteristics. Table 3 shows these different characteristics. It emphasizes that inpatients seem to be always worse off than outpatients which makes it not entirely unexpected that there are more problems with the inpatient process.

- Table 3. Main differences of out- and inpatients

	Outpatients	**Inpatients**
Mobility	Good: mobile/ walking	Bad: immobile/ lying
Escorted	Yes: By partner, child etc.	No: only brought to CT by nurse
Plannability	Good: appointment made by patient/ general physician	Bad: filed on the day by ward
Sickness	Moderate	Severe/ co-morbidity
Information	Good: information available in system	Poor: Information late/ not in system

3.2 Problem Analysis

3.2.1 Identification

Part 3.1 shows that there are possible problem sources in the processes of in- and outpatients themselves and in the patient characteristics. To identify the most impairing problems interviews were carried out with the main CT-personnel. The three women had a mean age of 23.7 years and a mean work experience in the MCC Hörde of 2.5 years. The transcribed interviews can be found under Appendix 7.2 in the original language (German).

All three interviewed women stated that they really like to work at the MCC, which is foremost due to the good working climate and the friendly colleagues. However, they all stated, too, that there are problems which need to be handled to improve the efficiency of the process. From the interviews the following 5 biggest problems could be identified:

1. Frequency of missing information on inpatients
2. Frequency of missing information on outpatients
3. Difficult planning and registration of inpatients
4. Frequency of “bad veins” of inpatients
5. Frequency of “bad veins” of outpatients

Even though it seems that there are only three problems that only occur in different patient types it is important to distinguish them. Number 1. and 2. mean that information important for the scan is missing. Such information can be a contrast agent allergy, creatinine level or detailed information about the sort of scan that has to be performed. If this information is missing for outpatients, which does not happen often, they need to call the responsible physician, which means a lot of work as extern physicians are often hard to reach immediately. When information about inpatients is missing, the responsible ward needs to be called which is easier than calling an extern physician but also happens more often, in up to 50% of inpatients.

Number 3. describes the difficulties to give the inpatients a time slot for their scan. The wards can register a patient on every time of the day, but the reserved time slots are only available between 13:30 and 14:30. Patients that are announced before or after this time are normally scanned in interim times between outpatients, or outpatients have to wait if there is not enough interim time. This problem only occurs for inpatients, because outpatients have an afore registered appointment. However, when inpatients are scanned in interim time, outpatients sometimes have to wait for their delayed scan.

“Bad veins” in number 4. and 5. pictures a problem that occurs in all cases where a vein catheter has to be placed. In patients with thin, fragile or mobile veins this placement is difficult and

can take a long time before being executed well. Patients in the MCC get their vein catheter for contrast agent while already lying on the CT-platform. If such a catheter takes a long time to be placed, a delay in scanning can be expected. The problem is divided in in- an outpatient because the severity and frequency differ between these two patient groups.

3.2.2 Ranking

Part 3.2.1 shows that there are indeed problems which impair the efficiency of the CT-process. In this section a ranking of these problems will be given to show which one is the most impairing and which one is the least impairing. Therefore, a MCDA using MACBETH was performed.

Before the software could calculate the different weights for the problem and with this show the ranking, the criteria on which the performance of the problems was scored needed to be ordered according to the preference of the stakeholders. The criteria were: mental impact, extra time, extra work, extra material and complexity in solution finding.

In a focus group the most important stakeholders were asked to give their own opinion on the order of the criteria. The stakeholders were a quality manager, a physician, a patient and one from the main CT-personnel. All of them put extra time as the most important criterion and extra material as the least important one. In between these, the preferences differed. Whereas the main CT-personnel ranked mental impact higher than complexity solution finding, the quality manager and the physician ranked the other way round. The patient did not know which one of the two he should put first but thought that extra work needed to be place two.

After giving their own opinion, they were asked to come to a consent. As the first and the last place were already the same for everyone, there was no problem deciding on these. They also decided to put extra work on place two very quickly. Complexity solution finding was put on third place because the majority then voted for this position. However, the main CT-personnel was not too unhappy about it, because the quality manager could convince her that it is important to solve problems effectively so that there is more room for improvement in other areas.

With this the following order was decided:

1. Extra Time
2. Extra Work
3. Complexity Solution Finding
4. Mental impact
5. Extra Material

Afterwards the scores for the different problems on the criteria could be determined. The main CT-personnel was asked e.g.: *To what extend does missing information on inpatients causes extra work?*

The answers could range between no (0) and very high (100). The performance table (Table 4) shows these scores.

