Benchmarking food logistics of Dutch hospitals

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"Vision without action is just a dream

Action without vision is just activity

Vision and action together can change the world"

Joel Barker President infinity, Ltd.

Preface

As part of graduating and obtaining a master degree of Industrial engineering and management a individual research has to be conducted with the aim of improving circumstance(s) within a company or industry. For this purpose I have been working together with IFC, a consultancy company for hospitality located in Almelo, and AMC, a university hospital in Amsterdam. My goal is to find solutions that will help to improve AMC's current food logistics as well as to provide insights for the development of a new food concept. To achieve this goal I have benchmarked several Dutch hospitals.

During the assignment I have met a large group of people, full of energy and the will to increase the quality of life of the patients in their hospitals. I thank each of the persons I have met. In particular I thank the following people.

Wendy Haas, for being my colleague for the first part of the research and for her optimistic spirit during little stagnations within the research.

Mathieu van der Maat, my supervisor from AMC for always giving positive critique and guiding us through the process.

Hans Woolderink, my supervisor from IFC who initialized this project and thus made it possible for me to complete my studies.

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Theo Lescure

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Management summary

Research goal

Due to decreasing government funds for hospitals, AMC, the academic medical centre of Amsterdam, wants to reduce costs involved with patient services while increasing hospitality by optimizing the food logistics. To achieve this, a new concept for food logistics must be development and evaluated. IFC, a consultancy company that specializes in health care hospitality, has been tasked by AMC to assist with this. The objective of this joint AMC-IFC research is split into two parts. The objective for part I and II are the following:

Part I: Create an overview of the current process and the opportunities for improvement.

Part II: Provide solutions to increase the efficiency of the current food logistics and provide recommendations for the food concept in development.

Approach

No clear overview of the current food logistics process is available. Therefore, an analysis of this process is conducted first. After that we focus on finding a solution to occurring problems.

Approach part I:

In order to create an overview of the current process, we apply the management framework of Hans, Houdenhoven & Hulshof (2011). To fill in the framework we make several observations. First, we identify the stakeholders and determine their position, which is done using the typology of Mitchell, Ange & Wood (1997). By holding interviews with the stakeholders, key performance indicators (KPIs) are composed. These KPIs help to identify where AMCs priorities lie when rating the food logistics process effectiveness. Second, we make observations in the food logistic process at AMC. Third, we identify how the food logistics are planned and controlled. After completing the three steps we can fill in the framework and are able to analyze the horizontal and vertical connections between the planning and control functions. After performing a baseline measurement we are able to compose a problem cluster and find the opportunities for improvement.

Approach part II:

In order to provide solutions we perform a benchmark of the Dutch hospital's food logistics. To design the benchmarking study, we first research relevant literature. Based on the work of Hoorn

(2005) and Watson (1993) we formalize and construct a benchmarking approach. The most important step in our benchmark is to split the logistic process into smaller sub process and benchmark each of these individual functions in order to improve the overall process. We split the process into five sub processes and additionally we elaborate more on warm meals after we discussed the five sub processes. The five sub processes and are:

1. *Storage*
2. *Goods receipt*
3. *Ordering process*
4. *Food logistics on the wards*
5. *Reverse logistics*

The benchmark is conducted at eight Dutch hospitals. Due to time constraints of the research, we performed interviews with stakeholders instead of forming a task group and conducting a complete benchmark. These stakeholder are the service managers of the participating hospitals.

Next to benchmarking Dutch hospitals, we also interviewed the suppliers of AMC regarding how effective, based on their experience, the food logistics at AMC are. The suppliers of AMC also supply other hospitals and nursing homes making their opinion on food logistics within healthcare a valuable source of information.

Results

The results are discussed per part. The first section of Part II focuses on the current food logistics. The second section of part II details the expected results of the food concept being developed.

Results part I:

We now have a clear overview of the current logistic function at AMC. The more prevalent problems we found from the problem cluster are:

- **Storage function**
- **Ordering process (within the food logistics)**
- **HACCP compliance, which jeopardizes the service rounds being on time**

HACCP stands for Hazard Analysis and Critical Control Points. This is a systematic preventive approach to food safety and biological, chemical, and physical hazards in production processes that can cause the finished product to be unsafe. HACCP encompasses measurements to reduce these risks to a safe level. The challenge AMC faces, due to the amount of time the products are exposed to

normal temperature before placed in cooled storage, is keeping product temperature under the mandatory safety threshold temperature.

Results part II, improving the current food logistics at AMC:

A solution to the storage function at AMC can be found in J.W. Haas (2013), so we shall focus on the ordering process and HACCP compliance. During the benchmark we found that many hospitals are removing the food administration from the ordering process. In most cases the food administration is tasked with checking the orders before they are sent to the supplier. By giving food assistants the freedom to directly order from the suppliers some handling is removed from the ordering process. The benchmark proved that this way of operating works.

AMC is unique in facing a problem with HACCP compliance, which arises from having a completely decentralized storage system for storing the wholesale function. Three possible solutions are found:

1. **Invest in a central cooling storage where the products can be stored temporarily.**
2. **Invest in cooling trolleys which can be used by the supplier instead of regular trolleys to deliver the products.**
3. **Deliver the products at a later time during the day.**

The first two solutions solve both the HACCP compliance and the endangerment of disrupting the primary process, being the service rounds. However, for these solutions to be viable, large investments are needed. The third solution only addresses the issue of the endangered primary process, doing less to solve the problem concerning HACCP. This third solution requires a lower investment however, and we verified that the supplier supports this solution.

Results part II, providing insights for a future food concept:

Several insights are gathered from the benchmark:

1. MST is building a new hospital in which they will implement a food concept that closely resembles what AMC is developing as their future food concept. This makes MST a good partner to perform a follow-up benchmark.
2. In order to improve patient ordering by implementing a digital ordering system, another option is to make use of a call centre. Using a call centre is a cheaper investment than using a digital system and also keeps a human touch on the ordering process.

3. The use of service employees is a trending topic in hospitals and each of the participants agreed with the increase in hospitality these service employees provide.
4. Going from premade cooled “warm meals”, which are regenerated before being served, to a self supporting kitchen will improve the service the hospital can offer concerning dinner. As hospitals can offer a wider choice of component composition for warm meals, as well as have a stronger influence on portion sizes.
5. Another topic centred around warm meals is the use of time blocks that allow patients to eat at desired times instead of at a fixed time that might not represent their regular eating pattern. Even though hospitality can be increased by letting patients choose at what time they would like to eat it creates several problems of its own. This was discovered by UMCN, which experienced problems on group rooms. Due to having an number of rooms for multiple patients the processes around dinner and nursery kept colliding during the dinner times due to the variability in eating time, but fixed times of nursery tasks. UMCN quickly aborted working with a food concept that contains time blocks.

Recommendations

We advise that AMC removes the food administration from the ordering process, to decrease the handling in the ordering process. Second, AMC should look into the possibility of having the supplier deliver at a different time. Doing so will create less stressful hours in the morning for the food assistant and make sure that hospitality remains a priority. If this is not possible due to the internal logistics streams, investing in cooling cars or a central cooling should provide the same result, however these solutions require a bigger investment.

For the long term process improvement we recommend AMC to study the experiences of MST. This will allow AMC to analyze what problems MST has encountered, and adjust their strategy accordingly. The use of time blocks is a subject discussed by most hospitals. However, looking at UMCN, we recommend AMC do not recklessly implement them. A pilot will be needed to make sure that the jobs of the nurses and those of the food assistants can still be run in parallel without conflicts. As for patient ordering, we recommend that AMC take call centres into consideration as a viable alternative to digital ordering. These call centres might prove to require a smaller investment while prove to be more user friendly. Finally, we see that service employees are playing a more important role in Dutch hospitals and we therefore encourage AMC to continue their efforts in creating a service employee education program.

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Part I

Preliminary Research

Analyzing the current food logistics at AMC

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1 Introduction

In Section 1.1 we describe why the research is conducted. Section 1.2 gives a brief background of the parties involved. After that the problem description is given in Section 1.3, followed by the research objective in Section 1.4 and the research questions in Section 1.5. Finally, Section 1.6 explains the methodology to be used in Chapter 2 to describe the current situation.

1.1 Motivation

Hospital food, school meals, and other institutional catering share a reputation for predictable awfulness (Bender, 1984). 23 years later, patient meal delivery systems in healthcare still produces low patient satisfaction scores in comparison to the scores achieved by other hospital services and departments (Schirg, 2007). Customer expectations have risen over the years. At first room service was a 'nice to have'. Now it is the industry standard; patients are expecting options and quality to be the norm, rather than being surprised by it (Aase, 2011). Besides, reducing food waste has become a priority in hospital food service management (Williams & Walton, 2011). The challenge for healthcare organizations during the upcoming decades is to deliver more patient care of higher quality, while efficiently allocating less financial and human resources.

1.2 Research Context

We perform this research project at the Academic Medical Centre (AMC) in Amsterdam, one of eight academic hospitals in the Netherlands. As academic hospital, AMC has three major tasks. Its first and primary task is patient care. Furthermore, since the hospital is linked to a university, it educates and trains medical students, and carries out medical research. Finally, AMC performs top referent care: special, mostly expensive, complex, diagnostic procedures and treatment. Their focus is so much on research and education the knowledge- and specialization level of the hospital are much higher than within local hospitals. It is because of this specialty that patients are referred to an academic hospital by their physician. AMC treats 56 thousand patients annually. As 'general hospital' for the population in the hospital's catchment area, only about 60% of the patients visit AMC for top referral patient care. In 2011, AMC counted 1,002 hospital beds, they performed 387,549 outpatient visits, 31,086 day care admissions, and 30,129 clinical admissions accounting for 202,560 patient days (Academic Medical Center, 2012).

AMC states that 'a professional organization that wants to be innovative, should value the improvement of various internal processes higher than the apparent convenience of old habits'

(Academic Medical Center, 2012). This statement creates the mission and policy principles for the upcoming five years. More specific, AMC wants to distinguish based on quality improvements using research and they need to improve on facility services. A solid financial policy is one of the important boundary conditions in realizing strategic goals. One of the first activities was therefore the collaboration with the VU Medical Centre (VUmc) into 'Alliantie AMC-VUmc' in 2011 (AMC & VUmc, 2011).

Within AMC the department of 'directorate services' is, among other areas, occupied with all logistic functions around food. Their mission statement is based on providing the best hospitality for patients as well as employees, which they tend to achieve with well working logistic functions and movements. Their vision based on the food provision is to provide an optimal amount of nutrition to the patient to speed up their recovery and prevent complications (AMC, 2013). These mission and vision statements will prove important for our research as our solutions will only be of use when they are in line with these statements.

1.3 Problem Description

Plans for a big renovation of AMC makes that the current food logistics has to be analysed. Aimed to make improvements on the short term, but in the end to advice AMC how to organize a new food concept. Analysis of the current food logistics learns that there is a discrepancy between the current situation and the desired situation regarding the food logistics of AMC. However the main problems in the process of AMC's food logistics are not known on forehand. Therefore in research question two we will do research into this.

1.4 Research Objective

Our research objective is to map the current performance of AMC's food logistic function to make a contribution in organizing this logistic function efficiently and identifying the bottlenecks to give advice on how to optimize the current system.

1.5 Research Questions

1. **What is AMC's current situation of the (food) logistics?**

To have a good overview of the current situation we observe the activities of AMC's food logistic processes and interview stakeholders. Chapter 2 then gives an overview of the main characteristics of the system based on process (2.1), performance (2.2) and management (2.3). We make a

flowchart of the different processes, elaborate the Key Performance Indicators (KPIs) of the relevant stakeholders, and use the framework for health care planning and control of Hans et al., (2011) to structure the various planning and control functions and their interactions.

2. **What are AMC's main problems in the process of (food) logistics?**

This question answers which problems occur within the logistic processes and which problems

are out of scope for this research. Therefore we make a problem cluster (2.4) based on the answers as found in the previous research question. We make a distinction between the costs of the food logistic services and the hospitality, defined as the discrepancy between the product and patient wishes, as counterparts in the hospital food service.

3. **How can AMC's current performance of the food logistics be improved?**

The third question focuses on finding improvements to the current situation based on the problems found in the second research question. To justify which problem we choose to focus on we investigate which core problem, that can be influenced, has the highest contribution to solving the main problem. Since our main research has to result in two separate master theses we split this research question into two different paths so that we can work on this last research question individually.

1.6 Methodology

To reach answers on our first research questions we undertake three separate activities. First we do a stakeholder analysis to ensure that we interview the most important people for our research. The interviews together with our own observations results in a process flow of the current situation of AMC's logistic function concerning food including information about product mix, demand and supply. Together with the map of the global structures and organizations we come to an answer on the process part of the first research question as elaborated Section 1.6.1. Second, we use a framework for health care planning and control (Hans, Houdenhoven, & Hulshof, 2011) developed for mapping organizational structures within hospital or health care organizations. This framework provide guidelines to systematically map details around the current food process and give us information about the management of AMC's logistic function concerning food as answer on the management part of RQ 1 as described in Section 1.6.2. Third, in Section 1.6.3 we bring in theory about the performance measurement. For which we need to elaborate further on stakeholders, Section 1.6.4 and KPIs, Section 1.6.5 as method to research the third part of RQ1. As we need a clear

way of identifying the KPIs we refer to theory on how we done this in Section 1.6.6. Finally in section 1.6.7 we make a bridge to the next chapter on how to use the theories in practice.

Information on the three aspects process, performance, and management is useful to identify bottlenecks. To provide a structured overview of these bottlenecks we make a problem cluster as method to answer question 2.

Research question 3 is a demarcation of our research based on a consideration between the core problems. Our individual thesis shows which problem to solve to realize the highest contribution at the lowest costs.

1.6.1 The business structure

According to Slack, Chambers & Johnston (2010), figure 1 visualizes an organization. In its very basic form an organisation can been seen as a "black box" that transforms resources into an output. Based on these output one can measure how well, efficient and effective this black box has operated.

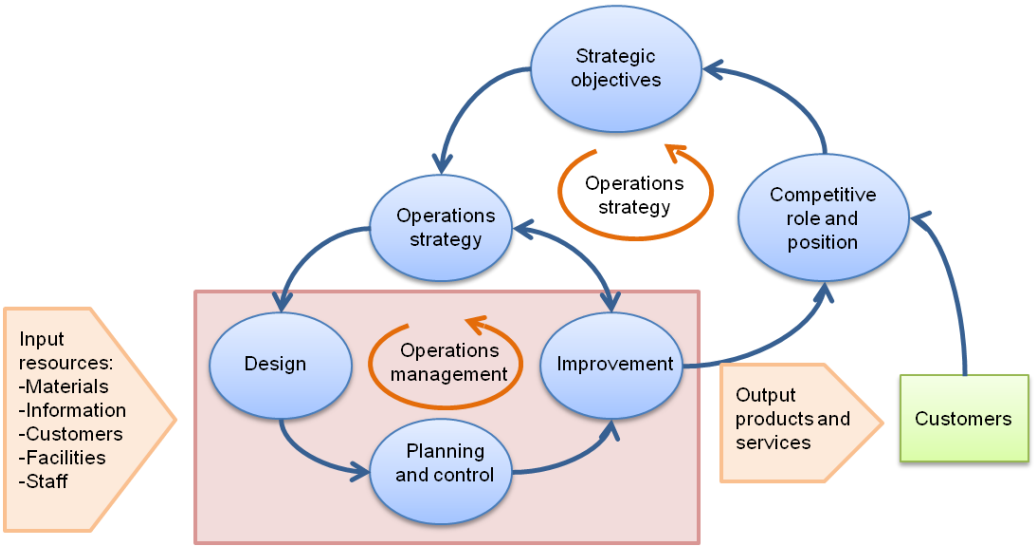

Figure 1: Operations Management Map (Slack, Chambers, & Johnston, Operations Management, 2010)

All of these boxes are correlated. In order to improve the output of an organization we first need to look at the current performance by measuring the current output. Then look at the process (how are things done?) and the management (how is the process planned and controlled?) within the organization. Comparing the output with the output when changes are made to the process and/or management shows the improvements of the system. In practice changing management is of most influence as they decide what process to use.

1.6.2 A framework for mapping the current process and management functions

According to Hans, Houdenhoven & Hulshof (2011) most known frameworks for planning and control within business are only focused on specific managerial functions. This has the drawback that the frameworks are not behaving that adequate in practise. Therefore within this article a proposition has been made for a framework that focuses on all managerial aspects at once and focuses on use within the health care sector. So either hospitals or health care centres should be able to use the framework as shown in figure 2.

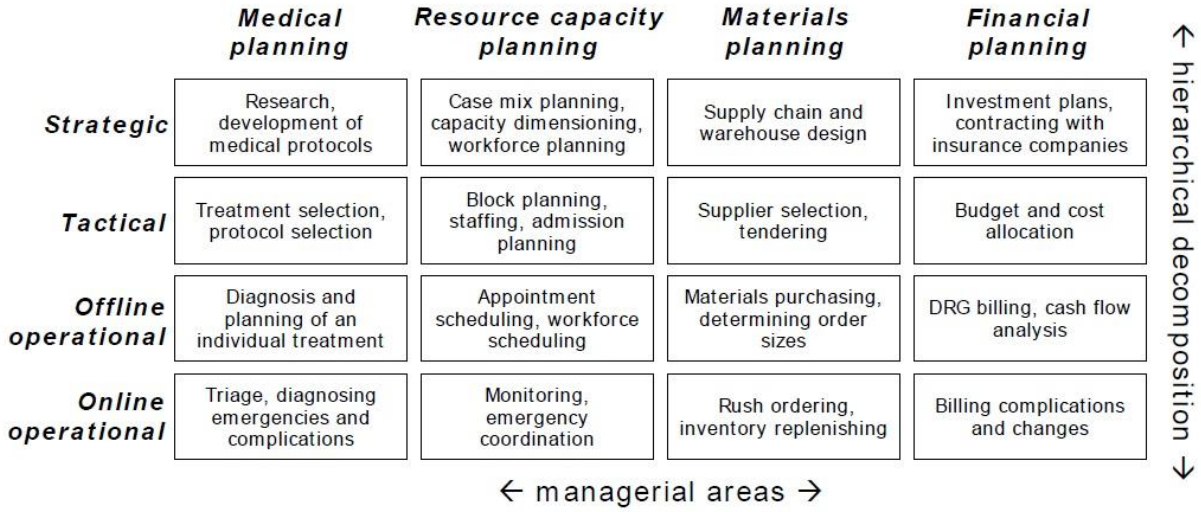

Figure 2: Example application of the framework for health care planning and control to a general hospital (Hans, Houdenhoven, & Hulshof, 2011).