- Table 4. Performance Table of multi-criteria decision analysis

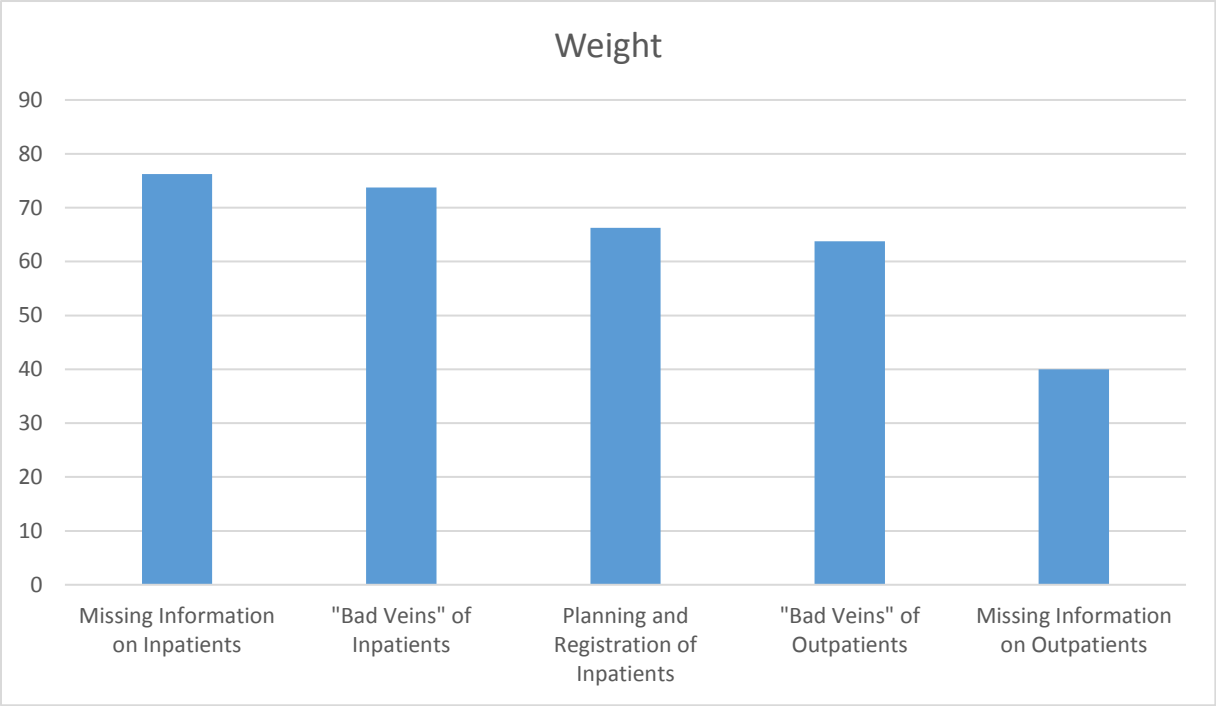
	Extra Time	Extra Work	Complexity Solution Finding	Mental Impact	Extra Material
Info In	75 (high)	75 (high)	75 (high)	0 (no)	100 (very high)
Info Out	25 (low)	25 (low)	50 (medium)	0 (no)	75 (high)
Bad Veins In	75 (high)	75 (high)	75 (high)	50 (medium)	75 (high)
Bad Veins Out	75 (high)	75 (high)	75 (high)	50 (medium)	25 (low)
Register	50 (medium)	100 (very high)	75 (high)	0 (no)	25 (low)

Table 4 shows the performance as defined by the main CT-personnel. It is remarkable that extra material scores very high in missing information for both, in- and outpatients. They explained, that when information is missing they sometimes engage in unnecessary processes, so that material is wasted or that they need to find out the lacking information themselves which costs material that would normally not be used. Also remarkable is the difference in extra material for “bad veins” for both patient types. The main CT-personnel explained that inpatient veins are often worse than outpatient veins, so that when they first try to enter with a needle they have to change the needle later for a tinier one. Whereas, for outpatients they do not have to change the needle that often.

Another noticeable column is mental impact only “bad veins” scored higher than zero. This is due to the fact that this criterion is only about feelings such as anger and distress. The main CT-personnel stated that missing information or inpatient registry is such a normal work task for them that is does not cause such feeling anymore, whereas “bad veins” does, because the patient is in pain when a catheter does not get placed correctly fast which causes stress for the personnel when the process of putting the catheter in does not work as wished.

The results of the other steps can be found under Appendix 7.3. In the software abbreviations were used so that e.g. mental impact becomes impact.

With this the weights for each problem (Figure 7) could be calculated by the software. It shows that missing information on inpatients seems to be the problem causing the most impairment on the process. Missing information on outpatients on the other hand causes the least impairment. This can be due to the frequency that information for inpatients is missing. Also the physicians of outpatients are often not called by CT-personnel, but by personnel of the information desk which lowers the impact on the extra work for CT-personnel.



- Figure 7. 5 main problems of CT process and weights of Multi-Criteria Decision Analysis

3.2.3 Simulation

To assess the efficiency of the process the scan times per patient needed to be examined. Therefore, the standard time schedule for outpatients was simulated over a year (260 working days) for every day. First the scan times of outpatients were calculated by using means and standard deviations with a normal distribution. Then the remaining interim time, thus the time that was over between two outpatient appointments, was calculated. Additionally, the times needed for inpatients for every day over a year (260 days) were also simulated. This was done by simulating inpatient numbers per day through mean numbers and standard deviation based on a normal distribution and then simulating the scan times per patient, also with mean times and standard deviation based on a normal distribution. With this the mean inpatient times per day were calculated. Table 5 shows these results. The PERT-formula was not included as the probability that one of the three situations occur was evenly distributed.

- Table 5. Outpatient interim time per day (mean, maximum, minimum, standard deviation) and inpatient time per day (mean, maximum, minimum, standard deviation) for the three different simulations (optimistic, realistic and pessimistic) in hours

	Optimistic	**Realistic**	**Pessimistic**
Mean Interim Time	4:12:36	3:42:01	3:19:54
Max Interim Time	5:05:09	4:38:28	4:19:58
Min Interim Time	3:33:01	2:54:53	2:32:42
Standard Deviation	0:18:56	0:22:18	0:21:48
Mean Inpatient Time	1:29:13	1:49:46	2:28:43
Max Inpatient Time	4:13:00	4:42:42	6:02:58
Min Inpatient Time	0:11:30	0:00:00	0:08:00
Standard Deviation	0:40:59	1:00:09	1:19:44

The results in table 5. show a decrease in mean interim time the more unfavorable the simulation is: 4:12 hours interim time in the optimistic simulation and 3:19 hours in the pessimistic simulation. The same goes for maximum and minimum interim time. The standard deviation increases from 0:18 hours (optimistic) to 0:22 hours (realistic) and decreases to 0:21 hours (pessimistic). This means that less time between outpatient scans is available for other work and also inpatient scans.

The mean inpatient times increase the more unfavorable the simulations get: 1:29 hours in the optimistic simulation to 2:28 hours in the pessimistic simulation. The same trend can be seen for maximum time and standard deviation. An exception is the minimum time. There the time ranges from 0:11 hours (optimistic), to 0:00 hours (realistic), to 0:08 hours (pessimistic). So not only is there less interim time available, there is also more time needed for inpatients

Table 6 shows the percentages and total numbers of the cases when there was enough time in the simulated year for inpatients; and when there was not enough time. In the table the planned time slot for inpatients (see 3.1) was also included to see if there was a day when this time slot gave enough room for inpatients. This was done by taking the difference of outpatient interim time and inpatient time. The results show that there were no days with enough time for inpatient with only the planned time slack. In all 260 simulated days the time needed was higher than the time given through the time slot.