The framework integrates all managerial areas (horizontal) and involves all hierarchical levels of planning and control (vertical). The vertical axe is subdivided hierarchically into three levels: strategic, tactical, and operational where operational is distinguished in offline (in advance) and online (reactive) planning. Below we give a description of each of the 8 attributes placed on the axes of the managerial table.

The managerial areas have the following meanings:

- **Medical planning:** in manufacturing applications usually known as technology planning. Its function is the management decision making, implementation of new technologies and the clinical decision making.
- **Resources capacity planning:** Under this area will fall all decisions regarding the planning of the renewable resources. A renewable resource is a resource that is used and will stay available for use, like spatial resources, staff, transport wagons, re-usable instruments, etc.
- **Materials planning:** materials planning concerns the non-renewable resources. These are the resources that will be depleted after the process ends
- **Financial planning:** This aspect of the framework addresses how the organization should manage its costs and revenues to achieve its objectives.

The hierarchical decompositions on the vertical axe:

- **Strategic**: strategic planning addresses the long-term / structural decision making, based on long-term forecasts of demand.
- **Tactical:** The tactical level is the most intangible level of the four. There is less uncertainty about the future events as is at the strategic level but there is still more uncertainty than at the operational level. Demand is partly known, and partly needs to be forecasted. This level has more capacity flexibility than the operational level. It can, for example, be decided to hire flex-workers based on the forecast.
- **Operational:** This is the area that is based on the here and now. And it is split into two subcategories:
    - *Offline:* The day to day planning and decision making for short term events. There is almost no capacity flexibility and (elective) demand is unknown.
    - *Online*: This area focuses on the monitoring and control of the process as it happens. An example is the insertion of an emergency patient into the elective schedule.

The current situation of the planning and control policies of AMC's food logistics, for reference department G5, are described in Chapter 2 using the hierarchical levels from the framework.

1.6.3 Performance measurement

Before defining our performance indicators it is important to realize what properties of well-defined performance indicators are. Literature search learns that characteristics and appropriateness of performance measures differ based upon the purpose of measurement (Behn, 2003; Franceschini F., 2006; Franceschini, Galetto, Maisano, & Mastrogiacomo, 2008; Parker, 2000). Performance indicators aimed to improve should give insight and understanding in behaviour of employees and how this behaviour can be influenced (Behn, 2003). Managers for example need indicators which reflect how their own activities influence behaviour of their employees. Performance indicators are only useful for measuring systems when they have goals to reach. These goals of the performance indicators should then be reached by performing activities aimed at influencing the behaviour of employees in order to improve the outcome of the organisation.

1.6.4 Stakeholder analysis

To identify the determination of stakeholder positions we use the typology developed by Mitchell, Agle & Wood (1997). This typology classes stakeholders based on three key attributes: power, legitimacy, and urgency. Power means the influence to change organization where legitimacy stands for connections of a stakeholder with the organization. Urgency means how soon situation should change, regarding to the stakeholder. Combine these attributes identifies the type of stakeholder.

Having just one attribute means low priority from point of view of that type of stakeholder. Priority is high when all three attributes are present. Then the stakeholder can be defined as definitive (Mitchell, Agle, & Wood, 1997).

1.6.5 Key Performance Indicators (KPIs)

We choose to cluster the KPIs based on the five basic performance objectives by Slack, Chambers & Johnston (2007): Quality, Speed, Dependability, Flexibility and Costs. This to structure the KPIs and create a more tightly defined set of objectives that relates specifically AMC's logistic function concerning food (Slack, Chambers, & Johnston, Operations Management, 2007).

Quality means the consistent conformance to customers' expectations or in this case the quality of AMC's foodservice. Speed stands for the elapsed time between customer requesting products or services and receiving them. Time aspects like throughput times from ordering to receiving goods till distribution to the individual patient will be taken into account. Dependability is delivering, or making available, products or services when they were promised to the customer. The error free ratio, time fluctuations and reliability of the system in total will be analyzed. Flexibility is the degree to which an operation's process can change what it does, how it is doing it, or when it is doing it. In this case the assortment of products, menu cycle and ability to eat on another time or place as normal are aspects to involve. Finally, the costs of stock, personnel, and overhead is analyzed. (Slack, Chambers, & Johnston, Operations Management, 2007).

Beside of clustering the KPIs according to the performance objectives we also formulate the KPIs in such a way that they meet the SMART requirements. Each of the letters represents a different aspect each KPI should meet in order to be a useful KPI. Specific, Measurable, Attainable, Relevant and Timely. (See: (Bovend'Eerdt, Botell, & Wade, 2009;); (Shahin & Mahbod, 2007)).

1.6.6 Identifying KPIs

Now that we know how to cluster KPIs and what requirements they should meet we elaborate on how to identify them. In order for us to get to know the KPIs relevant to AMC we hold a survey with the stakeholders, see Appendix II.2. Using a survey as a research strategy we learn the KPIs and receive a snapshot of how the process functions at the current time (Kelly, Clark, Brown, & Sitzia, 2003).

The method to use to execute this research strategy is face-to-face interviewing because explanation of the question from both sides is necessary. Our interview is based on open ended questions only,

since these kind of questions give more response and the best information on the research question. Open-ended questions are more complete and clear and standardization afterwards make comparing of the results possible (Emans, 2002). To compare the results it is essential to interview the different people in the same way based on a structured questionnaire.

A good research has the characteristic that its purpose is to address a single clear and explicit research question (Kelly, Clark, Brown, & Sitzia, 2003). Therefore our interview only focus on finding the KPIs as defined by the stakeholders. In this case we try to gain a preferable minimum of around three KPIs from each of the contestants.

Bias of the interview is prevented by evaluate the interviews afterwards. This evaluation is based on the validity, completeness, relevance and intelligibility. Ask for explanations, repeat questions to clarify, repeat answers and summary the results validate the answers of the respondents and make them more reliable. Finally, the conversation after the interview could gave insight in rightness of the answers, because the respondent uses this moment to optimise his/her part of the interview (Emans, 2002).

1.6.7 The Problem Cluster

All the above is needed to answer research question 1. Here we describe how to answer research question 2. Let us first, as a reminder, quote research question 2: What are AMC's main problems in the process of (food) logistics?

With all the methodology just described we gain insight into the current situation and thus also the current problems. To order these problems we use problem clustering. Within the problem clusters arrows are used to show the relations between causes and effect. At the top of the problem cluster is the main abstract problem as usually given by the problem owner and from there move backwards across the causes. Here the problems will become more abstract and measurable. A lot of problems can be revealed this way and it can be hard to select a main problem to solve from this. There are however 4 guidelines (Heerkens & van Winden, 2012).

1. When possible preferably take a cause as problem and not its created effects.
2. Do not continue to move backwards across causes until you reach the big bang. Stop, when problems are reached that cannot be influenced anymore because they happened too far in the past.
3. In the problem cluster only those cause-effect-relations of which you are sure should be present.

4. From the problems that remain choose the one that will have the most expected benefit for solving the main problem as defined by the problem owner.

Keeping track of these 4 guidelines we can identify the key problems. However as the problem cluster is subdue to subjectivity looking back at the problem cluster and making changes due to new insights is a must.

Thereafter in order to judge the problems and how they will behave after changes are being made we need to have indicators relevant to the problem to measure. For this end we make use of the KPIs as described in Section 1.6.6. With the use of KPIs it will be possible to measure whether the logistic functions performs closer or better than the wanted threshold after the implementation of our solutions.

1.6.8 How to implement the frameworks into our research

We want to find bottlenecks within AMC's logistic function concerning food. Therefore we need to find what we can about process and managing this process, or the black box of AMC. We do this by filling in the framework we gave in the Section 1.6.2 for AMC focussed on the food logistics.

To map the process we need to conduct some research. Basically finding out how the process works means we have to stand in AMC's hallways and check at what times every food employee passes. As IFC has already done some intensive research on this we can use a lot of their data. This saves us quite some time. We need to collect the missing data however.

Now the managing part of the black box is a bit harder. For this we need to fill in and make use of the framework for health care planning and control as discussed above. To fill in this framework we also need to make observations of the process. As some parts of the framework are based on vision, it is important to gasp AMC's vision. To include AMC's vision into the framework, the majority of the framework is filled in based on interviews with the managers in charge.

We have not yet addressed the measurement of the current result. In order to measure this we need to find what Key Performance Indicators (KPIs) are found most important by the stakeholders. After filtering out immeasurable KPIs we need to rate them in order of importance. Once this is done we measure the current result based on the important KPIs. For the creation of the KPIs we need to list all stakeholders and determine the most important ones, this will be done in Chapter 2. IFC has already done some partial research into this and also provides already a quite extensive list of KPIs.

However we need to check whether these KPIs are still the ones that matter, and if they are still correctly ranked.

Once we have the flowchart of the process, the filled in managerial framework and a measurement of the current results we start looking for problems within the black box. The results of mapping AMC's food logistics can be found in chapter 3.

Finding these problems will be achieved by making use of a problem cluster. As discussed in Section 1.6.7 this problem cluster is used for finding the root problems. And from here on we will select the problems which will positively influence the main problem the most if solved.

2 Current Situation

2.1 The food logistics processes

AMC's logistic function can be seen as a black box as discussed in chapter 1. Resources go in, like employees and prepared food. Products and services come out, which in this case is the meal to the customer together with the service for getting the meal. The black box has to be subdivided into a series of events: Design, Planning & Control and Improvement. In this section we will focus on the design of the process. The design of the current process as presented before you is based on stakeholder interviews together with our own observations of different parts in the logistic process.

In order to describe the process we make a distinction between the processes of wholesale & bread (decentralized storage), warm meals (centralized storage) and supplier logistics. We discuss them in the mentioned order so we start off with the logistic process around the wholesale. In the Appendix you can find the flowcharts with more detail about the process. On figure XX1 below you will find the helicopter view of the wholesale logistic process.

Figure 3: The logistic process of bread and wholesale at AMC

Stock management is the start and end of the cycle. Based on how much stock there is and what the demand will be new stock is ordered from the supplier van Hoeckel. Once they have received and processed the order they will use cross picking for each of the units in AMC and then send the trolleys with the orders to AMC in the early morning. The orders arrive at the general receipt of AMC and from here on they are distributed to the correct units by the internal logistic centre. At the pantries the orders than have to be unpacked and stored in the appointed storage rooms.

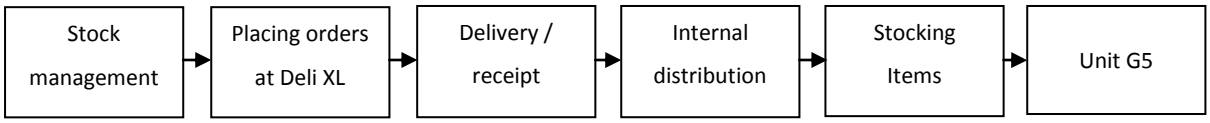

Figure 4: The logistic process of warm meals at AMC

Figure 4 shows the global logistic process of the warm meals. This process is quite related to the process of the wholesale products. However, it has a few differences, with the most important being that a central stock is used for these products instead of decentralized stocking. Therefore an extra

action is put in between where the items are sent to the central cooling storage. The internal distribution has also more handlings as each evening the meals need to be order picked by the warehouse employees before the logistic employees can distribute them to the units. Thus the cross order docking for the warm meals happens internally instead of it being done externally, by the supplier. For the details see the Appendix.

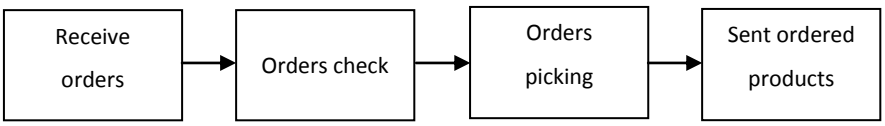

Figure 5: The logistics order picking at the supplier, Sligro, of the wholesale

The logistic process at the supplier of wholesale products is of another kind. Figure 5 shows the global process overview for this. We visited the supplier, Sligro, of the wholesale to see how they receive the orders of AMC and process them. As AMC uses the portal created by Sligro to order their products almost everything goes digitally and does not require a lot of check. Checks are done at random, or when suddenly a real high amount of an usually unused product are ordered. Most orders however are going straight into the system which automatically creates order picking lists for the warehouse employees. These employees pick the orders per unit. All the trolleys for AMC are then placed together and wait until the morning. Near before the trolleys are sent freeze products are added (like ice cream). After that the trolleys are put into the trucks which bring the orders to AMC. Sligro has made a big use of information and digital technology and runs very smoothly on these.

Table 1, on the next page, provides information on which days each of the products is ordered and delivered in normal settings.

	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue
Warm (order)									
Warm (delivery)									
Wholesale									
Dairy (order)									
Dairy (delivery)									
Chilled (order)									
Chilled (delivery)									
DKW (order)									
DKW (delivery)									
Freeze (order)									
Freeze (delivery)									
Bread (order)									
Bread (delivery)									

Table 1: The order and delivery days of the different food products at AMC (colour codes are used for quick reference on which days are connected).

2.2 Performance

In the paragraph above we have described how the current process is designed. Within this section we describe which (type of) stakeholders were involved and how to measure the performance of the current process based on the KPIs as given by stakeholders.

2.2.1 Stakeholders

Together with M. van der Maat, manager patient services and definitive stakeholder, we discussed whom the stakeholders would be regarding this research. These stakeholders would then qualify as important source of information for this research.

Appendix I shows an overview and reasoning of the determination of stakeholder positions based on this typology. Table 2, on the next page, gives an summary of the types of stakeholders identified.

Stakeholder		Power	Legitimacy	Urgency	Type of Stakeholder
Name	**Function**				
Mr. M. van der Maat	Manager Patient services	+	+	+	Definitive Stakeholder
Ms. F. Bakker	Staff advisor patient services	+/-	+/-	+/-	Discretionary Stakeholder
Mr. M. Boer	Manager logistics service centre	+	+	+/-	Dominant Stakeholder
Mr. I. Brandao	Project manager logistics directorate services	+/-	+-/	+/-	Dominant Stakeholder
Anonymous	Administrative Assistant at Basic Administration Directorate Services (BADS)	-	-	+/-	Demanding Stakeholder
Anonymous	Floor manager	+/-	+/-	+/-	Dependent Stakeholder

Table 2: The stakeholders from AMC and their importance

2.2.2 Performance measurement

In order to identify the KPIs we make use of face-to-face interviews with the stakeholders. The downside of face-to-face interviewing can be that respondents could give social-essential answers. Good information on forehand about the independency of the researcher and what will occur with the results could be a good way to prevent this (Emans, 2002). Therefore we inform the stakeholders by email about the aim of our interview, see Appendix II. Doing this helps to set the mindset of the interviewees in the right direction making it easier to reach our goal (Emans, 2002). During the interview we use of a few probes that are important during an open question interview. These probes are: 1. How do you mean that?, 2. Tell me more about that matter and 3. Anything else? (Fowler & Mangoine, 1990).

Next to that we ask all the respondents whether we could record the interview. In doing so we try to prevent that we apply too much interviewer judgement on the answers and made sure we could record all the answers from the respondents, willing to participate, in exactly the way they answered the question (Fowler & Mangoine, 1990).

The exact answers to the questionnaires will be kept out of this report as some of the participants wanted to stay anonymous. All answers are however woven throughout the report and used in answering our research questions. An empty example of the questionnaire as used during the interviews can be found in the appendix.

2.2.3 Key Performance Indicators

Table 3 lists the KPIs as defined during the interviews with each of the stakeholders at AMC. Some of these stakeholders have also mentioned the compliance with HACCP rules as a KPI. However as you either live up to the HACCP rules or you do not, which is not an option, the compliance of HACCP rules is always present. Therefore compliance of HACCP rules is judged as being a restriction and will be treated like that for the remainder of the report.

Performance objectives	KPIs
Quality	Employee satisfaction
	Customer satisfaction
	Discrepancy between demand and assortment
Speed	Cycle times
	Time efficiency of employees tasks
Dependability	Amount of unavailable product from the assortment
	Amount of complete and on time intern deliveries
	Time fluctuations in service rounds
Flexibility	Flexibility in product and service
Costs	Amount of thrown away products
	Amount of food consumed by others than patients
	Costs per patient per unit

Table 3: Key Performance Indicators

Performance indicators are not equally important. Management should assign priority to the different indicators. Since not all performance indicators could score high for a specific improvement plan, it is good to know how importance of indicators is related to each other. After prioritizing indicators a plan should be made, there must be some actions and there should be parameters to measure the improvement of performance (Fortuin, 1988). In Appendix 4 the KPIs are further elaborated.

The measurement of patient/customer satisfaction concerning food in AMC has recently been done by hospitality research as Bachelor Thesis of a student hospitality business of the Saxion Hogescholen (Koerhuis, 2012). This research is used as baseline for the satisfaction of these dependent stakeholders. The questionnaire as used in this research is compared with the evidence based method to accurately measure patient satisfaction with foodservices; The ACHFPSQ: The Acute Care Hospital Foodservice Patient Satisfaction Questionnaire (Capra, Wright, Sardie, Bauer, & Askew, 2005). While quality of food is the main predictor of foodservice satisfaction it is a multidimensional construct influenced not only by the technical aspect but interpersonal, environmental and personalized service aspects also (Capra, Wright, Sardie, Bauer, & Askew, 2005). While the design

and content of Koerhuis's questionnaire differs partly, the multidimensional way of measure foodservice makes methods useful for measuring the baseline performance of foodservice based on patient satisfaction.

2.3 AMC's food logistics management process

In Chapter 1 we gave a small description on each of the 8 attributes placed on the axes of the managerial table. So we know what each of the 16 squares stands for in the framework. Now it is important to realize that each of the squares in a row or column are connected with each other. For example look at the row of offline operational. In resource capacity the amount of employees are planned, based on the amount of materials that need handling under material planning. Where in the financial planning we notice how to distribute our money. In medical planning we check what treatment patients get assigned which influences the materials that need to be handled. If we look vertically. There should be a relation between the decisions made at the strategic level, based on mission and vision, the tactical level, where the strategic decisions are carried out and the operational level, where the mission and vision should be brought into the day to day operations.