The times that could be used for inpatients with the optimistic simulation was in 99.6% of the days sufficient and only one day resulted in too less time. With the realistic simulation the number of days with enough time increased to 14, which gives a proportion of 94.6% of days with enough scan time for inpatients. The pessimistic simulation had the lowest proportion of days with enough time from the simulations (71.5%). In there a total of 74 days did not have sufficient time available for

inpatients. This means that even with the most optimistic simulations there was a day when inpatient scans needed to be cancelled or performed in overtime.

All the times calculated with the simulation are only the times where the scanner is in use. In these results the times for other tasks are not included. However, these other tasks are also part of the daily workload which has to be done to ensure a well-functioning process. Other tasks can include billing, recreation of the images, phone calls from or to physicians, wards or other parties included in the process, and distribution of the contrast agent to the patients. Also tasks such as refilling the stock or maintenance work has to be done but not on a daily basis.

- Table 6. Percentage and total number of days when there was (not) enough time for inpatients in a year for the three different simulations (optimistic, realistic and pessimistic) and the time slot for inpatients

	Optimistic	**Realistic**	**Pessimistic**	**Time Slot**
% Enough Time	99.6%	94.6%	71.5%	0%
% Not Enough Time	0.4%	5.4%	28.5%	100%
# Days Enough Time	259	246	186	0
# Days Not Enough Time	1	14	74	260

In addition to the interim time and inpatient times the scanner utilization was calculated (Table 7). Utilization describes the proportion of the available time (10 working hours per day) that the CT-scanner is actually operating. It shows that the more unfavorable the simulation, the higher the average, maximum and minimum utilization, and the standard deviation.

- Table 7. Utilization per day (mean, maximum, minimum, standard deviation) for the three different simulations (optimistic, realistic and pessimistic)

	Optimistic	**Realistic**	**Pessimistic**
Mean Utilization	0.73	0.81	0.91
Max Utilization	1.03	1.14	1.35
Min Utilization	0.54	0.61	0.68
Standard Deviation	0.08	0.11	0.14

4 Discussion

The aim of this paper was the assessment of the process efficiency of the MCC Hörde. The analysis shows that the process efficiency of CT-processes is not optimal. Even though, the outpatients care is organized well, just as expected from a specialty clinic which is in charge of the care of outpatients. The process of inpatient care is less well organized and even less well documented. This leads to some bottlenecks when the combination of the two patient types becomes apparent. This can be due to the uncommon nature of this combination and low experience and possible comparisons. Still, it is important to increase the efficiency of this combination to enlarge the efficiency of the whole MCC. This can be done by solving problems that arise due to this patient combination.

The analysis also shows that problems do occur, which is, in most cases, related to the different processes and characteristics of in- and outpatients. Through the analysis it was found out that there are problems that have a high potential to increase the efficiency if they are solved effectively, namely: Missing information on inpatients, missing information on outpatients, difficult planning and registration of inpatients, “bad veins” of inpatients and “bad veins” of outpatients. If these can be solved the MCC Hörde would be one step closer to the goal set by the legislation to modernize statutory health insurance care [20]. Especially time, or the lack of it, is a great factor to focus on, when trying to improve the process. The simulations showed that it is important to save time by improving the process quality and thus to ensure that there is enough scan time for the amount of patients, which is also in line with the aim of giving enough health care capacity for all patients with statutory health insurance [20].

4.1 Limitations

One limitations of this research is the small number of interviews. Only three interviews would normally be considered as not enough and for research with a larger scale and reach this would be insufficient. However, as this is a case study of only one MCC with only five employees working at the CT on a regular basis, the number of three interviews can be viewed as representative.

The choice of the MCDA method is also a possible source of limitations. All methods have their own pros and cons and characteristics. Different decision making situations need different MCDA methods as Guitouni & Martel describe in their article: Tentative guidelines to help choosing an appropriate MCDA method [14]. Widely used methods, such as Analytic Hierarchy Process (AHP), give the user the advantage of an intuitive structure and easily usable application [21]. Contrary to this, MACBETH is a more difficult application which does not have an intuitive structure. The method needs to be studied well before one is able to use it. The questions can be confusing for the study population and need to be communicated very well to avert errors or mistakes. However, it was checked beforehand if MACBETH would be applicable in the situation at hand and the user of the software had previous successful experiences with the system. It was also checked twice whether the study

population understood the tasks correctly or not. Therefore, I assume that MACBETH was the correct choice for this paper.

Another remark is the quality of the data used for the simulations. Due to various reasons described in section 2.2.3 it was chosen to use estimate data, even though various statistical procedures exist that can handle missing data. The article by Schafer & Graham describes the need for good statistical procedure that handle missing data and analyze the state of the art in this field [22]. Nonetheless, the question here is, whether the existing procedures are applicable in this situation. Normally, they are used in case of partly missing data such as “don’t know how to answer” or “refused to answer”. These cases happen e.g. when only partly answered questionnaires are handed in. However, in the case of the MCC no data at all was given in a reliable manner. Some data could be extracted from the system but mistakes in this data were found or they matched the data provided by the main CT-personnel. The choice to fully rely on the judgment of the main CT-personnel of course limits the quality of the results taken from the simulations. Therefore, the simulations were kept simple and are used only to substantiate the other findings. It was known that time is an important criterion when analyzing the efficiency of a process and the simulation showed that there is not enough time in some cases. This was already expected as the experienced main CT-personnel mentioned it. However, the quantitative data illustrates the problem even more.

If the MCC wants to rely more on the simulations for future research or improvement projects, the simulations should be improved with better data. Therefore, I propose to start collecting more data on patient types and scan times.

Even though the aforementioned limitations do reduce the quality of some study parts, the total outcome can be used in practice, as the identified problems pose a high potential of improvement.

4.2 Implications and Recommendations

The German law GMG (legislation to modernize statutory health insurance care) aims to enlarge the competition of MCCs and therefore rises the need for process efficiency and good solutions to existing problems [20]. Parts 3.2.1-3 implicates that the chance for improvement is present for the MCC Hörde. Therefore, possible solutions were elaborated to be presented to the MCC and point out improvement chances. Part 3.2.2 shows that inpatients add bigger problems to the process than outpatients and therefore it was decided together with the MCC that the solution finding process in this paper will focus on the top three problems. A brainstorm session with the quality manager and the radiologist in charge of the CT was held to discuss possible solutions proposed by the researcher and to eventually find more fitting solutions.