On the next page we filled in the health care framework for the AMC. We have specified each activity as narrow as possible so that we could state surely that the activity was done by a specific employee. And because the activities each have to be put in their own squares of the framework without overlap, splitting some tasks in smaller activities was needed. The guiding documentary explaining all the connections between the tasks and activities can be found in appendix 5. Within this documentary each square of the matrix will be discussed and beside the connections with other squares also found bottlenecks will be revealed.

		Managerial areas			
		Medical planning	Resource capacity planning	Material planning	Financial planning
Hierarchical decomposition	Strategic (Long-term policy +/- 5 years)	Research, development of nutrition; Choice of IT system.	Renovation of the hospital wards; Layout based on new food concepts dependent on the service level as determined in policy.	Storage design: Decentralized storage of wholesale products on ward pantries and BBW. Centralized in case of warm meals.	Investment plans for the new food concept when renovating the wards; Project SPA in the kitchen.
	Tactical (Within a period of one year)	AC/MP: Assortment determination.	FM/FFE: Staffing (day / noon shifts) IB: Maintenance contract of BBW. Rules on how to fit up the tray. Management: distribution of tasks / responsibility in distribution process. MP: Overall staffing	Inventory management: stock levels related to storage design and service level Management / Purchasing department: Supplier selection, based on the program of requirements; FAD: Connecting the assortment with the demand of the patients; Tendering for outsourcing warm meals; FAD: Determining order size and frequency. Management/purchasing: Contact with suppliers and make agreements about ordering process, delivery time, frequency, method of delivery etc.	Management / Purchasing department: Financial contract with suppliers; Employee costs; The way of billing (now bit devious / too much paper use).
	Operational offline (Daily)	N: Individual treatment selection, by filling in a food request form.	FM/ FFE: Roster fixed/non fixed workforce; BBW usage/availability; FA: Control night refrigerator . FA: fit up the trays for the warm meals.	FA: Determining order sizes wholesale products by using min max lists; FAD: Control and posting of wholesale orders; FAD: Ordering of warm meals G: Receipt wholesale products. D: Intern distribution of wholesale products FA: Stock replenishing; FA: Preparing meals. W: Storage, stocking and control of warm meals. W: Order picking of warm meals D: Intern distribution of warm meals	Costs of food losses; Costs of gas, water, light and electricity usage; BADS: Billing of order costs of wholesale products and warm meals for patients. LSC / FA/ BADS: administration: control, invoice and archiving of orders.
	Operational online (Daily)	FA: Take actions to realize nutrition intake of patients.	Anticipate on unexpected demand: FA: Communicate with FA's from other units about what each pantry has in stock; FA: Exchange of units in stock in case of food shortage on one unit; FA: Sent out emergency backorder to FFE. FFE: Backorder of warm meals.	FA: Anticipate on wrong order deliveries and fluctuations in deliver times (can result in high work pressure); FA: Do not want to sell "no" to patients.	BADS + N: Bill the costs for wholesale products and warm meals for others than patients, i.e. guests and nurses.

List of Abbreviations: MP: Manager Patient services FA=food assistant, FAD= food administration, LSC= logistic service centre, FM= Floor manager, FFE= first floor employee. N= nurse, AC = Assortment Commission, BADS: Basic Administration Directorate Services, B: Business administration office, G: goods receipt, W: Warehouse employees, D: Distribution, IB: Industrial Business

Now that the managerial framework has revealed what bottleneck there are (as can be found in appendix 5) we will discuss the problem cluster for AMC's food logistics in the next section.

2.4 Problem Cluster

The problem cluster of AMC's food logistics structures the found bottlenecks in the system. Structuring them will show us what the main problems will be. These main problems are written in a coloured box. All together the cluster will give answer on the second research question. Finally this problem tree will justify which problems we will choose to focus on to answer the third research question (Section 1.5). The problem cluster is available in appendix 6.

We make a distinction between the costs of the food logistic services and the hospitality, defined as the discrepancy between the product and patient wishes, as counterparts in the hospital food service. Costs were split up in material costs and personnel, where personnel costs were influenced by low time efficiency and the high amount of flex workers. Material costs were further split up in raw materials, logistic costs and overhead (the costs of gas, water, light and electricity usage). The losses of food, before or after serving to the patient, are high unnecessary costs. Raw materials and logistic costs have the highest contribution to the problem of high costs and have both also a lot of core problems, like waste and big stock. Hospitality is split up in product, behaviour and environment with their core problems, the use of a push system vs. a pull method and finally the poor usage of the food request form.

When looking at the main problems we see that the question whether to hold or arrange the product on a centralized or decentralized way is the most important question. This question holds for; the dishes, the bread buffet car, the warm meals, the wholesale function, the night refrigerator, the ordering of meals and the billing of improper food use. Another problem that occurs are inefficient activities which are spread throughout the process.

3 Conclusion of the preliminary report.

Now that we have fully mapped the current situation of the food logistics at the AMC we can continue to work on specific problems within this process. We came to this problem cluster and the problems it revealed by following our methodology as described in Section 1.6. The extensive use of the methodology can be found in Chapter 2. Here we analyzed the main characteristics of AMC's food logistics based on performance, process and planning and control. From the analyzed we conducted the flowcharts of the process. For the performance we identified the needed

stakeholders, with whom we were able to conduct 12 KPIs. We also described how to perform a zero measurement analysis that is needed to know how the process is performing in its current state. This is yet unknown and thus makes comparison between a current state and a future state with recommended changes impossible. To evaluate planning and control we used the managerial framework that allowed us to structure the various planning and control functions within AMC and how the interact with each other. Finally we came up with a problem cluster from which we formulate the following 2 research questions:

1. How should storage be organized? Which of the wholesale products should be stored centralized, decentralized or in a grey area in between.
2. How can we improve the process by eliminating unnecessary steps and increase its efficiency?

Both these questions will be answered in the follow up section of this report. As this is a master assignment, cooperation between the two authors stops. They will each individually answer one of the questions. Wendy Haas will study the storage policies and answer the first question. Theo Lescure will study the inefficient activities and use benchmarking to optimize the process in order to answer the second question.

PART II

Benchmarking

Benchmarking the food logistics of eight Dutch hospitals

By:

BSc. MSc. T.R.A. Lescure

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4 Introduction

Part II further elaborates on the outcome of part I that evaluated the current situation of the food logistics at AMC. In Section 4.1 we discuss the motivation for part II. The problem description is discussed in Section 4.2. Followed with the research objectives in Section 4.3. Finally, we detail the chosen approach to achieve our research objectives in Section 4.4 discussing the approach.

4.1 Motivation

In part I we encountered a number of problems within the food logistic processes. Solutions to these problems enable an improved logistic process by increasing hospitality and reducing costs. Besides finding solutions to the current problems we address the future food concept, being developed by AMC in order to increase hospitality in the future. As this food concept is in development, it allows for input based on practices found at other hospitals.

The future food concept embodies all meals provided for within the hospital. Therefore, we also evaluate the processes centered around warm meals in addition to bread meals and the wholesale function.

4.2 Problem description

The problems found within the current food logistics, regarding wholesale function and bread meals are:

1. How to organize the storage layout
2. Improving the ordering system for nutrition
3. Reducing trouble with HACCP compliance.

The first problem is discussed in Haas (2013). As such, we focus on problems two and three. Next to these two problems another issue that is not discussed in Part I is the future food concept of AMC. To further develop their future food concept, AMC wants to know how other hospitals organizes their food logistic processes. By evaluating processes and policies at other hospitals, insight into AMC's own food logistics may be gained and incorporated within the future food concept.

4.3 Research objective

The objectives for this research are:

1. To conduct a literature study about benchmarking.

2. To provide solutions for increasing AMC's current food logistics efficiency, regarding the wholesale function and bread meals.
3. To provide recommendations to support decision making regarding the future food concept.
4. To provide information about other Dutch hospitals in order to identify benchmarking partners to find solutions to (future) problems.

4.4 Approach

To achieve our objectives we formulate the following research questions (RQ):

RQ 1: What is benchmarking, and how can we apply it?

To perform a benchmark across several Dutch hospitals we first conduct a literature study to learn the definition of benchmarking and how to conduct a benchmark well. With the acquired knowledge that comes from answering this RQ we are in a position to achieve the other objectives.

RQ 2: How are the food logistics organized at other Dutch hospitals?

Following the formulation of our benchmark, we are able to properly assess Dutch hospitals. Performing the benchmark shows us how other Dutch hospitals organize their food logistics. Using this benchmark we can make a comparison between each of the hospitals that participated.

RQ 3: What is the view of AMC's suppliers regarding the food logistics at AMC?

As the suppliers of AMC are supplying other hospitals as well, they have a good insight into the development of food logistics in the market. The suppliers might therefore provide solutions that they encountered in practice at other hospitals. AMC involved van Hoeckel, one of their main suppliers, in the development of the future food concept, therefore it will be a good practice to combine our findings.

RQ 4: Which solutions did we find during the benchmark with regard to improving the current food logistics at AMC?

Answering RQ4 allows us to properly address AMC's current problems within their food logistics. These solutions are ready for implementation within the close future.

RQ 5: What practices did we experience that AMC can add or take into consideration for their future food concept?

Next to addressing the current problems AMC also wants consult for their future food concept. Answering RQ 5 allows us to provide AMC with insights and ideas which they can take into consideration for their future food concept in development.

5 Benchmarking literature

This chapter discusses the answer for RQ 1: **What is benchmarking, and how can we apply it?**

Section 5.1 gives a brief background on benchmarking. Section 5.2 highlights which steps are needed to perform a well designed benchmark, according to two benchmark guides found in literature. Section 5.3 summarizes what we have learnt from the literature. Finally, Section 5.4 discusses how we can use the gathered knowledge in practice.

5.1 Benchmarking a background

5.1.1 Definition

The definition of benchmarking that was created by the International Benchmarking clearing house and which was presented at an APQC (American Productivity & Quality Center) conference, found a consensus among 100 companies:

"Benchmarking is a systematic and continuous measurement process; a process of continuously measuring and comparing an organization's business processes against business process leaders anywhere in the world to gain information which will help the organization take action to improve its performance (Watson, 1993)*."*

Quoting from an article by Dr. J. FL. Kay we find that:

"Benchmarking is a process of comparison between the performance characteristics of separate, often competing organizations intended to enable each participant to improve its own performance in the marketplace. Its objectives are to obtain a clearer understanding of competitors and of customers' requirements. Benchmarking will also enable innovations (either of process or product) to spread more rapidly through an industry and across industries where appropriate (Kay, 2007)*."*

Both these statements argue that benchmarking is a continuous learning process in which a comparison is made between one's own performances and those of the peers. Once the comparison has been made, an analysis has to be made to learn about the differences in the processes that cause the gap(s) in performance. With the knowledge gathered from this research, measures can be taken to improve current processes in order to close the gap and eventually exceed the best in class.

5.1.2 Benchmark generations

Benchmarking has known several generations. The first is known as reverse engineering. Reverse engineering is very product orientated. You take a product from your competitors and dismantle it to analyze how it is constructed and which components are used. By applying this kind of research companies are able to reproduce products from competitors and exceed with new better versions of the product.

The second generation is competitive benchmarking. Introduced by Xerox, in the late 1980. They used benchmarking to copy the production process of their cheaper Asian counterparts in order to retake market share. During this generation, companies performing the benchmark only look at other companies within the same industries. Xerox was the first to have dedicated teams study how competitors were running their processes. They kept records of this research and after publishing these, changed the industrial world. A lot of companies would follow in their footsteps by performing competitive benchmarks.

As a process might be executed better in a different industry, the third generation came to life; process benchmarking. An advantage of studying processes from companies in other industries is that they are more likely to cooperate as they are not your direct competitors. However, this increases the difficulty of the benchmark due to the industrial boundaries, and differences in corporate cultures.

The fourth generation is called strategic benchmarking. Within this generation not only the processes and products are of importance but also the strategic decisions made.

The last generation is an overlap of all the formal benchmark techniques but then applied on a global scale. As such this generation is called global benchmarking.

5.1.3 Different types of benchmarking

This section provides an overview of the different types of benchmarking. There are four different types divided into two classes.

The first class is Internal benchmarking. This class embodies the comparison of one's own process performance. The same process done at different sites can be benchmarked in order to find the best way of organizing them. Internal benchmarking can also be used to study to what extend a change affects a process. This can be studied by conducting a zero measurement, implement the change, do a second measurement and compare the results with the numbers from the zero measurement.

Doing so is a good way of analyzing the effects of changes to a process. External benchmarking, discussed below, should start with internal benchmark studies, as internal benchmark studies require a self examination. The results from the self examination are then a good baseline for external benchmarking.

Next to internal benchmarking we have external benchmarking. External benchmarking can be further divided into (1) competitive benchmarking, (2) functional benchmarking and (3) general benchmarking. For each of these benchmark types the cooperation of external companies is needed for a successful benchmark.

1. **Competitive external benchmarking:** For this type of benchmarking only the best practices of direct competitors are being studied. As direct competitors have to be involved it can be difficult to find cooperation. The right balance between giving and receiving information has to be found. This balance is important in order for all the participants to feel comfortable. Another risk of competitive benchmarking includes the tendency of looking at factors that made the competitor(s) distinctive rather than searching for the factors contributing to excellence performance at one's own company.

2. **Functional external benchmarking:** Functional benchmarking means that companies outside the scope of one's own industry are searched, on which to perform a benchmark. A pitfall, for this benchmark type, is that different industries have different constraints, therefore when implementing changes based on the same process performed within another industry an analysis has to be made on whether all constraints can be made the same or can be adapted. If matching of constraints fails, there is a high chance that the implemented changes will not reach expected results.

3. **General external benchmarking:** For external benchmarking time is spent on comparing the exact same process between companies. For example, the accounting practices of a hotel against the accounting practices of the best in class manufacturing company. The downfall of this benchmark type is that it might take a lot of time to complete. Furthermore as no attention is paid to surrounding factors modification to the research outcome is needed in order to meet the organization's own standards. Once the organization's own standards are met the solution can be implemented.

5.2 Benchmarking steps

Now that we know what benchmarking is and what types of benchmarking are available, we take a more in-depth view on how benchmarking works and which steps are involved. For this purpose we look at the benchmarking steps described by G.H. Watson (Watson, 1993) and A. van Hoorn (Hoorn, 2005). Watson made a generalized benchmark model by combining the benchmarking steps with the PDCA-cycle developed by Deming. Van Hoorn made a benchmarking model for the purpose of benchmarking Intensive Care Units (ICUs) at Dutch academic hospitals. These different benchmark models are explained in the next sections.

5.2.1 Benchmarking according to Watson.

Watson has compared benchmarking methods used by companies. Companies base their benchmark models on the successful Xerox benchmark model. However the essences of the models stay the same. To offer a more generalized guideline on how to perform a benchmark on a tactical and or strategic level Watson combined the essence of the benchmark models with the well known PDCA-cycle developed by Deming. PDCA stands for Plan-Do-Check-Act. PDCA knows the following benchmark steps: Planning the benchmark, collect the necessary data, analyse the data for performance gaps and enablers, improve by adapting process enablers.

Each of the steps from the Deming PDCA cycle and their relation to the benchmark studies as created by Watson are discussed below. The detailed steps that need to be undertaken in each of the steps can be found in Appendix 7.

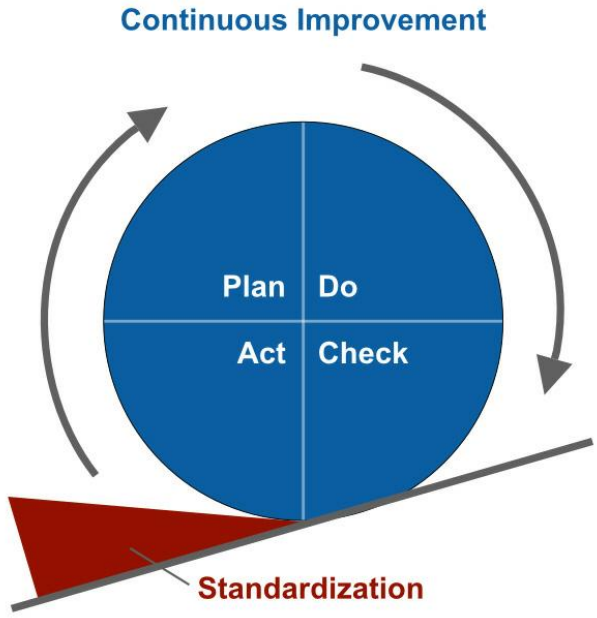

Figure 6: The plan-do-check-act cycle

Step 1. Planning:

The planning of a benchmark has three phases.

1. The company that wants to benchmark should perform a SWOT analysis.
2. The process to be benchmarked should become well documented and characterized in order to make comparison possible.
3. Requirements for selecting benchmarking partners have to be formulated.

For selecting a benchmark partner the next set of criteria might provide a solid basis to start from:

Type of business; Company culture; Organizational structure; Employee profile; Company demographics; Multinational facility or geographic representation; Product size or complexity; product technology; process technology; key financial performance indicators; Distribution channels; Decision-making style of management.

Using these criteria, for selecting a business, prevents that benchmarking partners are chosen in a subjective manner. ("I like how that company works, lets choose them"). Using an objective view is preferred as it prevents from researching those companies from which ideas cannot be implemented due to differences in constrains and restrictions.

Step 2. Do:

Stage two consists of data collection. After choosing the benchmarking partners it is time to perform interviews with questionnaires, based on the data from step 1, in order to get the first data.

There are three phases in this stage:

1. Internal data collection. (how do we do it?)
2. Secondary research. (what is known about the subject already?)
3. External research/data collection. (how do they do it?)

The first and third are almost identical. They are based on collecting the same process details with the difference being that the first phase focuses on internal process details and the third is based on externally collecting of the same process details. The second phase, the secondary research, is about doing a literature research on the opportunity of improvement found in phase 1. Doing this research prevents the wheel from being reinvented. During the secondary research we also do additional research on the benchmarking partner. To make sure we do not discover hidden objects during the actual benchmark.