The brainstorm session started with the first problem: missing information on inpatients. Already in the interviews the CT-personnel stated that it is “foremost a communicational problem”. It

was proposed by the researcher to ask the ward to only register inpatients when all information is filled in. Concerns were put forward that this was already sometimes asked but still forgotten. However, the radiologist was positive that constant communication could persuade the ward to deliver all information on time.

Another possible solution, proposed by the quality manager, could be to make it impossible for the ward to file inpatient scans before all information is filled in. This option needs to be checked with the IT department to see if such a hurdle could be entered into the system. Even though this option would solve the problem, the participants were more in favor of the first option, and wanted to talk to the wards first before forcing them. Both options would save time by decreasing the amount of phone calls where CT-personnel had to ask for the missing information. With this the outpatient interim time could be used more efficiently and inpatients could be planned more spontaneously.

As the problem of "bad veins" occurs in both, in- and outpatients, and as the process of placing catheters is very similar it was decided to find a solution for both patient types. Therefore, problem number four was also included in the solution finding process due to the decision made during the brainstorm session. The proposed solution from the researcher for the problem was placing the catheter outside of the scanner room in, for example, a separate room where both patient types would get their catheter. This would reduce the occupation time of the scanner and reduce the total scan time for all patients. It was asked where this could be done and the radiologist proposed the changing rooms for outpatients as a possible place for outpatients because they are already using this room anyway. In the brainstorm session it could not be decided whether the changing rooms are actually a good option, due to their small size and only moderate lighting. A separate room for inpatients could not be identified as the facility of the MCC is already occupied to a high extent.

An option for inpatients would be to place the catheter in the lesser occupied second scanner room. However, when this scanner is also in use or when patients are lying in bed this option is impossible. Another idea was to ask the wards to place the catheter before sending the patient. Concerns were raised that the wards would not want to do this. A conversation with the wards is necessary to find out if this option is realistic or not.

It was also proposed that radiologists and CT-personnel could share the task of placing the catheter. This would reduce the amount of work for CT-personnel and physicians could place the catheter while they brief patients. This is again only an option for outpatients and could be combined with placing the catheter in the changing room.

The last problem discussed in the brainstorm session was "difficult planning and registration of inpatients". As this is a more complex issue, literature about similar problems was used to enlarge the expertise on the field of time slot planning. The literature showed that break-in-moments could be a fitting theory [23]. The paper by van Essen et al. deals with minimizing the waiting times for

emergency surgery. In their case, emergency surgeries start once an ongoing surgery has been finished. This can be translated to the situation at hand. Inpatients can also be scanned once the previous scan has finished. Van Essen et al. propose the use of evenly spread break-in-moments to enlarge the amount of times an emergency surgery can start [23].

At this moment the time slots for inpatients are assembled between 13:30 and 14:30. Therefore, planned break-in-moments are only given in this period. If this amount of time is not sufficient or if patients are registered earlier or later, outpatient interim time is used to scan inpatients (see part 3.1). This leads to waiting times for outpatients and for an unpredictable planning for inpatients. If the MCC could spread the time slots for inpatients more evenly throughout the day it could lead to less waiting times and more predictability. The radiologist also mentioned that even if one time slot would not be used, delay from previous scans could then be lowered. Therefore, it was agreed that the proposed solution would be worth to try out.

After the discussion the participants agreed on trying to recommend the solutions in table 8.

- Table 8. Recommended solutions

Problem	Solution
Missing information on Inpatients	Ask ward to not register inpatient scans before all information is added to system Backup: enter hurdle to system
Bad Veins Outpatients	Use changing room (if possible) to place catheter, divide task of placing catheter between physicians and CT-personnel
Bad Veins Inpatients	Ask ward to place catheter before sending patients Backup: use second scanner room (if possible)
Difficult planning and registration	Spread inpatient time slots more evenly over the day / introduce more break-in-moments

5 Conclusion

The process efficiency of the Medical Care Center for Radiology by Prof. Dr. Uhlenbrock & Partner in Dortmund Hörde is not perfect and has high potential to be improved. Especially by refining the inpatient process time can be saved that is needed to scan all patients.

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7 Appendix

7.1 Definitions

Inpatient Time	Time that is needed to scan inpatients
Outpatient Interim Time	Time between outpatient-scans when the scanner is not in use
Process Efficiency	Level of performance of a process that uses the lowest amount of inputs to create the greatest amount of outputs
Registration	Notification to scan inpatient send to CT-personnel's agenda by ward
Time Slot	Time period of 15 minutes in CT-schedule, every patient gets a time slot; one hour of time slots is reserved for inpatients

7.2 Interviews

All personal data from the interviews was removed due to privacy and secrecy issues.