Step 3. Check:

This step deals with data analysis of the collected data. Within this step there are five phases:

1. Data analysis
2. Data presentation
3. Root cause analysis
4. Results projection
5. Enabler identification

The first four steps are self explanatory. The fifth step means, identification of those process candidates that can be adapted and thus are candidates for implementation. All the phases in this step focus on measuring the gap between one's own business and the best in class, after which a search is undertaken for those processes that can be adapted in order to close this gap.

Step 4. Act:

Step 4 revolves around implementing selected improvements within the organization based on the gained knowledge from the benchmark study.

This step can be divided into the following phases:

1. Select improvement projects
2. Set goals for improvements
3. Develop action plans
4. Approve action plans
5. Implement action plans
6. Recognize contributions of actors
7. Monitor the benchmark requirements

Through these steps, companies are able to perform a benchmark study. Placing the steps in the Deming PCDA cycle helps to guide companies though the process. As most managers are aware of the PCDA cycle, therefore using this cycle makes sure managers have a base to stand on. Here we listed all the activities to be undertaken according to Watson. Van Hoorn's method does not use the Deming PCDA cycle. However it was a very concrete guide written for benchmarking ICUs at university medical centres in the Netherlands.

5.2.2 Benchmarking according to Van Hoorn

To be able to benchmarks the ICUs at the academic hospitals in the Netherlands, van Hoorn came up with a modified benchmark model. He divided the benchmark model into two phases. Within the first phase the whole problem is described, the benchmark partners are chosen and the boundaries are set. These are steps 1 to 4 as written down below.

The first phase consist of the start up of the benchmark and has the following four steps:

1. Choosing and setting boundaries for the process to benchmark
2. Choosing the benchmark partners
3. Choosing the themes of the minor researches
4. Mapping in detail the process to be benchmarked.

In the second phase, an in-depth research is conducted on the minor studies picked in the first phase. For this phase, steps 5 to 8 as mentioned below are performed. These steps have to be taken within each of the minor researches. The steps are the following:

5. Defining the measurements and key performance indicators
6. Doing the measures
7. Analyzing the results
8. Creating and implementing the improvements which are found

The first four steps are part of an iterative process which should be repeated throughout the research in order to maintain the right scope of the benchmark. As written steps 5 to 8 are performed inside step three. This cycle of step 5 to 8 has to be repeated for each of the minor studies. When later on during the benchmark new point of interests are discovered, steps 5 to 8 make it easy to side track and research these new points of interest.

5.3 What did we learn?

We have learned that there are different benchmark generations as well as different benchmark types. Internal benchmarking is needed in order to gain a good self examination and to have a guide line for an external benchmark. Performing internal benchmark we are able to find points of opportunity which we then exploit during the external benchmark.

In order to compose a good benchmark research we studied the literature. From literature we came up with two guides we use as a guideline. The main difference between the two models can best been shown in a visualization.

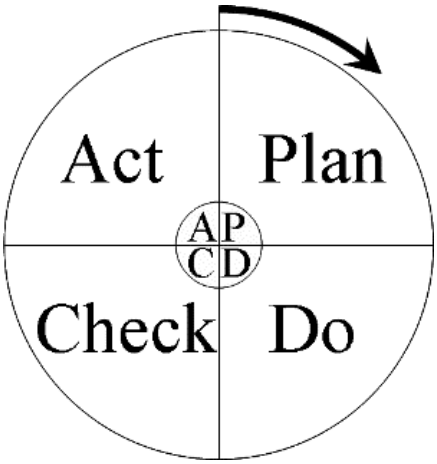

Figure 7: PDCA cycle (Watson, 1993)

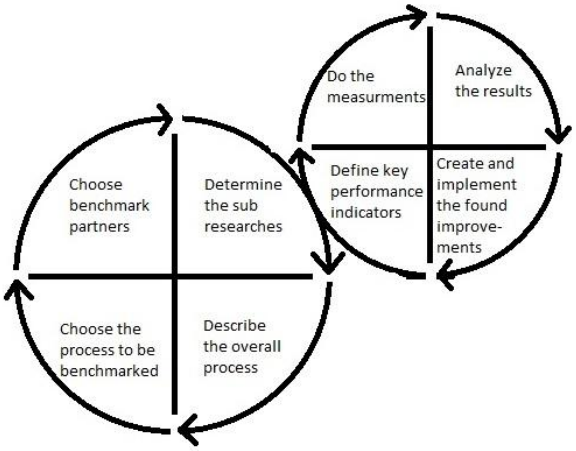

Figure 8: PDCA double cycle. (Hoorn, 2005)

As observed in the figures 7 and 8, the guide offered by Watson (figure 7) is based on a single cycle whereas the guide as offered by Van Hoorn (figure 8) is based on a research cycle within the main research cycle. The difference lies in the fact that Watson expects that the user sets very tight boundaries from the start. The problem with this is that when a new point of interest is discover or a new boundary needs to be set, it proves to be hard to adjust the benchmarking study. In the method described by Van Hoorn we first determine what the overall process is that we want to examine. Then during the first PDCA cycle at step three (check) sub processes within the overall process are defined and these are examined into more detail during the second cycle. Once all the sub processes are examined, with the second cycle, the last step of the first cycle can be completed. The solutions found in the second cycle, for improving the sub processes, will improve the overall process. Of course, some of the sub processes can turn out to be already performing optimally thus requiring no changes to that part of the overall process.

For this report we use a combination of the models. By integrating the PCDA benchmark cycle of Watson into the model by van Hoorn as being the second cycle. Thus the second cycle in figure 8 becomes the cycle from figure 7. Thus, in order to study the sub processes we move along the PCDA cycle of Watson.

We focus on the overall process; logistics of food/drinks within AMC. To be able to benchmark this process, we cut this process down into smaller processes, determined sub researches, on which we can use benchmarking to improve the overall process. Even though we make use of the model as

created by van Hoorn for benchmarking the ICUs at the Dutch academic hospitals, we do not negate the work from Watson. He uses the PCDA cycle for describing the steps to be done in a benchmarking research and this is usually a well understand concept by management. Furthermore Watson has a better detailed map of which activities need to be undertaken. Van Hoorn steps are defined specially for IC benchmarking making it easier to misunderstand or misinterpret one/some of the steps.

In conclusion:

Benchmarking incorporates studying other companies, be it competitors or businesses in different industries. The goal of benchmarking is not to blame and shame on what aspects a company does wrong. Instead a benchmark goal is to provide useful and positive arguments and recommendations for the participating companies that will help them to increase their effectiveness in the evaluated process. As such a benchmark can only be performed with a mutual cooperation. We discussed that there are many documentations on how to perform a benchmark. From these we chose to use Watsons and Van Hoorns approaches. Combining these two approaches allows us to perform a benchmark of the food logistics at Dutch hospitals and the execution of this benchmark is found in the remainder of this report.

The overall process has already been described in the preliminary research report. In the next chapter we set hard boundaries for the overall process and we describe which sub processes are present within the overall process based on the benchmark approach from Van Hoorn.

6 Applying the benchmark to AMC's food logistics.

6.1 Introduction

To perform a benchmark on the food logistics at hospitals, we split the food logistics into five sub processes and we add a separate section for warm meals. Therefore we have 6 parts of the food logistics that we can benchmark individually. These sub processes are discussed in sections 6.2.1-6.2.5. Each section describes what the sub process incorporates, how the boundaries are set and what the current situation is, at AMC. In Section 6.2.6 we discuss warm meals. Warm meals is given an separate section to enable us to elaborate on the food concepts used by the hospitals. In Section 6.3 we close the chapter.

6.2 Dividing the food logistics into sub processes

Before splitting the food logistics into several smaller sub processes we define the boundaries for the overall process. The food logistics boundaries for our benchmark are defined as:

The process between the point where the supplier drops off its goods for the hospital until the point where the patient receives the meal of their choice at his/her bed.

6.2.1 Storage

Sub process definition:

Storage embodies the way the products are stored within the hospital. We make a distinction between products for warm meals and those from the wholesale function.

Why we chose this as a sub process:

How storage is organized determines how the rest of the food logistic process is organized. Having a decentralized storage requires different movements and methods of ordering than having a centralized storage. How the storage of all products should be organized is a separate research topic, and is performed by Haas (2013). Haas researched each of the individual products of the wholesale function and determined whether each one should be kept in a decentralized or centralized storage. We look at how applying different forms of storage functions affects the food logistics as a whole.

Current situation at AMC:

The wholesale function stock is stored using a decentralized storage layout, meaning that the complete stock is divided across the different pantries. Each pantry has its own supply and is responsible for their own stock. In other words, the food assistants are in charge of maintaining stock levels. In the event of a stock-out, the food assistants contact the first floor employee who then secures the requested product from a pantry with excess stock.

The premade warm meals are stocked in a central cooling area. From here, meals are transported to the pantries each day. Food administration is in charge of the warm meal stock levels, with the actual stock levels being provided to them by the logistic employees.

6.2.2 Ordering system

Sub process definition:

The processes centred around external ordering are included into this sub process.

Why we chose this as a sub process:

How the ordering system is organized is determined by the way the storage is organized. With a decentralized storage, there may be many employees in charge of ordering their own stock, while at centralized storages there is only a single stock to account for.

Current situation at AMC:

At AMC the food assistants and the food administration are involved in the ordering process for bread meals and wholesale function. For warm meals only the food administration is in charge as these are kept in a centralized storage, enabling easy tracking of stock levels.

Since the bread meals and wholesale functions are stocked at the pantries each pantry is responsible for its own stock. Thus the food assistants have to place orders to replenish stock. These orders are then first checked on errors by the food administration. After this check the orders are sent out to the suppliers.

Currently AMC is dissatisfied with the amount of time the food assistants have to spend on the ordering process. Therefore, AMC is evaluating whether this process can be carried out by the logistics employees. To achieve this they want to automate the process by implementing scanners and scan tags for each product. One issues with automating the process, turned out to be the min/max lists used for reordering products (See Section 7.4.3). The current used min/max lists turned out to be outdated. As there are no current numbers on movement of products from the wards it

was not possible to generate new lists efficiently. This, together with the high variety in demand, is the reason AMC's food assistants rely more upon their own expertise rather than on these lists for reordering stock.

6.2.3 Goods receipt

Sub process definition:

Goods receipts contains the processes of receiving supplies from the supplier and transporting these supplies to their destination within the hospital.

Why we chose this as a sub process:

At hospitals with centralized storages, received products may be stored directly into storage space. However, at hospitals with a decentralized storage the transport process can be longer and can contain extra handling. As we are curious to know what methods are used for transporting the goods from general goods receipt to the pantries we incorporated this process in our benchmark.

Current situation at AMC:

General Goods Receipt (GGR) is where the products are delivered. Since AMC has a decentralized storage, the products arrive on trolleys, which have already been cross docked for each pantry. GGR serves as an important HACCP control point. Wholesale function products received at the central good receipt should comply with HACCP safety temperature thresholds, so a measurement must be performed. If the product temperature is above the threshold then the whole order will be sent back. After this quality control, products are held in an open area until the logistic employees are ready to move them to the pantries. At the pantries, the products are given another HACCP measurement. If the products are above the temperature threshold this time it is AMC itself that has to destroy the order. Therefore, compliance of HACCP is important to prevent waste and unnecessary costs. Since there is no temporary cooling area where the products can wait until they are being bought to the pantries, the products can reach critical temperature, especially during summer, when they arrive at the pantry. Food assistants therefore have to immediately transfer the products from the trolleys to the refrigerators in the pantries. As this happens in the morning when the food assistants also need to prepare breakfast, which is the primary process, there is a risk breakfast will be delayed.

The products for warm meals do not face this problem as they are placed within a centralized cooling storage behind the goods receipt the moment they arrive. Thus having a short travelling time and

almost no waiting time, in an open area, these products have a low chance of reaching the temperature threshold.

6.2.4 Food logistics on the wards

Sub process definition:

This sub process is split into two parts:

- *The process from pantry/kitchen toward patients*
- *The ordering process used by patients, to receive the food and drinks they want*

This sub process focuses on all processes centred on brining the meals from the pantry or kitchen, to the patient. As well as the ordering process for the patients are embodied in this sub process.

Why we chose this as a sub process:

Within this sub process we evaluate what the last steps are for the patient to receive their desired meal. As hospitals offer great varieties in meals, patients have the option to choose which meal they want. Therefore, we look at the ordering process for patients as well. We put these two processes together within the same sub process, because they are closely related and the same employee is usually involved in both processes.

Current situation at AMC:

AMC uses a menu card from which patients can choose what warm meals they would like for dinner. Menu cards are delivered during the first coffee round and collected at lunch. These orders have to be sent to food administration before 14:45. All the other meals, bread and snacks, are picked “a la minute” from the BBW, meaning patients can choose from what is available on the BBW and get it served immediately.

To deliver food and drinks to the patients, AMC uses food assistants. For the distribution of the bread meals and snacks, these food assistants use BBWs. For the distribution of the warm meals, open trolleys are used in which the trays with warm meals are placed.

6.2.5 Reverse logistics

Sub process definition:

Here we look at the reverse logistics of all the resources (reusable items; plates, cutlery, etc.). In other words, the process from the patient's room back to the pantries.

Why we chose this as a sub process:

After patients consume their meals, the used resources have to be collected for further use. After the resources have been collected and are back in the pantry, the food logistics cycle restarts. Within this sub process we focus on the organization of dishwashing.

Current situation at AMC:

At AMC, the dishes are collected at separate round, approximately 75 minutes after the meals have been brought to the patients. The dirty dishes are collected and then brought to the decentralized dishwashing areas, one next to each pantry. All the leftovers are thrown away at this point and the dirty dishes are washed clean.

6.2.6 Warm meals

Sub process definition:

This sub process is chosen to elaborate further on warm meals.

Why we chose this as a sub process:

Warm meals usually require different logistics processes in comparison to other meals. This due to the difference in preparation, as well as differences in expiration dates of the products. Therefore, we create an extra subsection in order to address warm meals. Within this section, we elaborate further on warm meal topics that were not yet incorporated within the other sub processes. The most important topic being the food concepts used by hospitals.

Current situation at AMC:

AMC uses regeneration as a food concept for warm meals, meaning that they buy pre made meals. These are pre cooked, cooled and sealed off. AMC receives these meals and only needs to regenerate (heat them) for around 40 minutes. To achieve this, AMC has an oven that can contain 16 meals at once at each of the pantries. Their goal is to move from this concept to one with the availability of a kitchen on each floor. This would allow them to prepare fresh products, however, AMC is not excluding the use of premade ingredients for the meals.

6.3 Conclusions

In this chapter we have presented the sub processes that we use for the benchmark. These sub processes are:

1. Storage
2. Ordering system
3. Goods receipt
4. Food logistics on the wards
5. Reverse logistics
6. Warm meals

For each of these subjects we discussed what the current situation is at AMC. With this knowledge we are able to make the comparison between AMC and the other hospitals. How the sub processes are functioning within the other hospitals is described in the next chapter. After Chapter 7 we are able to make this comparison and draw our conclusions in Chapter 9. In Chapter 7 we start with providing general data about the benchmarked hospitals. After drawing our conclusions from the general data we discuss the sub processes as formulated within this chapter.

7 How are the food logistics organized at other Dutch hospitals?

7.1 Introduction

Within we discusses the answer for RQ 2: **How are the food logistics organized at other Dutch hospitals?**

This chapter introduces the data gathered, during our benchmark at eight Dutch hospitals. To perform the benchmark we applied face to face interviews. This interview has been added in appendix 8. The stakeholders with whom interviews are taken are listed in Table 4.

Hospital/ supplier	Representative	Title
Gelre	Marcel van Walraven	Manager Hotel
Deventer ziekenhuis (DZ)	Marjan Streppel	Head food
Medisch spectrum Twente (MST)	Bert van Ulzen	Team head nourishment
Ziekenhuis Groep Twente (ZGT)	Inge Beernink	Product group manager Logistics
Maasstad (Mstad)	Mirzet Mehmedagic	Service manager food & drinks
Universitair medisch centrum Nijmegen st. Radboud (UMCN)	Jaap Buis	Operational manager nourishment
Gelderse Vallei (GV)	Angelique Honderdors	Head Hotel services
Groene hart ziekenhuis (GHZ)	Rein van der Nagel	Coordinator kitchen

Table 4: overview of participating hospitals and contacts.

First we evaluate generic data for each of the hospitals in Section 7.2. Then we discuss the gathered data on each of the sub processes. Method of storage in Section 7.3, ordering system in Section 7.4, goods receipt in Section 7.5, food logistics on the wards in Section 7.6, reverse logistics in Section 7.7 and finally, Section 7.8 which elaborates on warm meals.

7.2 General information about participating parties

The incorporated hospitals are known for using food concepts similar to AMC's current food concept, or for having a unique food concept within the Netherlands. Within this chapter we compare the hospitals with each other. By presenting general data of each hospital we are able to determine whether solutions found at other hospitals are viable for AMC, or whether they might not work due to different working conditions or hospital culture. One factor is hospital size, as such an overview of the different hospital sizes is shown in Figure 9. From figure 9 we observe that AMC is the largest, with UMCN being close in size. The remaining hospitals form two categories. The first category of hospitals are around 2/3rd the size of AMC and the second category are those hospitals that are a 2/5th of AMC's size.

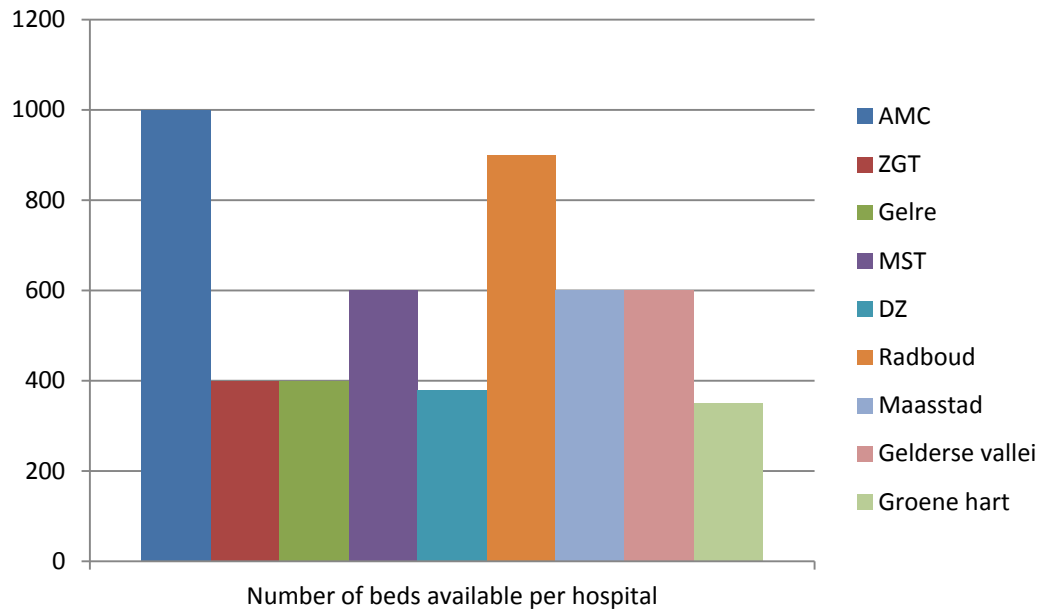

Figure 9: Amount of staffed beds at each of the benchmarked hospitals

The number of locations a hospital has, can influence the logistic function. We define a hospital as a hospital with different locations, if this hospital has two or more locations located in different towns. Gelre has two locations, one in Apeldoorn and one in Zutphen, but only uses the location at Zutphen for the production of warm meals for both locations. As one location is used for cooking meals of both locations we conclude that Gelre is using an integrated process between its locations. ZGT has a location in Almelo and Hengelo. These two locations operate individually but are connected by a central storage facility. We come back to this in Section 7.3. The remaining hospitals have one location.

A third point that can influence the day-to-day processes is the patient staying time. Hospitals want to provide the largest variety possible when offering meals to their patients. To accomplish this they strive to have a different menu for each day the patient eats at the hospital. Each hospital we interviewed used a 7 week menu which cycles with different menus during the different cycles. From figure 10 we see that average length of stay of patients is 5 days. From Figure 10 we conclude that there was a notable difference in 2011 in average patient stay time. With a maximum variety of almost 3 days (Maasstad against AMC). We see that all hospitals are centred around a stay time of 5 days. In practice we observe that menus are fixed from Monday till Sunday. According to these numbers hospitals are able to serve patients a different meal for each day they are in the hospital.

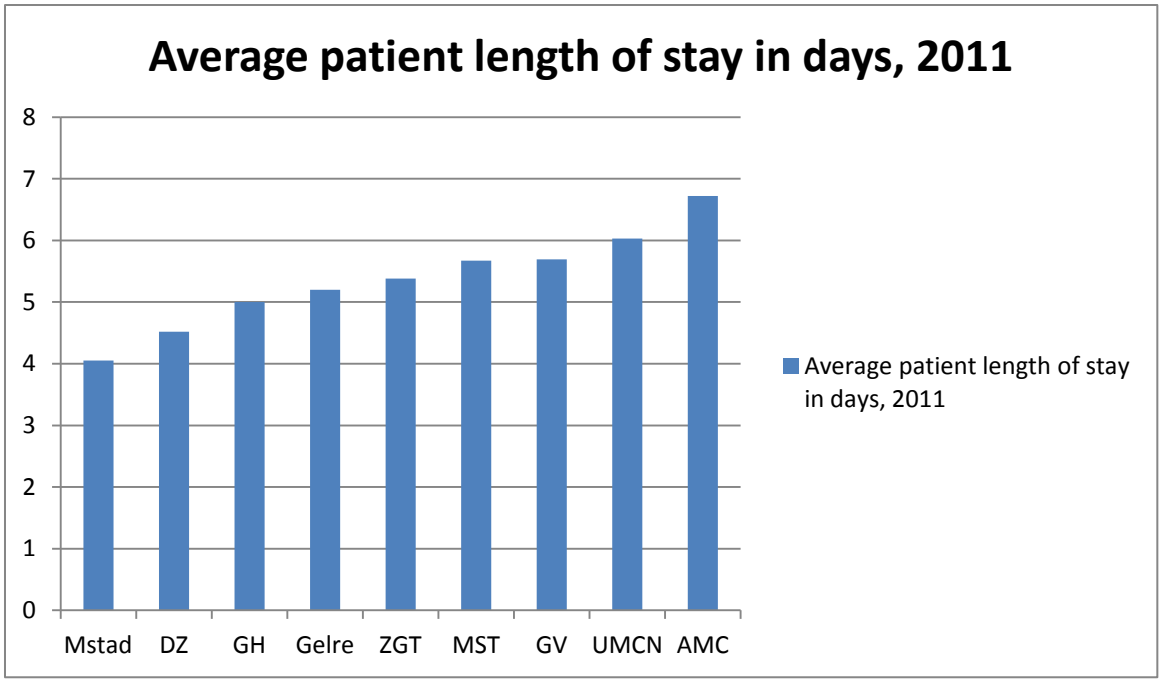

Figure 10: Average patient stay time per hospital (Bouwman, 2011)

With this general information about each hospital in the back of our heads we continue by trying to grasp a bit of each hospitals culture with the help of the KPIs from part I in the next section.

7.2.1 Allocating priority points over KPIs, by each hospital

In the preliminary report we conducted KPIs for judging the food logistic process. After these KPIs had been listed we asked the definite stakeholder, Mathieu van der Maat, to allocate 100 priority points over the KPIs.

In a search for benchmarking partners it is important to search for those that share the same culture or work with the same principles. Therefore we asked all the participating hospitals to allocate 100 priority points over the same KPIs. The results are displayed in table 5. For each hospitals the top priorities, given most priority points, are green. Besides the top priorities per hospital, we also highlighted the top three KPIs based on the average of all the allocated points.

Performance objectives	KPIs	AMC	Gelre	DZ	MST	ZGT	UMCN	Mstad	GV	ZGH	Average per KPI	Standard Deviation
Quality	Employee satisfaction	23	0	10	5	10	10	5	0	10	8	7
	Customer satisfaction	23	20	10	25	50	50	20	40	20	29	14
	Discrepancy between demand and assortment	4	5	10	5	0	0	5	0	0	3	3
Speed	Cycle times	4	10	5	0	0	0	10	0	10	4	4
	Time efficiency of employees tasks	23	5	10	5	0	0	5	10	0	6	7
Dependability	Amount of unavailable product from the assortment	3	5	10	0	0	0	10	0	10	4	4
	Amount of complete and on time intern deliveries	4	5	5	20	10	0	10	30	10	10	9
	Time fluctuations in service rounds	1	5	5	0	0	0	5	0	0	2	2
Flexibility	Flexibility in product and service	3	20	5	5	20	10	15	10	10	11	6
Costs	Amount of thrown away products	8	10	10	5	10	20	5	0	10	9	5
	Amount of food consumed by others than patients	3	5	10	5	0	0	0	0	20	5	6
	Costs per patient per ward	1	10	10	25	0	10	10	10	0	8	7
TOTAL		**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**0**

Table 5: Allocation of 100 priority points over the KPIs by each hospital

The first conclusion from table 5 is that only one row of the table is completely green. This row is the customer satisfaction, meaning that each of the hospitals places a high value on customer satisfaction. When looking at the different allocations the hospital provided, the second conclusion we draw is that two types of management have allocated the points. The first type has allocated points to every KPI, while the second type chooses to place a high focus on a small selection of KPIs and allocating zero priority points to the other KPIs. This indicates that there are different decision making cultures present within the hospitals.

An interesting point when looking at the ranking of the KPIs by each of the hospitals is that two of them have only been given high scores (shared first place) by AMC, namely, employee satisfaction and time efficiency of employee tasks. This shows that AMC has a different mindset on what they want to achieve with a change to the food logistics. They seem to be suffering from inefficient time use by the employees regarding their tasks. Other hospitals, judging from the KPI ranking, seem not to face this problem. Interestingly, employee satisfaction is also judged as an important factor for AMC. It is interesting to see that AMC scores these two KPIs very high while other hospitals score these low or ignore them completely.

When looking at the average scores we observe that the top three KPI's are: customer satisfaction, flexibility in product and service, and amount of complete and on time internal deliveries. Which confirms our observation that AMC has the mindset of regarding customer satisfaction highly, but is less common in its other top priority KPIs.

7.2.2 Strongest point of each hospital based on their own observation:

We asked each hospital for their strong points and their bottlenecks in the current process. Asking for their strong point can give a quick overview on which hospital could have a best practice in particular food logistics areas. Their reactions are:

Gelre	
Very content with	*Goods receipt, Each sub process has its negative points but goods receipt is working well.*
Largest bottleneck	*Amount of waste.*

Deventer ziekenhuis	
Very content with	*Warm meals, the diversity in choice and the process. A la carte ordering of meals.*
Largest bottleneck	*Availability of certain products that are only available on recipe (hard to obtain from the market).*

MST	
Very content with	*Using fresh product, with a coupled kitchen. The associated quality price balance of this process.*
Largest bottleneck	*Ordering process for warm meals is outdated. Time between patient ordering and receiving should be decreased, as currently this time amounts to 28 hours.*

ZGT	
Very content with	*Currently not yet satisfied with any of the sub processes. Due to developing a new concept and fine tuning.*
Largest bottleneck	*There are too many transfer moments of nutrition products. Would like to have suppliers deliver to kitchens directly. Patients have to eat at fixed times.*

Maasstad	
Very content with	*Logistic movement from storage to the wards.*
Largest bottleneck	*Nutrition being used by people for whom it's not meant.(like employees or guests).*

UMCN	
Very content with	*The whole process as currently in use. However, each sub part still has room for improvement. The new concept for handling guest dinners.*
Largest bottleneck	*To long time between patient ordering and receiving of meals. Orders have to be placed before 14:00. This means that orders placed between 14:00 and 17:00 are missed.*

Gelderse Vallei	
Very content with	*Time between patient ordering and receiving meals.*
Largest bottleneck	*The forecasting or required ingredients for warm meals. These components are the Largest source of waste.*

Ziekenhuis Groene Hart (ZGH)	
Very content with	*Good collaboration between kitchen and logistic services.*
Largest bottleneck	*Time between patient ordering and receiving of these orders.*

A word of caution is that the reactions are biased as they were asked to the hospital themselves and are thus personal opinions. Besides asking for the strong points of each hospital, we also asked for their largest bottleneck, to evaluate what the biggest problems, concerning food logistics, are and whether these relate to those of AMC. From the statements above we observe that the most mentioned bottleneck is the duration of the cycle time between patient orders and delivery. The hospitals that did not mention this bottleneck have unique problems. AMCs bottleneck is the efficiency of the logistic process for food. However, this is incorporated in almost each of the mentioned bottlenecks mentioned by the hospitals.

7.2.3 Hospitals working on a new food concept:

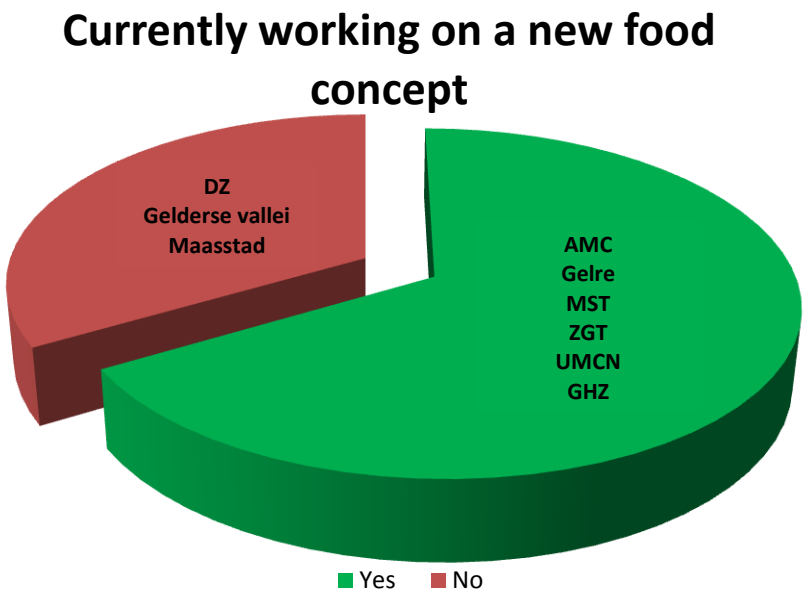

Figure 11: Division of hospitals who are working on new concepts and those who are not

AMC is working on a new food concept and we are interested whether other hospitals are currently working on new concepts as well. We concluded that Deventer Ziekenhuis, Gelderse Vallei and Maasstad are not working on a new concept. These hospitals are improving their current concepts, which are recently (within the last 5 years) implemented. The other hospitals are working on new food concepts and MST is actually building a new hospital in which they will implement a new food concept. This concept MST is going to implement resembles closely to a layout of the floors that AMC is embodying in their future food concept. Following developments at MST is thus interesting for AMC.

An observation we make is that the hospitals that have real short times between patient orders and delivering to their beds are not developing new concepts. While the hospitals that still struggle with longer time periods between patient order and delivery at their beds, AMC, Gelre, MST, ZGT, GHZ and UMCN, are all working on new food concepts in which they try to reduce this order-delivery time. Among all the participants of named hospitals there is a consensus that having a long time between ordering and delivery does not fit in our current age.

7.3 Storage

Storage is a key aspect of the food logistics. This is based off data we gathered , from which we observed that the organization of Goods Receipt (Section 7.4) and the Ordering System (Section 7.5) are highly influenced by the manner storage is organized.

A trivial question when looking at the organization of storage is whether to keep stock centralized or decentralized. AMC struggles with this and Haas (2013) has written a report on this faced issue. Her report looks closely at which products to keep in a centralized stock and which to keep in a decentralized stock. We however address the effects of keeping a centralized or decentralized stock on the food logistics.

7.3.1 The way hospitals organize their stocks.

Table 6 summarizes our findings concerning the organization of storage. In Table 6 we distinguish between the way products for warm meals and the way products for wholesale are stored.

Centralized		Combination centralized/decentralized		Decentralized	
Wholesale	Warm	Wholesale	Warm	Wholesale	Warm
	AMC			AMC	
	DZ	DZ			
		Maasstad	Maasstad		
Gelre	Gelre				
MST	MST				
	ZGT	ZGT			
	UMCN			UMCN	
Gelderse Vallei	Gelderse Vallei				
GHZ	GHZ				

Table 6: Overview of the way each hospital has arranged their storage

From Table 6 we conclude that within this research's boundaries, both UMCs are unique with regard to stocking wholesale products. Both of them use a decentralized way of storing their wholesale function. This is in contrast with the other hospitals, these make use of centralized storages. DZ, Maasstad and ZGT make use of a decentralized stock as well, but they support this with a central stock: the decentralized storages are supplied by the centralized storage.

ZGT's storage organization is unique. Namely, ZGT has two locations one in Hengelo (the one visited) and one in Almelo. To supply both these locations they have a central storage facility on the industrial park in Hengelo. This means that all suppliers place their deliveries at this central storage facility. From this facility, products are transported to the two hospital locations. Organizing the storage process like this makes it possible to resupply the hospitals whenever needed, due to the high level of control provided by a large centralized stock.

AMC is currently searching for possible solutions to the pressure put on the food assistants caused by the current system. Namely, food assistants at AMC are required to unpack the trolleys while also

preparing the breakfast rounds. One solution that is studied is to let the logistic employees unpack the trolleys at the pantries. To provide AMC with arguments whether letting logistics employees unpack the trolleys is a viable solution we asked the hospitals which employees are in charge of unpacking delivered goods. Table 7 gives an overview of the results to this question, making a distinction between warm meals, wholesale and stocking the bread buffet trolley.

Hospital	In charge of stocking warm meals	In charge of stocking wholesale	Wholesale into the bread buffet trolley
AMC	Logistic employees	Food assistants	Food assistants
Gelre	(happens at the other location)	Kitchen employees / Food assistants	Kitchen employees
DZ	Food service employee	Logistic employee	Food service employee
MST	Storage employees	Storage employees	Food assistants
ZGT	Food assistant	Food assistant	Food assistant
Maasstad	Supplier employees	Supplier employees	Food assistant
UMCN	Back office employee	Back office employee	Food assistant
Gelderse vallei	Kitchen employees	Kitchen employees	N/A
GHZ	Kitchen employees	Kitchen employees	N/A

Table 7: Categorization of which employees are in charge of restocking the storage per hospital.

From table 7 we observe that if AMC wants to apply logistic employees into the stocking process they should look at DZ. However, they should take into consideration that DZ is smaller and internal travel times are shorter. Another consideration is that DZ makes use of a centralized storage, meaning that storing received goods at pantries can be done at any time on the day. Besides this freedom on scheduling when to unpack delivered trolleys, another advantage is that not all the pantries have to be done at the same time. Whereas AMC has to unpack all the trolleys in the morning hours simultaneously as not doing so would mean that the last trolleys to be unpacked will have violated the HACCP requirements.

Another solution of reducing the work pressure of the food assistants is applied by UMCN. At UMCN, they use a flexible workforce of students/part time workers who are in charge of the back office at the pantries. Their tasks among others is the stock the storage of wholesale and warm meals at the pantries. Next to that they help with setting coffee, tea and comparable small jobs. Making sure that the food assistants can focus their time on where they are originally hired for, helping patients with receiving enough nutrition and liquid.

7.3.2 Waste

In this section we evaluate the waste percentages per hospital. In Figure 12, MST and GH are excluded because of a lack of data about waste percentages within these hospitals. We observe that AMC is among the hospitals with the lowest waste percentage. It is important to note that these numbers cannot be fully accounted for. As we asked each hospital for their waste percentage, however, each hospital uses different measurements for calculating these. Therefore, no hard conclusions can be drawn from the figure. We believe that it still provides a indication we can use for comparison meaning.