7.2.1 Interview 1

A.: Was ist deine Funktion im MVZ Hörde?
I1: Patienten annehmen, die vorbereiten, das heißt auf den Tisch legen, Zugänge legen. Halt auf die Körperhöhe einstellen die gefahren werden soll (nennt Beispiele). Dann, wenn ich alles eingestellt habe wird die Tür geschlossen, weil es ja auch halt Strahlung gibt, und dann halt das Programm fahren (2.a).
A.: Warum hast du dich für das MVZ Hörde entschieden?
I1: Also ich war erst beim Orthopäden in der Praxis, aber mich hat das total interessiert an diesen Geräten zu arbeiten. Einfach das mit zu nehmen. Im Praxis Alltag ist das halt so Anmeldung und so, das kriegst du ja schnell hin. Und ich dachte für den Lebenslauf zu wissen, dass man Röntgen kann und vielleicht auch ein CT und MRT fahren kann ist eigentlich praktisch. Das ist halt im Lebenslauf gut und die Leute sehen es halt auch gerne, also Arbeitgeber und so. Deshalb dachte ich es ist ein guter Plan, und nimm es einfach mal mit. Es macht mir bisher auf jeden Fall Spaß.
A.: Nach meiner Woche die ich hier mitgucken durfte habe ich ja gesehen, dass ihr hier sehr viele Patienten habt es aber trotzdem eigentlich sehr gut läuft. Woran glaubst du liegt das?
I1: Erstens daran, dass wir uns hier alle wirklich gut verstehen, wir kommen alle gut miteinander klar und wissen auch alle was die Aufgabe ist. Wir sagen zb morgens der eine setzt sich vor den Computer und fährt alle Programme und der andere setzt rein legt Zugänge und stellt ein. Und wenn das alles Hand in Hand läuft dann funktioniert das auch einfach. Auch wenn es manchmal echt stressig ist, auch zu zweit noch, wenn jeder weiß was zu tun ist läuft das einfach (2.b).
A.: Ich möchte für meine Arbeit gerne mehr erfahren über die Kombination aus ambulanten und stationären Patienten. Wie findest du überhaupt diese Kombination?
I1. Klar wir fangen morgens schon mit 30 Patienten an, überwiegend natürlich aus ambulanten Patienten, wo dann auch noch ein paar stationäre drin geschoben sind. Das ist ziemlich stressig manchmal, weil du weißt halt morgens nicht ob es bei 30 Patienten bleibt oder ob zwischendurch noch mehr stationäre angemeldet werden (3.b/ 4.a)). Klar, können wir nichts dran ändern, wir sind halt im Krankenhaus. … wie ich das finde… also es ist stressig, aber es ist machbar. Und es muss halt gemacht werden.
A.: Wie genau ist das organisiert mit der Kombination?
I1: Also die ambulanten Patienten haben immer einen Termin, melden sich also an und holen sich einen Termin (1.b/ 4.b). Und die stationären werden von den Ärzten angemeldet (4.a). Wir haben jetzt eine Lücke in unserem Terminplan, das heißt wir haben ne Stunde Zeit da werden nur stationäre Patienten angemeldet, ambulante Patienten kommen dort nicht rein. Das heißt wir haben da so eine Pufferzeit, das ist ganz gut, weil in dieser Zeit kannst du eigentlich ganz gut einige stationären Patienten abarbeiten (4.a).
A.: Gibt es irgendwelche Vor- oder Nachteile die dir besonders bei ambulanten Patienten auffallen?
I1: Wir haben ja immer 15 Minuten pro Patienten (4.a/b), manchmal ist das einfach echt nicht machbar (3.c). Wir haben natürlich auch alte Patienten, die brauchen einfach ein bisschen länger (3.a). Die müssen sich ausziehen und so ne. Also ich da kein Problem mit, wenn du alt bist wirst du halt etwas langsamer. Und dann muss man die auflegen, dann findest du nicht direkt einen Zugang. Wir haben ja sehr viele Untersuchungen wo wir Kontrastmittel geben. Manchmal dauert das dann 20 Minuten und dann kommt es natürlich mit jeden 5 Minuten immer mehr in Verzug (3.b). Also

allgemein reichen 15 Minuten aus, weil du hast halt auch manchmal Untersuchungen die laufen in 2 Minuten durch. Ansonsten ist es bei den Patienten halt manchmal stressig aber sonst läuft es gut.
A.: Die gleiche Frage zu stationären Patienten. Gibt es da irgendwelche Vor-, oder Nachteile die besonders auffällig sind?
I1: Was halt wirklich ein Nachteil ist manchmal, die Patienten zu bestellen nach unten. Du hast dann grade einen Puffer von 10 Minuten wo du denkst da könnte jetzt schnell jemand kommen von den stationären Patienten. Dann musst du natürlich erst mal anrufen und dann müssen die Leute auch erst mal Zeit haben den Patienten runter zu bringen (3.d). Das ist halt ein Nachteil, der ist nicht schlimm, aber würde das alles etwas schneller gehen würden wir weniger Verzug haben. Ansonsten werden die angemeldet und… joa ansonsten läuft das ganz gut. Das ist halt nur wie schnell die Patienten runter kommen ob das halt schnell läuft.
A.: das anmelden kommt dann von der Station aus?
I1: Genau, die melden das an, wir ziehen das zu uns rüber und bei Nachfragen rufen wir die Ärzte höchstpersönlich an (4.a).
A.: Gibt es irgendwelche Probleme in der Zusammenarbeit mit den Stationen?
I1: Also es wäre schön, wenn Ärzte von vornherein so den Krea wert eintragen würden. Vielleicht auch den TK wert. Weil wir müssen dann oft halt rum telefonieren und en Krea wert erfragen… das nimmt einfach Zeit weg in der wir halt was anderes machen könnten (3.d). Ansonsten läuft das alles ganz gut.
A.: Und was nimmt so am meisten Zeit weg?
I1: Also das rum telefonieren halt, aber auch schwierige Zugänge. Und wenn Patienten Fragen haben, also das ist ja eigentlich kein Problem ich beantworte die ja gerne, oder halt schwierige Patienten die dir erst ihre gesamte Lebensgeschichte erzählen.
A.: Gibt es denn etwas, dass du gerne Verändern würdest?
I1: ...gut also ich meine, wenn man jetzt so nachdenkt, dass wir wirklich manchmal 40 Patienten am Tag haben, fragt man sich natürlich: kann man nicht irgendwie eine Zeit haben ab wo nicht mehr angenommen werden… was heißt angenommen, wir haben ja auch viele Notfälle… das Problem ist wir müssen die ja drannehmen. So an sich hab ich nichts, das ich verändern würde, weil man kann nichts dran verändern. Du hast nun mal die vielen Patienten, wir sind ein beliebter Standort. Also ändern eigentlich jetzt nicht. Ich mag meine Kollegen und wenn mit denen alles klappt macht das arbeiten auch spaß und dann kriegen wir das auch mit 40 Patienten am Tag hin.
A.: Okay, super. Dankeschön!