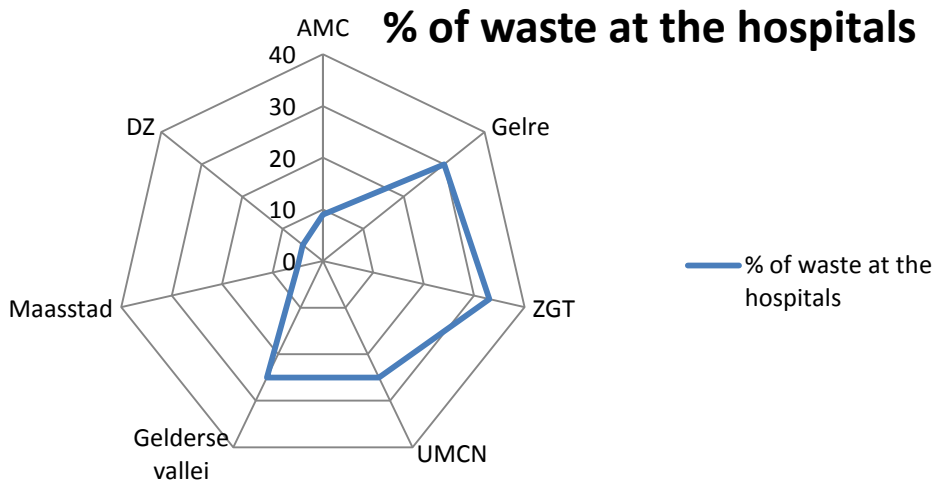

Figure 12: The percentages of waste per hospital (Note: no numbers available for MST and Groene hart)

Another conclusion we draw from Figure 12 is that waste below 5% has only been achieved in those hospitals that have a short ordering to dinner receiving time. These are DZ and Maasstad. Contradicting to this conclusion, Gelderse Vallei which has a system build around complete freedom of patient ordering is showing a high amount of waste. This can be addressed to the fact that Gelderse Vallei still cooks their own food. Whereas DZ and Maasstad only use premade dinners. Beside that it is also interesting to notice that the Gelderse Vallei uses a central kitchen whereas DZ and Maasstad make use of decentralized pantries. As Gelderse Vallei is cooking meals themselves the problem arising is that some components cannot be made within the time span they guarantee. Therefore, for these components big bulk is created at once, based on forecasts. This bulk is what creates the largest waste percentage for Gelderse Vallei as what remains of the bulk at the end of the day has to be disposed. Further research will be needed to verify whether a short cycle time between a patient ordering and a patient receiving his order leads indeed to less waste. Or whether this is achieved by other areas of the process.

Even though Groene hart has no numbers available about their amount of waste. They claim to have a very small waste percentage, which never gave them a reason to measure the waste. This low

waste percentage is accomplished by their customer driven ordering method. Using this method ensures they only require a minimum storage area. More on their customer ordering method in section 7.4.2.

7.4 Ordering system

Section 7.3 gave an evaluation of the hospitals organize their storage functions. Within this section we discuss how the hospitals order their products. We do not focus on, which specific products are ordered. Instead, we take a broader view on how the process around ordering these products is planned and controlled. First, Section 7.4.1 discusses the process around external ordering. Second, Section 7.4.2 discusses ordering support functions and methods.

7.4.1 Which and how many actors are involved in the external ordering process

The hospitals use resembling ordering systems. Most hospitals are aiming for JIT and lean systems. However, there are only a few that have a complete pull system where orders are based on patients orders. The hospitals that use a complete pull system are MST and GH. Using this ordering system has a huge drawback however, that is the cycle time between patients ordering and patients receiving their meals. This cycle time ranges between 28 and 36 hours at MST and GH and is thus at least seven times longer than at the other hospitals.

In Figure 14 we show an overview of which actors are involved in the ordering process. The starting boundary is set at the actor that inputs the order into the computer.

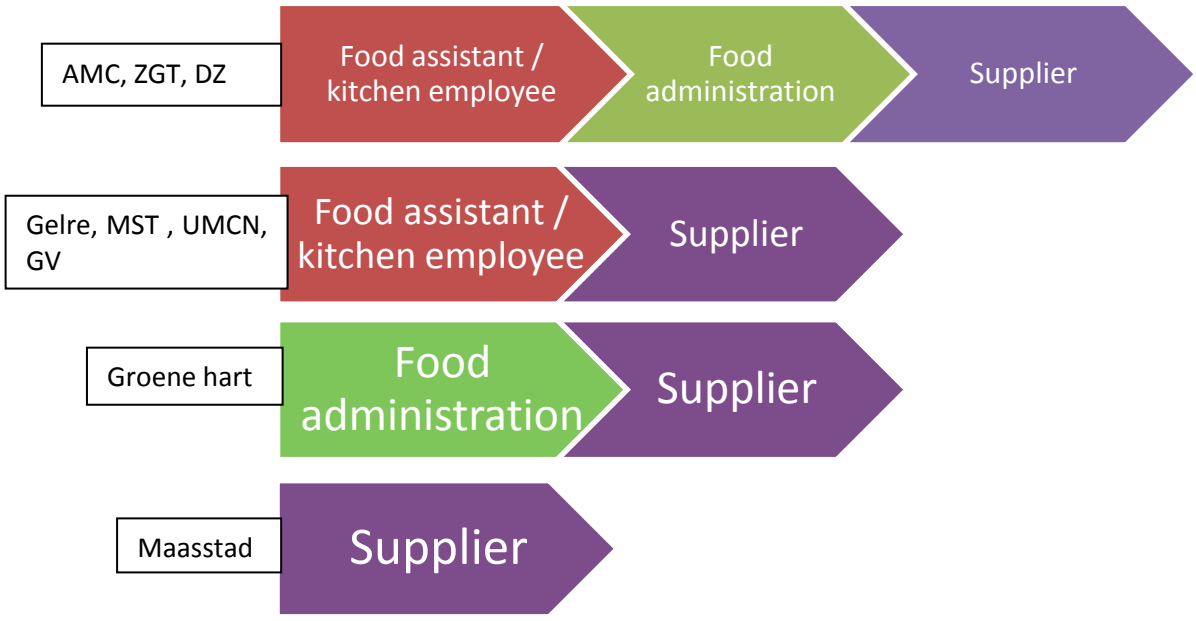

Figure 14: Who are involved in product ordering

From figure 14 we conclude that hospitals either have:

- *A single actor responsible for ordering*
- *A combination of an two actors responsible for ordering*
- *The supplier being responsible for maintaining the stock levels.*

AMC is one of the hospitals that falls under the category of hospitals that have two actors responsible for ordering. Evaluating the interviews we learn that hospitals are working on disengaging their food administration from the ordering process. By eliminating the food administration from the ordering process these hospitals move to a process with only a single actor being responsible for ordering. It could be argued that this would only be possible for smaller hospitals. However, one of the hospitals without food administration is UMCN. Elimination of the food administration from the ordering process is possible because the food administration in most cases perform checks that to some extend is also done at the suppliers. Hospitals without check points from the food administration did not report a higher order failure rate than normal.

MST and GH are both the hospitals with a full pull process. This means that the orders they place are based on the orders they gathered from the patients. At MST we observe that these orders are first collected and grouped at the food administration after which the gathered data is provided to the kitchen. It is then the responsibility of the kitchen employees to place orders after combining the data from the food administration and their knowledge on the stock levels. Contrary to all the other hospitals we observe that at GH the food administration has full responsibility for ordering. Here the kitchen employees provide up to date stock level data to the food administration, which is then combined with the patient orders. Again we like to point out that MST and GH do make use of a full pull system. However, they suffer from a lack of customer service due to the time in advance the patients have to decide what they want to eat.

Finally, we see that there is one hospital where the supplier is in full charge of the reordering process. This is the case at Maasstad. We are going to elaborate more on this in Section 7.5. For now it is sufficient to know that Maasstad is unique in having outsourced the whole food logistic up to the pantry, to the supplier.

Besides our interest in knowing which actors are involved in the food ordering process, we also asked other hospitals about the amount of time the ordering process took from the food assistants if they were involved. This has been asked because AMC is unsatisfied with the amount of time that is spend on ordering, each day, by the food assistants. Two food assistants spent roughly 20 minutes each,

each day to order the products. Added up to a full year this is quite costly. Therefore AMC wants to improve the efficiency of ordering.

In order to look for comparison between the time spend on ordering at hospitals, we inventoried whether the hospitals have time indications for the amount of time spent on ordering each day / week. Most hospitals are unaware of these numbers and therefore no good comparison can be made unless further research at each of these hospitals is conducted.

7.4.2 Methods used for ordering and IT support

Hospitals question what the best method is to determine when to reorder stock. AMC now works with a min/max list. Since it turned out during the pilot at AMC that the current min/max lists were not adequate causing errors with the orders (Section 6.2.2). We asked each of the hospitals what method they use for determining when a product has to be reordered. We observed that we can split the hospitals into the following four groups:

- **Minimum and maximum amount lists (min/max lists)**

  DZ, GV, Gelre, AMC make use of Min/Max lists. For DZ however, it should be noted that wholesale function products are being scanned by the logistic employees. At each of the other hospitals the food assistant or kitchen employees are in charge of ordering. Whereas we know for sure that at AMC the food assistant makes more use of experience than of the min/max list.

- **Food assistant experience**

  ZGT and UMCN clearly state that they do not make use of min/max lists. Here a strong value is given to the experience of the food assistants. It is believed that the amount of patients and their desires fluctuate too much to make use of fixed lists. Therefore, the food assistants have the freedom to order what is needed according to the circumstances. From Section 7.3.2 we concluded that UMCN and ZGT are among hospitals with higher waste percentages. It could indicating that using solely food assistant experience might lead to too much hoarding, which in turn leads to more waste. However, this can be one of multiple factors influencing waste percentages.

- **Customer driven**

  GH and MST make use of customer orders to determine what quantity to order. This is possible, because of a long waiting time for patients between ordering their meal and

actually receiving it (~28-36 hours). Even though this seems like a strong ordering system, as you would get exactly what you need, it also has the flaw that it is not very flexible. Accounting for the extra patients that arrive within the 28 hours but also need a meal on the same day they arrive, can only be done by estimations. For these incoming patients forecasts are made while placing orders.

- **Supplier driven**

  At Maasstad, the supplier is in charge of restocking. Maasstad uses a unique method. All pantries are stocked up completely each day. Where the products are placed in the shelves using the first in first out method. Restocking the pantries is done from the central storage. From this central storage within Maasstad stock levels are determined and orders are placed towards a warehouse of the supplier. From observing the use of this system, pantries are not concerned with ordering. As each day everything is refilled up completely. This can be achieved with the warm meals as well, because they are frozen premade products. Because these meals are frozen they have a reasonable long expiration date.

From the groups presented we conclude that AMC is in the group using min/max lists. We observed that the supplier driven method seems to be the most efficient. As the group that makes use of food assistant experience suffers from a lot of waste, while the customer driven group suffers from a very long cycle time. One application that makes the supplier driven method efficient is how all pantries are supplied from a central stock, and the stock levels are only monitored at the centralized stock. This means that hoarding occurs at a smaller scale. As example, from practice and interviews we evaluated that every person that places an order almost always orders a little bit extra for safety. However, when there are 15 pantries each ordering one extra item, you receive 15 extra items of which a fair amount will be thrown away. At Maasstad the orders are placed by a single employee to stock the centralized storage, from which the pantries are stocked. Expecting that this employee also orders one extra item, you receive only one extra item for 15 panties instead of 15. However, as mentioned this method would require a centralized storage space that is not available at AMC.

Since AMC is working with min/max lists they are curious to what extent they can automate the ordering process using these lists. Therefore, we asked other hospitals how much they automated their ordering process. The main feature of automation for the process would be the use of scanners and scanner tags which would eliminate parts of manual counting and quantity input. In Figure 15 we displayed which hospitals make use of such scanners.

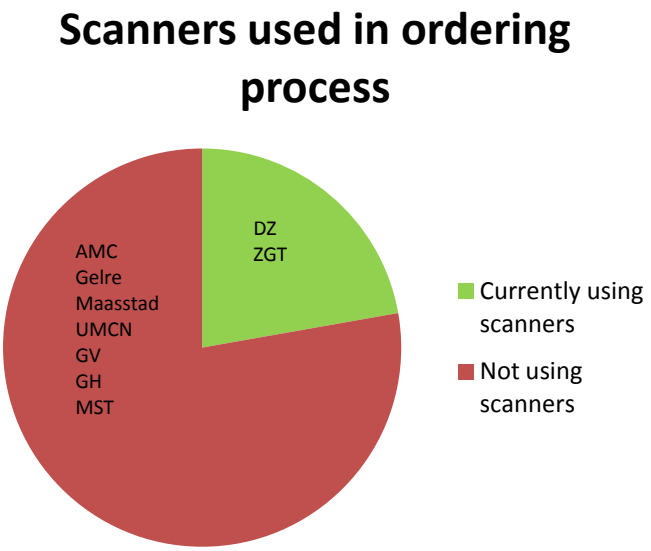

Figure 15: showing which hospitals use scanners and which do not.

Observing Figure 15 we conclude that only two hospitals are making use of scanners. At ZGT there is a complex scan tag system. Each time a food employee needs a new batch of products they place a scan tag on a dedicated wall. DZ and ZGT use their scanners for only a group of selected products. Due to time constraints and complexity, further research into these systems would be needed to give a complete advice to AMC.

At AMC there are multiple ordering systems running in parallel due to using the ordering portals of the suppliers. To find a solution for this problem we determined which IT systems other hospitals are using. However, we concluded that each hospital makes use of the ordering portals from their suppliers.

7.5 Goods receipt

For goods receipts we start with observing which different suppliers are supplying the hospitals in Section 7.5.1. In Section 7.5.2 we evaluate how these suppliers deliver the products. Finally, in section 7.5.3 we how hospitals deal with HACCP compliance.

7.5.1 Suppliers used and the integration of the suppliers

First, we determine the suppliers being used by the hospitals. Suppliers have an increasing role in the food logistics at hospitals. They swift from supplier toward partners. Therefore, AMC wants to learn whether other hospitals gain additional benefits from their suppliers.

Each of the hospitals uses one of the following suppliers when it comes to the wholesale and warm meals: Van Hoeckel, Deli XL, Sodexo, Huuskes. Next to these major suppliers, minor suppliers are used but we left these out of the research scope. We like to point out that Sodexo has a contract with Deli XL. So hospitals supplied by Sodexo are actually indirectly supplied by Deli XL.

Supplier	AMC	Gelre	DZ	MST	ZGT	Mstad	UMCN	GV	GH
Deli XL	X	X	X				X		
Huuskes		X		X	X				
Van Hoeckel	X			X			X		X
Sodexo						X		X	

Table 8: The suppliers used by each hospital

Table 8 provides an overview of which suppliers supply each of the hospitals. We conclude that five of the hospitals make use of a single supplier and that four of the hospitals have two suppliers, one for warm meals and one for the bread meals. Due to missing numbers we are unable to draw a conclusion on whether having one of multiple suppliers have a big influence on the effectiveness of the logistic process. Chapter 8 discusses the suppliers opinion on this topic.

Hospitals are working toward reducing their order sizes while increase the frequency of deliveries. With this development hospitals are doing research into the point of disengagement, meaning the point where ownership of the products changes from the supplier to the hospital. Figure 16 gives an overview for this point for each hospital. We conclude that only Maasstad, which works with Sodexo, has this point lower down the product stream (closer toward the patient).

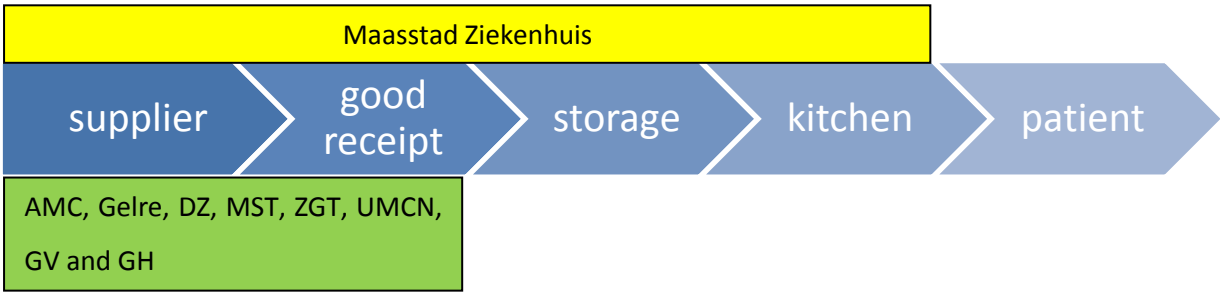

Figure 16: point of ownership change

Within Maasstad there are employees from Sodexo that are in charge of the storages, stock levels and internal distribution. Due to having employees from the supplier replace hospital employees, this is an expensive contract. When adapting such a method, a cost study would be needed to find the balance between hiring external employees and keeping one's own employees.

7.5.2 Methods of product deliveries at the hospitals

Another point of interest is the time of delivery at hospitals. We observed that each of the hospitals gets their delivery before 07:00 AM. One of the most mentioned argument for this, is that it is what the supplier wants. Since delivering so early allows them to let their trucks travel before rush hours. However, when evaluating the situation of AMC we conclude that receiving the products that early in the morning might not be ideal from a food logistics view. Namely, having to process the deliveries while also having to prepare the breakfast causes a risk of being late for the service round. Unfortunately, we did not discover a hospital that receives deliveries at a later time. Thus we cannot learn from the experiences of another hospital, concerning time of delivery.

AMC is experimenting with letting logistic employees being in charge of unpacking the trolleys at the pantries. This was doable during the pilot which was only held on one pantry, but applying this method to the whole hospital would create problems, as doing so would require at least one logistic employee per pantry in the morning. This requirement would be needed when holding onto the current way of ordering. At ZGT we saw another way of ordering. At ZGT instead of receiving the same food for each of the wards on the same day, there are clusters of wards that receive all items on the same day. So if for example five wards are clustered together. Each day during unpacking trolleys only five employees would be needed instead of 15. Which might make it possible to adopt such a process strategy. The drawback would be that the amount of items a pantry receives at once would be much larger, thus requiring a longer time for unpacking the trolleys.

7.5.3 HACCP

In Section 6.2.3 we explained how GGR also serves as an important HACCP control point within the food logistic process. As products with a high temperature, determined after a measurement, can be sent back stay the responsibility of the supplier. The problems at AMC occur at the second HACCP control point within the pantry. As the products might have gained a temperature that lies above the threshold. This is due to the fact that the received products, at GGR are hold in an open area, before they are distributed within the hospital and placed back into refrigerators. Especially during hot days in the summer this can quickly become problematic.