7.2.2 Interview 2

A.: Was ist deine Funktion im MVZ Hörde?
I2: Meine Funktion ist es Patienten zu untersuchen, sowohl ambulante als auch stationäre, also alle auch intensiv Station, Notfälle gehören auch dazu. Also für den CT.
A.: Warum hast du dich für Hörde entschieden?
I2: Gute Frage (lachen). Zum einen, weil ich immer schon im Krankenhaus arbeiten wollte. Ich hab ja direkt hier angefangen und ich dachte ich könnte hier viel mehr lernen als in einer Praxis. Und weil es einfach schön nah bei ist.
A.: Nach meiner Woche die ich hier mitgucken durfte habe ich ja gesehen, dass ihr hier sehr viele Patienten habt es aber trotzdem eigentlich sehr gut läuft. Woran glaubst du liegt das?
I2: Wir haben einfach ein gutes Team. Also wenn du eine Kollegin hast die nur auf sich bedacht ist dann läuft das nicht. Bei uns macht einer halt draußen am Computer der den Überblick hat, und der

andere macht halt drinnen, und das ist so Hauptsächlich wie es dann läuft. Du musst dich auch auf den anderen verlassen können (Beispiel krea und Kontrastmittel). Also wir arbeiten Hand in Hand und das funktioniert auch gut so (2.b).
A.: Ich möchte für meine Arbeit gerne mehr erfahren über die Kombination aus ambulanten und stationären Patienten. Wie findest du überhaupt diese Kombination?
I2: Hm, nö. Also mir war das schon klar, weil das halt im Krankenhaus so ist. Wir sind ja eine Praxis die im Krankenhaus arbeitet. Es gibt auch Krankenhäuser die haben nur eine Praxis, ohne dass das Krankenhaus involviert ist. Das schwierige ist halt einfach die Organisation. Also du musst halt organisieren und abschätzen: was ist ein Notfall und was kann noch ne Stunde warten. Wir haben ja viele Notfälle aber du kannst halt nicht 10 Notfälle auf einmal drannehmen und die ambulanten warten 2 Stunden (4.a/b). Da muss man halt abwägen (Beispiel). Die Organisation ist halt da sehr wichtig
A.: Und es ist dann organisiert, dass ihr selbst entscheidet wann wer drankommt?
I2: Genau. (Beispiel Notfall)
A.: Gibt es irgendwelche Vor- oder Nachteile die dir besonders bei ambulanten Patienten auffallen?
I2: Ja die sind halt alle mobil. Außer jetzt Rollstuhlfahrer. Aber ich schätze mal 90% sind mobil (1.b). Ich mein wir haben ja auch Hütte die zählen jetzt auch als ambulant. Aber das ist halt schon ein Vorteil. Die kriegen ein Aufklärungsgespräch, da wird alles vorher abgeklärt mit den Ärzten da sind wir als MTA außen vor. Da muss man dann nicht mehr alles nachkontrollieren wie bei den stationären (4.b)
A.: Und bei stationären Patienten ist dann wahrscheinlich der Nachteil, dass sie weniger mobil sind?
I2: Ja genau. Weniger mobil, nicht ansprechbar, sehr dement, haben keine Begleitperson dabei. ZB die ambulanten kommen ja alle mit Mutter, Tochter oder so (1.a).
A.: Gibt es denn auch irgendwelche Vorteile bei stationären Patienten?
I2: Ja also Blutwerte haben wir immer oder können wir sofort nachfragen. Medikamente können wir auch alle auf der Station nachfragen. Die kennen die ja auch besser. Die Station achtet auch darauf, dass die nichts essen vorher also, dass die nüchtern sind wegen KM Gabe. Ja das ist ein Vorteil.
A.: Wie läuft die Zusammenarbeit mit den Stationen?
I2: Gut. Also wir haben ja auch einen externen Transportdienst, die sind dann nur für den Transport der Patienten zuständig. Dann ruft man den an… ja ist klar manchmal muss man auch eine halbe Stunde warten bis der Patient kommt, aber damit rechnet man, die sind halt nur zu zweit oder dritt für alle Abteilungen verantwortlich. Aber das läuft eigentlich ganz gut. Man kann die anrufen, die geben dir auch direkt alle Blutwerte durch. Man kann auch die Ärzte anrufen, wenn man irgendwelche Fragen halt also das läuft alles gut (4.a/ 3.a/d).
A.: Wenn jetzt etwas passiert, was kostet am meisten Zeit?
I2: Zum einen, wenn man bettlägerige Patienten hat die um zu lagern, oder intensiv mit dem Tower für den Sauerstoff und alles. Oder wenn man bei den ambulanten Patienten keinen Zugang findet, weil die schlechte Venen haben (3.b). Oder wenn jemand auf KM reagiert sagt man ja auch nicht: setzen sie sich mal einfach ins Wartezimmer. Kann man ja nicht machen. Wenn die Angst haben muss man die beruhigen. Das kostet halt sehr viel Zeit. oder wenn die einem ihre Geschichte erzählen, dann kann man ja auch nicht einfach nen strich machen und sagen: so jetzt gehts los (3.a).
A.: Gibt es etwas, das du gerne Verändern würdest? Und wenn ja, was und wie?
I2: Oh das muss ich ein bisschen überlegen. Manchmal ein bisschen mehr Zeit bei manchen Patienten. Wie gesagt, wenn die im Rollstuhl kommen oder sehr dement sind reicht einfach eine viertel Stunde nicht. Sodass man sich ein bisschen mehr dem Patienten widmen kann, das läuft ja hier meistens wie am Fließband. Also das evtl, aber das ist halt einfach nicht machbar, weil wenn du

jetzt einen Notfall rein kriegst kannst du nicht sagen: ich habe jetzt für den aber eine halbe Stunde. Das Team würde ich gar nicht verändern

7.2.3 Interview 3

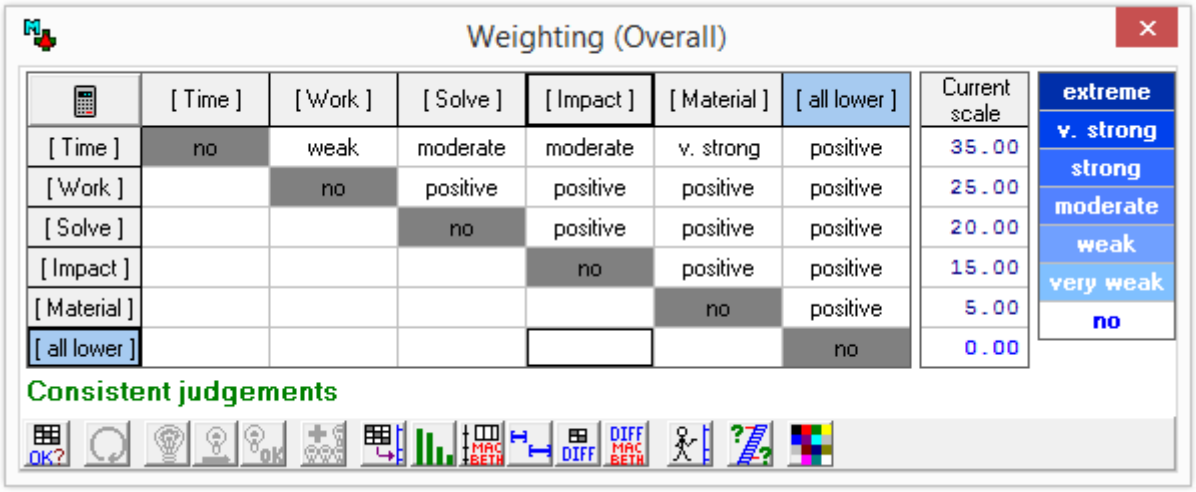
A.: Warum hast du dich für Hörde entschieden?
I3: Warum ist ne gute Frage (lachen). Nee, ich hab ich an einem anderen Standort beworben, da war aber keine Stelle frei. Die Personalabteilung hat mir dann hier eine Stelle angeboten, die ich dann angenommen habe.
A.: Und wolltest du in einem MVZ arbeiten?
I3: Ich habe mich einfach zufällig beworben.
A.: Trotz vieler Patienten läuft das sehr gut bei euch. Woran, glaubst du, liegt das?
I3: Durch das schnelle arbeiten, durch die Hilfe von Kollegen, Zusammenarbeit, Zusammenhalt (2.b)
A.: Wie findest du es, dass es hier so viele unterschiedliche Patienten gibt?
I3: Es stört mich jetzt nicht unbedingt, dass wir so viele ambulante haben, weil es ja nun mal eigentlich eine Praxis wo man ambulante Patienten bekommt. Nur ab und zu mit den Stationären, dass das halt sehr viel ist und man das nicht abschätzen kann wie viel da noch zu kommen. Manchmal finde ich das zu viel aber an einigen Tagen hast du dann irgendwie nur 2-3 und an anderen Tagen dann plötzlich 6-7 oder bis zu 10-11 (3.b)
A.: Wie ist das organisiert?
I3: Wir haben das ja jetzt neu mit einer stationären Lücke, das ist besser als vorher wo wir das nicht hatten. Da kann so ein bisschen besser planen. Die Patienten werden über den ganzen Tag angemeldet, dann kann man die in dieser Lücke planen einige planen und den Rest zwischendurch, und halt Notfälle werden dazwischen gemacht die aus der Ambulanz kommen (3.c/4.a)
A.: Gibt es irgendwelche Besonderheiten? Also Sachen die man zB überhaupt nicht planen kann?
I3: Also planen kann man zB die Notfälle nicht, da ist man dann manchmal schon überlastet kriegt dann noch Notfälle (Beispiel). Dann leiden halt die ambulanten Patienten darunter, aber man kann ja nichts machen, Notfälle gehen vor (3.a).
A.: Was sind deiner Meinung nach Vor-, oder Nachteile bei ambulanten Patienten?
I3: Die meisten können laufen, das ist schon mal ein guter Vorteil. Dass die besser vorbereitet kommen, die kommen ja meistens schon mit den Blutwerten. Dann steht schon genau fest wie was gefahren werden muss. Meistens ist es ja auch weil die Ärzte die Patienten aufklären wissen die meistens schon was zu tun ist (1.b). Ich finde das einfach besser vorbereitet im Gegensatz zu den stationären Patienten die waren angemeldet dann steht da manchmal kein Krea drin kein TSh drin. Da muss man dann hinterher telefonieren, das ist halt ein Kommunikationsproblem (3.b/d). Im Gegensatz zu den ambulanten Patienten da ist schon alles vorbereitet.
A.: Vor und Nachteile bei stationären?
I3: Vorteile an den stationären gibt es nicht unbedingt. Nachteil ist, dass die meistens im Bett kommen, nicht selber aufstehen können, ich mein die können nichts dafür aber das ist halt ein Nachteil was Wartezeit angeht. Die Untersuchung dauert halt länger, man muss die rüber ziehen, dann kommen die unvorbereitet, meistens ohne Zugang den wir dann noch legen müssen (1.a).
A.: Wie geht ihr damit um, wenn die so ganz unvorbereitet kommen?
I3: ja… meisten müssen wir das so hinnehmen. Also bei fehlenden Infos müssen wir hinterher telefonieren, was wieder Zeit kostet oder die Ärztin muss sich darum kümmern was auch Zeit kostet. Wenn die keinen Zugang haben leg ich denen halt einen. Aber wir versuchen halt immer oben zu sagen: bitte Krea, TSH eintragen und mit Zugang nach unten. Das wird trotzdem vergessen (3.d).

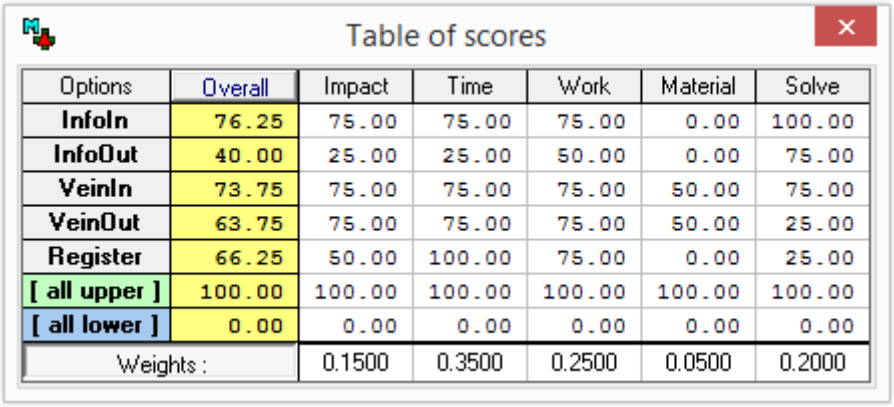
A.: Wie läuft die Zusammenarbeit mit den Stationen?
I3: Schwierig zu sagen… Also was die Kontrastmittel angeht, das haben wir ja auch neu, finde ich viel besser, weil dann vergessen die nicht jedes Mal das KM hier unten abzuholen, sondern geben das direkt dem Patienten (4.a). Der Ablauf ist viel besser. Ansonsten muss ich sagen, wenn man anruft und den Patienten bestellt passiert das nicht. Dann muss man 3-4-mal hinterher telefonieren, das auch immer anstrengend ist (3.d). (Beispiel mit stationärer Patient kurz vor Feierabend)
A.: Was ist am Zeitintensivsten?
I3: ja, schlechte Venen (egal ob A oder S) das ist sowieso schon ne Katastrophe (3.b). Ja ab und zu wenn die Aufklärung nicht stimmt dann kriegen wir zu spät die Unterlagen, dann fangen die zu spät an zu trinken oder es kommen 3-4 Patienten auf einmal, fangen dann gleichzeitig an zu trinken. Wir müssen dann halt den Patienten der zuerst den Termin hat zuerst drannehmen. Aber der andere wartet halt so lang und beschwert sich dann. Das bringt den Ablauf durcheinander. Und halt die Notfälle dazwischen (4.b/ 3.b)
A.: Gibt es etwas, dass du verändern wollen würdest? Und wenn ja was und wie?
I3: Verändern würde ich ambulante Patienten, dass die mehr Zeit dazwischen haben. Also manchmal ist 15 Minuten einfach nicht zu schaffen. Wenn alles gut läuft schafft man das. Also die stationäre Lücke ist wunderbar da muss man nichts verändern. Dass man das mit den Stationen nur besser abspricht, dass die nur mit Zugang Krea und TSH runterkommen, sodass man erst gar nicht hinterher telefonieren muss. Ich mein das ist Kommunikation, das ist einfach zu lösen. Und das man guckt wie man die Untersuchungen plant. Nicht 10 Abdomen hintereinander, sondern dazwischen auch mal native Untersuchungen, damit man Zeit aufholen kann