In Section 7.3.1 we concluded that AMC and UMCN are both unique in having a complete decentralized storage for the wholesale function. This unique storage organization is however also the source of the problems with HACCP. As at each of the hospitals with a centralized storage we observe that products that arrive are placed directly back into a cooling area. MST is building a new hospital in which they will change from a centralized storage toward a more decentralized storage,

has come to the conclusion that they keep a small centralized storage. Having this central storage allows them to temporarily store the products until there is time to distribute them internally to the decentralized storages. Since they are building a new hospitals they have incorporated this solution within the building layout. Implementing such a strategy will be harder for AMC.

UMCN, which also faced the same problem as AMC is facing now, invested in cooling containers as a solution to this problem. UMCN is the owner of these containers, but these containers are being used by the supplier. The ability these containers have is that they can stand within an open area while the products inside them stay cooled due to cooling elements. These containers can support the needed temperature for roughly four hours. These four hours are however critical during morning hours, because they allow food assistants to ignore the delivered products until they are done with the breakfast rounds. As such there is no risk of being late with breakfast and provide a less stressful service to the patients during the morning hours. Now the food assistants can unpack the containers during a low stress moment, after the breakfast round. Applying this method to the food logistics requires the supplier to participate, as they are obliged to use these special containers. Therefore, we asked the suppliers about their opinion about such an solution for AMC. Their reply can be found in Chapter 8.

7.6 Food logistics on the wards

Within this section we evaluate the movement between patients and the kitchens or pantries. We look at the movement of employees but also at the movement of information. We start with the movement of information by looking at the methods used by patients for ordering their meal in Section 7.6.1. Second, we discuss how these meals are brought to the patients in Section 7.6.2. Finally, we discuss the use of service employees in Section 7.6.3.

7.6.1 How do patients place their order

For each hospitals we describe how patients can order warm meals. We focus more on warm meals, as bread meals are, in most hospitals, ordered at the food assistant when they do their round, using an “a la minute” principle. The food assistant is able to deliver the order directly from the BBW.

We mentioned “most hospitals” as there are 2 exception, Groene Hart and Gelderse Vallei. At Gelderse Vallei each meal (so bread meals as well) is ordered by the patient using his bedside phone and the order is then delivered to the patient from the central kitchen. At Groene Hart each meal has to be ordered one day in advance from a paper menu. Figure 13 displays the methods used by patients to order their meals per hospital.

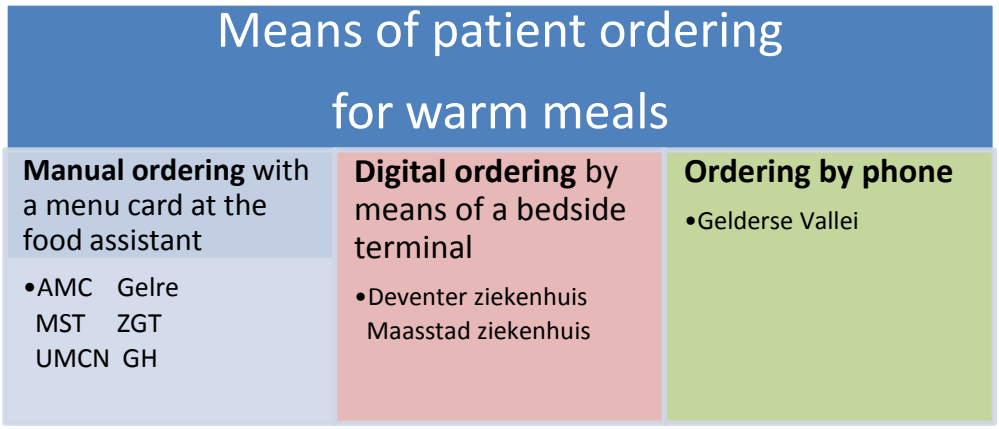

Figure 13: The schematic view of patient orders.

Evaluating Figure 13 we observe that Gelderse Vallei uses a unique patient ordering system. Beside this we also conclude that the three hospitals that are having short order-delivery times are not in the first category. Gelderse Vallei could have used bedside terminals for patient to order as well, but instead they decided to have a call center within the hospital. Using this method implies that patients call to the call center to place their orders. Each of the call center employees sits behind a pc and has all relevant data available about the calling patient. Most important data being their diets, but data about past orders and personal wishes (when available) as well. With this available data the call center employees can guide patients into ordering the right meals. Gelderse vallei chose for a call center instead of bedside terminals to keep the human touch on patients ordering meals. In the next section we go into more detail about how meals reach the patients from the pantry/kitchens.

AMC, is looking into new methods for their patients to order their meals, as the current used method involving the use of a menu card feels outdated. Looking at other hospitals AMC has created a vision toward the implementation of digital bedside terminals from which patients will be able to order their desired meals. However, looking at the use of a call centre, Gelderse Vallei has proven that such a call centre can also provide a viable option for changing the patient ordering process. It requires a smaller investment, while also keeping a human touch. Due to the human touch in the process the call centre will have a higher rate of adapting to sudden changes, which will not be there when the ordering process is digitalized. As it would require IT support to update the system.

7.6.2 From pantry/kitchen to patient

Each hospital makes use of fixed service rounds to provide something to eat and drink to patients. We can divide these service rounds into three major meal, breakfast, lunch and dinner, moments and three minor meal service rounds, also called coffee rounds. The three coffee rounds are in between the major meal moments and serve to provide patients enough liquids and extra nutrition to speed

up the recovery process. Gelderse Vallei is unique in using a At your request concept. This means that at Gelderse Vallei patients can call toward the call center anytime of the day to order anything of drink or food, available within the assortment. The At your request concept guarantees that these patients will receive their order within 45 minutes after their call. To make sure that all patients receive enough liquids and nutrition Gelderse vallei still makes use of coffee service rounds as well.

For the major meal moments we divide the benchmarked hospitals further, regarding their opinion and usage of time blocks. Time blocks is a method that allows patients to freely choose during what time they want to consume their meals. This method has created to provide eating patterns for patients that resemble their normal eating pattern with the idea of increasing their intake during each meal. However, time blocks can only contain up to a certain amount of people before their capacity is reached, which is tied to the kitchen capacity. If a time block becomes full it will disappear from the list to sign into and patients that order their meal will have a smaller choice of time blocks. Figure 17 shows the categories we divide the hospitals into.

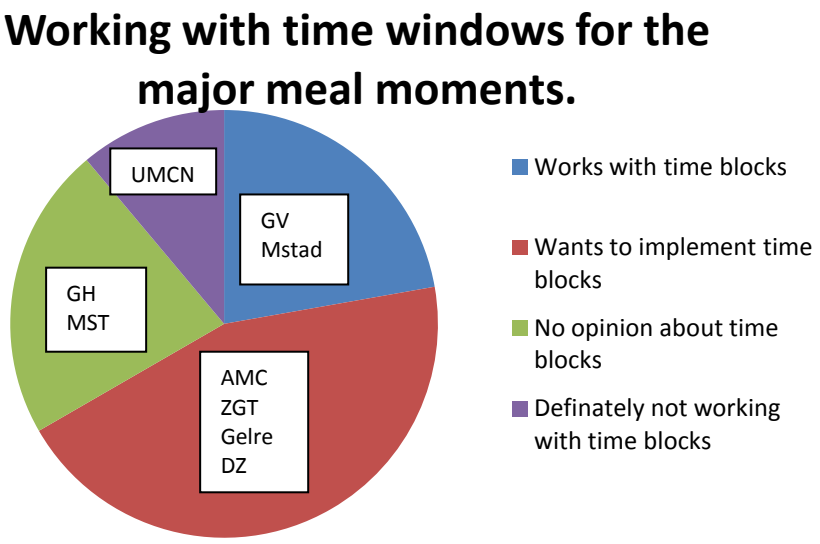

Figure 17: Overview of hospitals working and wanting to work with time slots.

Observing Figure 17 we notice that Gelderse Vallei and Maasstad are both working with time blocks. Giving patients a larger freedom to choose when they want to consume their meals. At Maasstad these time blocks are essentially available for dinner time. However at breakfast and lunch they walk multiple rounds with the BBW, In the morning they let patients sleep during the first breakfast round to return there on a second round. Thus some variability exists for the time of having breakfast. At Gelderse Vallei each of the major meal rounds is replaced by time blocks. Where the time block capacity is larger during breakfast and lunch and smaller during dinner due to the different capacity needed for a bread meal or warm meal.

The second and largest category from Figure 17 is the category of hospitals that consider the implementation of time slots. DZ has all digital systems already in place to implement time blocks and when their new system has stabilized they will start pilots with time slots.

Gelre is developing a system around time blocks as well. They are working on a concept, which addresses the problem of some of the time blocks reaching their full capacity before others. For this purpose Gelre wants to work with a combination of time blocks together with a "runner". This will be a dedicated employee that is available to "run" individual meals for patients that consistently want to eat within a time block that is full already. This way Gelre hopes to provide some extra service to patients that, for example, just came from surgery, and thus were too late for signing in their favourite time block to consume dinner. ZGT is just as AMC arguing that fixed dinner times is something that does not fit anymore in our age.

The third category from Figure 17 are the hospitals that are not yet thinking about time blocks. These are MST and Groene hart. These hospitals are focussing on reducing the cycle time between patients ordering and delivering meals to the patient. However, to this end they did not yet look into time blocks as this will be the next step.

Finally, the last category is a hospital that is defiantly not using time blocks in its food concept. Contrary to the other hospitals UMCN has used time blocks in the past but with some problematic results. Therefore, UMCN does not have any future concepts in which time blocks are involved. They are not against time blocks but admit that time blocks do not work for their hospital. The problems occurred on the wards during dinner times, due to the sizes of the rooms. Namely, UMCN has several rooms that can hold up to 6 patients. The problems that occurred was the colliding of nurse and food assistant tasks within the same room. As some patients would eat around 17:00 while in the same room another patient ordered their meal for 19:00, and a third patient ordered his/her meal between these times. This meant that the food assistants had to deliver meals at the same room several times within two hours, while at the same time nurses could not carry out necessary but somewhat appetite killing tasks at other beds while one patient was having his dinner. UMCN thus stopped working with time blocks based on the complaints received from their nurses and food assistants.

Based on this experience from UMCN, we asked how big the largest room is at the Maasstad and DZ. Both these hospitals are using new buildings (recently build and with the concept of time slots in mind). Interestingly, we observed that the largest room in both these hospitals can only hold up to 4 patients. A ward at Maasstad consists of 16 rooms for a single person and 4 rooms for 4 persons. This

is a completely different room layout than that of UMCN. Since the room layout of UMCN is similar to the room layout of AMC we advice that AMC takes a lesson from UMCN's experience.

7.6.3 Usage of the BBW

In addition to the different service rounds and time block we are also interested in the resources used for transport on the wards. AMC uses the BBW. Together with IFC they are wondering whether there is a new or better transportation tool that can provide better services. Each of the hospitals uses the same BBW and has the same complaints. The major problem, is the size of the BBW. As its original implementation is ability to prepare a meal in front of the patient, inside the patient room. Unfortunately, the size of the BBW does not allow it to be easily parked inside smaller rooms, in order to prepare a meal in front of the patient. At each hospital we noticed that the BBW are mostly standing on the hallways, out of sight of the patient. This indicates that the functionality of the BBW, being able to show to the patient what they can chose for breakfast / lunch, is usually lost. Except for Gelre no hospital has found a replacement for the current BBW. However, in contrary to AMC most hospitals use multiple trolleys for the different service rounds, whereas at AMC the BBW is used for each round except the warm meals. The drawback is the need for enough space to park all this material when they are not being used.

Gelre is actually purchasing a new BBW. They will switch from the same model AMC uses to a model that is smaller and a bit lighter, because instead of a electric cooling area it will only have a cooling box. Whether these will perform better needs to be evaluated in time.

7.6.4 Employment of service employee

During a single day a lot of different employees visit patient rooms, disturbing the patients rest. Therefore, AMC is looking into concepts to combine tasks of different employees into the task of a single employee. Doing so AMC wants to reduce the amount of employees needed to do all the tasks around the bed in a patient room, and because less employees enter the room have the patients recover with less disruptions. In Table 9 we display an overview of the usage of service employees versus food assistants at hospitals.

Hospital	Working with food assistants	Combination of service employees and food assistants	Working with service employees	Implementing service employees	Seeing a benefit of using service employees
Gelre		X		X	X
MST	X				X
ZGT		X			X
Mstad			X		X
GH	X				X
GV	X				
UMCN	X				X
DZ			X		X

Table 9: Usage of service employees.

Observing Table 9 we notice that there are two hospitals, DZ and Maasstad, that only have service employees in service. ZGT works with a combination of service employees and food assistants. They look at the specific needs of each ward. Then based on these needs, ZGT selects a combination of service employees, nurses and food assistants for the ward. Gelre seems to have a contradicting input in the table. They are working with a combination of service employees and food assistants and are at the same time also implementing service employees. Gelre has such a data input, because Gelre has two locations. Service employees have been introduces at the location of Zutphen but are still in concept phase at the location of Apeldoorn. The last conclusion we draw from Table 9, is that with the exception of GV all hospitals see the benefits of the implementation of service employees. Gelderse vallei does not see a direct improvement from the implementation of service employees. One major feature of service employees would be that they create a stable contact point for the patient. However, GV argues that due to all the different shifts in hospitals even these service employees would change at least once each day. Therefore, GV argues that the service employee is more an improvement seen from a process perspective but not directly so from a patients perspective. The other hospitals have a strong consensus that the benefit will be a decrease in patients rest disturbances. While also providing a stable contact point. We think GV makes a valid point, but we believe that the current situation will be improved by the implementation of service employees.

The amount of tasks a service employee has exceeds those of a food assistant. This leads to a discussion of how many beds should be assigned to a service employee in comparison to a food assistant. For this purpose we evaluated the situations at the hospitals, which we summarized in Table 10.

Hospital	Service employee	Food assistant
AMC	-	26
ZGT	-	-
MST	-	30
Gelre	14 (Zutphen)	20 (Apeldoorn)
DZ	-	-
Maasstad	16	-
Gelderse vallei	-	-
Groene hart ziekenhuis	-	-
UMCN	-	24

Table 10: Maximum number of beds a single employee should handle.

Table 10 is far from complete, because most hospitals were unsure about their average number of employees on a ward due to varying numbers on the wards. For these hospitals the amount of employees on a ward are determined by the type of ward. The amount of care the patients on a ward need, determines the maximum amount of beds that are assigned to a single employee. Fortunately, some of hospitals were able to provide us with some data. From this available data we conclude that the amount of beds assigned to a food assistant range from 20 to 30. While the service employees either have 14 to 16 beds assigned. So according to the available data replacing all food assistants with service employees would require recruiting additional staff in order to be able to cover the same number of beds. However, as service employees will also perform certain tasks from other type of employees, as cleaners, some of these might become redundant as well. A good study will be needed to provide a balance between increase in hospitality versus a possible increase in costs.

Maasstad has an unique concept regarding their service employees. Next to having outsource most of their food logistics to their supplier, they have also outsourced their service employees. All of their service employees are provided by Assist Zorg BV. This company ensure the right qualification and training of their employees and manages all the service employee activities at Maasstad.

7.7 Reverse logistics

When evaluating the Reverse logistics, AMC is specifically interested in the organization of dishwashing. To support AMC's decision making around this topic we observed the concepts used at other hospitals. These are discussed in Section 7.7.1.

7.7.1 Dishwashing

Focusing on dishwashing we make a distinction between centralized and decentralized dishwashing. After evaluating the used concepts, we concluded that there are three categories. Those hospitals that use centralized dishwashing, those that used decentralized dishwashing and those that use a combination. The hospitals using a combination, dish wash the resources from the coffee rounds at the wards while they dish wash the resources for warm meals in a centralized area.

From discussion with the hospitals we concluded two things. Doing the dishwashing in a centralized area makes the process more efficient, the downside however, is the amount of dirty dishes transported through the hospital each day. While decentralized dishwashing has the opposite effect. We noticed that hospitals tend to favour decentralized dishwashing for decreasing the amount of dirty dishes transported through the hospital. Nonetheless, most hospitals have a centralized dishwashing area that has been constructed in the layout in the past, in consistency with used concepts. Due to the investment costs for changing this layout, these hospitals stick with their current centralized dishwashing area.

MST, building a new hospital, will implement decentralized dishwashing in the layout. They believe that centralized dishwashing would have created a more efficient way of doing the dishwashing. Yet, they believe that doing the dishes on the decentralized kitchens will ensure less movement is needed. Benefiting the rest patients receive and reducing the risks of contamination from transporting dirty dishes. The focus of their new concept is, based on reducing movements within the hospital and the movement reduction is thus the main argument.

ZGT believes that decentralized dishwashing does create a benefit for reducing the amount of movement needed within the hospital. However, some question marks are put on the amount of noise a dishwashing machine creates, which could disturb the ward. As the layout has already been put out for a centralized manner of dishwashing ZGT will not change the way in which dishwashing is done.

7.8 Warm meals

AMC is considering a new concept for warm meals. This concept will introduce a central kitchen on each floor. Doing so, AMC wants to bring back the ability to produce warm meals themselves. Section 7.8.1 discusses how warm meals are being made at the hospitals and what food concepts are being used.

7.8.1 Warm meal food concepts

From the interviews, we gathered the different food concepts each of the hospitals use. These are summarized in table 11:

Hospital	Food concept	Hospital	Food concept
AMC	Regenerate	Gelderse Vallei	At your request
Gelre	Uncoupled central kitchen	Groene Hart	Coupled kitchen
DZ	Room service	Maasstad	Regenerate
MST	Coupled kitchen	UMCN Radbout	Assemblage kitchen
ZGT	Coupled kitchen		

Table 11: food concepts used at each of the hospitals

From table 11 we conclude that there are six different concepts being used. We observe that some of the concepts are used by multiple hospitals. However, hospitals using the same concept can execute them in different ways. Maasstad and AMC both use a regenerating concept, a concept for which no kitchen within the hospital is needed. The difference between both hospitals is that Maasstad makes use of frozen meals to regenerate, whereas AMC makes use of cooled meals for regeneration. The main difference between frozen and cooled meals being the expiration date.