7.2.4 Codebook

Domain	Subdomain
1. Patient Characteristic	a. Inpatient b. Outpatient
2. Work	a. Tasks b. Environment
3. Problem	a. With patients (annoying) b. With patients (problematic) c. With process (at CT-scan) d. With process (with collaboration)
4. Process	a. Inpatients b. Outpatients

7.3 MACBETH





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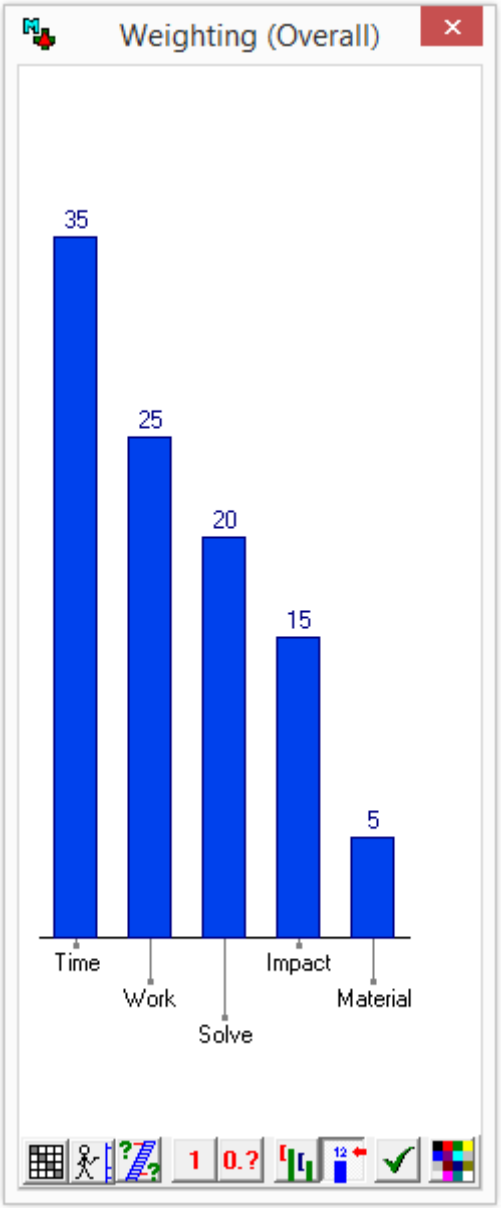
InfoOut	40.00	25.00	25.00	50.00	0.00	75.00
VeinIn	73.75	75.00	75.00	75.00	50.00	75.00
VeinOut	63.75	75.00	75.00	75.00	50.00	25.00
Register	66.25	50.00	100.00	75.00	0.00	25.00
[all upper]	100.00	100.00	100.00	100.00	100.00	100.00
[all lower]	0.00	0.00	0.00	0.00	0.00	0.00
Weights :		0.1500	0.3500	0.2500	0.0500	0.2000


Weighting (Overall)
35
25
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15
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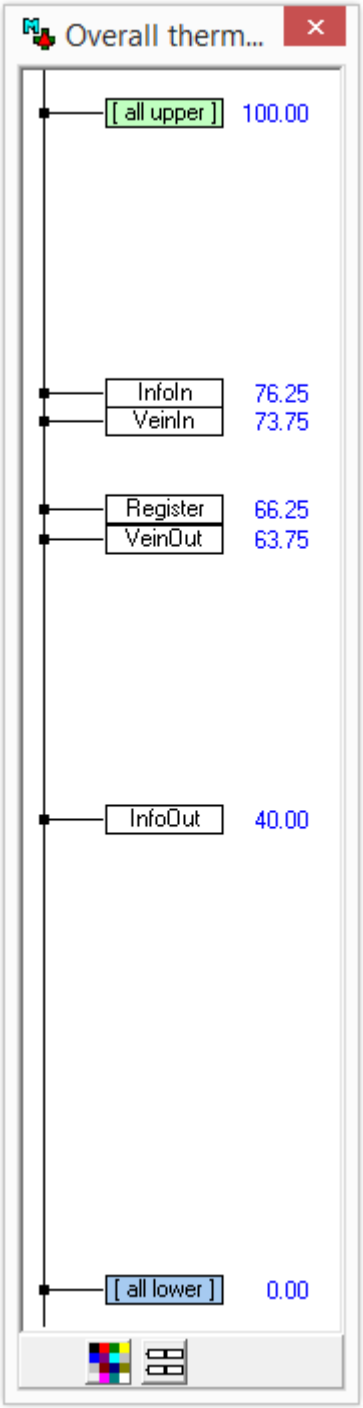
Time
Work
Solve
Impact
Material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