A brief explanation of each of the concepts:

- Coupled kitchen: all products are prepared/cooked at the moment they are needed.
- Uncoupled kitchen: All products are prepared in advance. Then they are cooled down or frozen. At the moment meals are needed these cooled or frozen products are being regenerated to the right temperatures and served out to the patients.
- Regenerate: The products are regenerated at the moment they are needed. The difference with uncoupled kitchen concept is that the premade meals are bought from external sources. As such no hospital kitchen is needed.
- Assemblage kitchen: A mix of coupled and uncoupled. At the moment meals are needed the meals are prepared from premade components to reflect the patient ordered meals.
- Room service: Same as the Assemblage kitchen, however, DZ has invested in room service employees as such there are no more food assistants working within the hospital, instead all patients are supported by service employees.
- At your request: Uses a coupled assemblage kitchen. Only this kitchen is in operation the whole day as Gelderse Vallei offers their patients the freedom to order their meals at any desired time.

We divide the concepts into two categories, those concepts that are supported by a kitchen and those which are not. There is only one concept which does not require a kitchen and that is the regeneration concept used by both AMC and Maasstad. These two hospitals only require an oven to regenerate (heat) the frozen/cooled meals to the desired temperature.

The other hospitals use a kitchen on site for the preparation of warm meals. Evaluating the differences between the two concept we conclude that the main advantage of using a kitchen, is the freedom to mix components based on the desires of the patient. At AMC the patients can choose a meal but as these meals are all premade, meaning all the components of a meal are already packed together in the same packaging, mixing components is not optional. The menu card at GH and GV have way more options than the menu card at AMC. On the menu cards from GH and GV, each category of nutrition provides a list of possible components. For example from the category meat a patient can choose between chicken, bacon or meatloaf. There are restrictions to the amount of components from the same category a patient can choose to make sure they get all the components necessary. Nonetheless, patients have a huge freedom in determining what they want to eat for dinner.

The second advantage of working with an in house kitchen is control over portioning. The premade meals used for regenerating are having a fixed size. It is possible to reduce the size of the meal by scooping half the portion away, but unfortunately this half usually ends up in the garbage bin and contributes to the amount of waste generated. In contrast, using an own kitchen creates a freedom to produce dinners with different sizes. Although these sizes are fixed with the usual options being ½, 1, or 2 as a meal size. These are needed to create a better productivity in the kitchen. Complete customization for every patient would still be too time consuming.

Concluding from these observations we remark that hospitals that use a kitchen have a larger control on meal component mixing and portioning for warm meals. This creates a larger hospitality while reducing the waste at the same time. However, a drawback are the costs for sustaining and building a kitchen. AMC wants to invest in building a centralized kitchen/restaurant per floor. From the mentioned argument we conclude that this will indeed offer more service towards the patients by granting them a bigger variety in meal composing.

8 Suppliers opinion of AMC's current food logistics

8.1 introduction

The answer to RQ 3 is discussed within this chapter, RQ 3: **What is the view of AMC's suppliers regarding the food logistics at AMC?**

In Section 7.5 we mentioned that hospitals are creating partnerships with their suppliers, rather than using them as the regular supplier. To further investigate this and learn the view of the supplier on this point we interviewed the suppliers from AMC. During these interview we asked for their opinion about AMC's food logistics and the cooperation between suppliers and hospitals.

The following representatives have been interviewed:

Deli XL	Annita Holthuis	Manager Advice & organization
Van Hoeckel	Martin van Asselt	Commercial regional manager
Van Hoeckel	Paul Vrinzen	Project manager

Table 10: overview of contacts spoken too during interviews with suppliers

Concluding from Table 10 Van Hoeckel has been given more attention as they are currently working on amplifying their cooperation with AMC by running a project together with AMC on bringing more efficiency within the hospital and reduce waste (Paul Vrinzen is in charge of this).

Deli XL has also been spoken too as they are in charge of delivering the warm meals. Both of these suppliers were asked whether they see trends within the market, and what they would suggest to improve the food logistics within hospitals, with AMC specifically. Section 8.2 discusses our interview with Deli XL while Section 8.3 discusses our interview with Van Hoeckel.

8.2 Deli XL

According to Deli XL a major trend toward decentralizing food production is taking place in the Dutch hospitals. However, advice is giving to not simply follow the leaders in this change. Instead, first do a research on how practical this is with the current layout of the hospital. Calculations on the extra handling costs for keeping separate stocks throughout the building are required. Still, as supplier they see a rising demand for closer cooperation. This includes a higher level of logistic handling for the supplier. There is an increase in demands toward the suppliers to not simply drop the deliveries at the goods receipt but to actually move the goods toward the different decentralized depots within the hospital. As Deli XL mentions this is possible however, it would cost the hospitals more money, to

attain such service. It is up to the hospitals to calculate their costs versus profits before making such arrangements.

8.3 Van Hoeckel

According to van Hoeckel a lot of extra services are available. However, costs will rise as well with every extra service that is being offered. At this point Van Hoeckel is working on a new concept “klein schalige woningen” (KSW). KSW is based on the food logistics in the elderly care. However, it is possible to increase the scale of operation to the needs of hospitals like the AMC. The core of the concept focuses on the reduction of bulk deliveries. This means that bulk packages are opened at Van Hoeckel and items are then distributed into the cross docked orders. For hospitals this would mean that they need less storage space for these bulk products as well lose the handling of having to unpack these items themselves. KSW is developed because Van Hoeckel observes that the market shows a trend toward small ordering. This comes forward from the increasing trend show at the clients of Van Hoeckel. These clients are focusing more on decentralized ordering while reducing their centralized stocks.

Another trend Van Hoeckel noticed, is one that we mentioned in Section 7.5. Namely an increase of suppliers, which attain partnerships with the hospital rather than just being a supplier. This incorporates that hospitals are searching for closer coordination and cooperation of their suppliers in order to reached an well oiled logistic process from source until sink.

Van Hoeckel expects that savings within the logistic process can be achieved when AMC would order less frequent a week, while ordering more of the products at once. It is up to the AMC to do calculations on whether this would indeed create more time for employees to focus on other activities and whether this is possible with the current storage possibilities.

An additional point of interest for AMC is hat van Hoeckel is positive about changing delivery times. This is an issues AMC can look at. As mentioned in Section 7.5.3 a solution to reducing stress level on the food assistants in the morning is offering them a way to unpack trolleys with new deliveries at later times. As there are not cooling cells for temporal storage within AMC one option is to let the supplier deliver at a later time during the day. Van Hoeckel is positive about changing these times and thus this might be a valid option to study.

Paul Vrinzen, is currently working together with AMC to reduce the waste. He gave us a few insights as well regarding the current food logistics at AMC.

- **Place the risk at the supplier:** According to Vrinzen AMC should discuss with the supplier to keep more stock at the supplier. Especially slow movement items, as these are usually bought in to big portions, due to their bulk packaging. Leading to the hospital ending up with products that passed their expiration date. Creating extra waste

- **Deliver times of the products:** Together with Vrinzen we observed the problems that arise from the early deliveries, which create stressful mornings at the pantries. According to Vrinzen AMC should make clear what they want to prioritize. We assumed that AMC gives a lot of credit to the stable state of the starting times of the breakfast rounds. This means that AMC should look at this process and then delete the events that jeopardize this stable state of the process. After mentioning the solution of UMCN we observed that it is probably a cheaper option to look at the delivery time of supplier first. As we see the logistic process has high peaks at which the food assistant is busy with feeding the patients. At low peaks between these rounds however the food assistant should have time to place all delivered products in the dedicated shelves.

8.4 Conclusion

Both the suppliers mention that they have a hard time to oversee the whole process as Deli XL is in charge of the warm meals while Van Hoeckel provides the products for all the other meal moments. Deli XL mentions that caution should be taken when following the markets trend of decentralizing storage and kitchens. Further Deli XL is open for changing its delivering process or take on increased responsibility and task within AMC. However, such extra services would require a higher payment.

Van Hoeckel argues that AMC could increase their role within AMC's food logistics by having AMC place more of the stock risk at the supplier, letting van Hoeckel store slow moving products. Second they believe that AMC could lose the stress of the food assistants in the morning hours by delivering the products at a later time during the day.

9 Conclusions

9.1 Introduction

Within this chapter we draw our conclusions from the Benchmark. These conclusions are the answer to RQ 4 and 5, these are formulated in Chapter 4 and were formulated as:

RQ 4: Which solutions did we find during the benchmark with regard to improving the current food logistics at AMC?

RQ 5: What practices did we experience that AMC can add or take into consideration for their future food concept?

For a clear understanding we split Chapter 9 in two sections. Section 9.2 discusses solutions for improving the current food logistics and contains or recommendations for the improving the current food logistics. Section 9.3 discusses found insights to support the development of the future food concept and our recommendations regarding these insights.

9.2 Conclusions observed from used practices

To answer RQ 4 we determined what points for improvement there are within the current food logistics. Part I describes the problems we encountered. Within Part II we focus on two of the main problems. These are the HACCP compliance and efficiency in the ordering process.

The HACCP compliance, and the accompanied jeopardize for breakfast rounds being late, has been discussed in Section 7.5.1. Within this section we compared the situation at AMC with the other hospitals. We concluded that the problem occurred solely at AMC, because they are using a complete decentralized storage. The solutions observed at other hospitals to deal with this problem are:

1. **Investing in cooling trolleys.** UMCN, which also uses a complete decentralized storage system faced the same problem. Their solutions has been to invest in cooling trolleys which can wait in open (chamber temperature) areas for up to 4 hours without becoming a risk of violating HACCP regulation. Using cooling trolleys would make investing in a central cooling area redundant. This implies that AMC does not need to restructure the layout of the hospital.
2. **Invest in a central cooling area**. MST is going to change from a centralized kitchen to multiple decentralized kitchens. They will implement this new concept within a new hospital,

where the layout is designed to support their concept. While developing their concept they had also stumbled upon the problem of HACCP compliance from the lack of a central cooling area. Their solution to this problem is to build a small central cooling area where the trolleys can stand and wait until the time arrives to unpack them. Using this central cooling area secures the HACCP compliance while assuring that the trolleys can unpacked at the most suitable time.

3. **Change the time at which the supplier deliver their products.** After discussion with the suppliers we found that another reasonable solution could be to change the times the products arrive at the central goods receipt. This would not directly address the HACCP risk but it would clear the pressure in the morning and would make sure the main activity, providing good service during the breakfast rounds, is executed without risk of being late.

Second, the ordering process. We discussed the food logistics ordering process in Section 7.4. From comparing AMC's ordering process with those of other hospitals we draw the following conclusions:

1. **Food administration:** First, we see that the majority of hospitals is working on removing the food administration out of the ordering process. This to enable food assistants to order directly at the supplier, while removing handling from the process. Even UMCN, which is of resembling size as AMC has enabled their food assistants to order directly from the supplier.
2. **Methods to determine when to reorder:** We conclude that there are four different methods being used for reordering. These methods are: Min/max lists, Food assistant experience, customer driven and supplier driven. From these methods the last two are not usable for AMC as the last one mentioned would require a complete integration of the supplier into the food logistics. Customer driven ordering resembles a strong ordering method. While it does provide less waste it also has a low hospitality, as such this is not an option. Second, we see that the hospitals that make use of purely food assistant experience tend to have more waste percentages. As such Min/Max lists is the most optimal method to be used for reordering.
3. **Automation of the ordering process:** We conclude that scanner are not yet completely integrated in any hospital. There are two hospitals which made a start with using scanner in the food logistics. These are DZ and ZGT, which use scanners for certain categories of products within the food logistics. From these hospitals lessons can be learned about how to implement scanners up to some degree, however, for full scale integration of scanner AMC has to develop a concept themselves. The first steps DZ and ZGT took will contribute to this.

RQ 4 has now been answered. We elaborate more on which solutions we recommend in Section 9.2.1. Additional solutions regarding storage of items are found in Haas (2013).

9.2.1 Recommendations for improving the current process

Evaluating our solutions for HACCP, we recommend AMC to start an pilot with the supplier delivering the orders at a later time on the day. As the supplier stands positive to this idea, it can be executed within the near future. This solution has no investment costs. However, it does not solve the HACCP compliance directly. It only solves one of the problems caused by the HACCP. Namely, the jeopardize of the primary process in the morning, and the associated stress this cause. If AMC wants to solve the HACCP problem completely they need to invest in either cooling containers or a centralized cooled area. It is important to note that even though the supplier is willing to try to work with different times, studies will be needed to determine whether this change of food delivery, by the supplier, time can exist in combination with the other logistic streams within AMC.

For the ordering process we observed how other hospitals have successfully removed the food administration from the ordering process. As UMCN, which has about the same size of AMC, achieved this as well we believe that AMC can follow in their footsteps. To determine when and what quantities to order we observed that min/max lists are a good method. However, AMC is lacking a good database with the necessary data for forecasting, which is required for this method to work well. DZ, GV do have such databases available. Learning from them how to set up such a database can prove to be very valuable. In order to provide information about automation of the ordering process a follow up study should be conducted. Possible candidates for such a study are DZ or ZGT.

9.3 Findings and conclusions, from practice, for the future food concept

Within this section we answer the last of the research questions as formulated in chapter 4, namely RQ 5. This RQ focuses on the new food concept that AMC is developing. For the implementation of this concept the layout of the hospital will be changed in order to include a central kitchen on each floor. This kitchen will be located in the central tower and will be supported by two small pantries at the outer towers. In addition of using the area solely as a kitchen the area will also serve as a restaurant, this way patients who are mobile enough can enjoy their meal in a social place. Contributing to enjoying meals consumed together with visiting friends and or family. The availability of a kitchen makes using premade meals redundant. However, AMC is not excluding premade components from these meals. The pantries are reduced to sizes that support the BBW functionality as well as products needed for the coffee rounds.

To contribute to the future concept we made the following conclusions from our benchmark:

Use MST or UMCN as a benchmark partner: MST currently works with a centralized kitchen but they are going to implement a concept where they have a layout with a decentralized kitchens per floor. To achieve this new concept they are currently constructing a new building. This concept resembles a lot to the future concept of AMC. As MST is closer to implementation, using them as a partner enables AMC to learn about possible problems or opportunities while preventing the wheel from being invented twice.

UMCN is implementing assembly kitchens into their pantries. Only half of the pantries have been modified yet. Although it does not resemble to the future vision of AMC, it might prove to be a viable alternative. It will be worth to study the possibilities and create a cost balance. The drawback would be losing the restaurant setting.

Forecasting: As is discussed in the report by Haas (2013) we recommend AMC to invest in a method to keep track of products on the pantries. Currently it is possible to check what enters the pantry due to back tracking the orders. However, once products arrive on a pantry all means of following the products are lost. Of course, at some point the products that are inside the panty leave the pantry, but we noticed that AMC does not know whether these products are used for consumption by the patients or whether these products have been thrown away. Keeping track of what patients eat enables forecasting and the use of min/max lists that resemble actual demand. DZ and GV are both having huge databases of past outgoing meals. These databases allow them to make forecast on products being consumed based on the amount of patients. At DZ they are able to specify their forecast even further, based on the mix of young and older patients and the ethnicity. These forecasts help DZ and GV with determining what to order, enabling them to order almost precisely needed quantities.

Warm meals: Section 7.8 discussed the warm meal concepts used at the hospitals. From this section we conclude that AMC is one of the two hospitals that does not prepare warm meals themselves. This causes a lower hospitality as seen at hospitals that are working with their own kitchens. These kitchens allow them to offer patients a wider variety in meal components and meal size.

Time blocks: From Section 7.6.2 we observed that most hospitals are willing to or already have implement time blocks. However we conclude that AMC should approach an implementation of time blocks with caution. UMCN has some negative experience from the use of time blocks. From UMCN's experience we conclude that time blocks cannot be implemented in any hospital. Especially hospitals

with layouts based on patient rooms with higher capacity on the wards prevent a good working implementation of time blocks, as observed at UMCN.

Patient ordering: AMC wants to update their patient ordering method. Currently a menu card is used to receive patient orders for warm meals, while an a la minute approach is used for all the other meals. AMC is happy with the a la minute approach. However, AMC wants a better modernized method for the warm meals. In Section 7.6.2. we evaluate the methods used at hospitals. From this evaluation we conclude that most hospitals make use of the same menu card method. Two other methods have been found. The use of a digitalized ordering system, which requires bedside terminals for each bed. Something that is missing at AMC. Second, we observed the use of an internal call center. The digital ordering systems are in use at DZ and Maasstad, while Gelre is also working towards implementing the same system as used in DZ. A call center is used at GV. We are surprised GV chose for a call center in a market where most are working toward digitalizing all the processes. GV argues that the use of a call center makes it possible to keep a human line within the patient ordering process. Increasing its user friendliness, especially for the elderly, who are commonly less trained in the use of computers/touch screens. Having a trained call center employee that helps a patient directly also prevents a patient feeling helpless while waiting on a food assistant who needs to provide help to place an order.

Service employees: Unfortunately we are unable to draw a strong conclusion due to missing data relating service employees. The conclusions we draw are that first, with one exception, Gelderse Vallei, all hospitals are supporting the idea of implementing service employees into their processes. Second, DZ, Maasstad and Gelre already make use of service employees. Maasstad is somewhat different from the rest as they have completely outsourced these jobs to an external organization. This organization provides Maasstad with qualified service employees. Finally, from the limited data we have we notice that more service employees than food assistants are needed in order to cover the same amount of beds on a ward.

Reverse logistics: Focussing on dishwashing we conclude that the both concepts used, are each other opposites. Using decentralized dishwashing makes sure there is less transport of dirty dishes, and creates more sense of responsibility on the wards for their tableware. Centralized dishwashing on the other hand enables more dirty transport within the hospital, however hospitals agree that it creates more efficiency. Besides there are some question marks around the sound decentralized dishwashing machine cause. Using a centralized dishwashing machine makes sure there will be no noticeable sound on the wards itself. MST chose for decentralized dishwashing facilities, in order to reduce movement as much as possible.

9.3.1 Recommendation for the future food concept

In order for AMC to complete their future food concept we recommend that they study how MST has organized their concept. MST is working on a concept resembling AMC's future concept as such learning from MST can improve AMC's concept. If AMC learns that the costs for the rebuilding are higher than the allowed budget, they could take a closer look at UMCN's concept. They have assembly kitchens within the pantry's allowing preparation of warm meals with a larger freedom than the current premade meals used by AMC.

Regarding time blocks we recommend that AMC takes a lesson from UMCN's experience to prevent from encountering the same problems when implementing time blocks. It might in fact be wiser to refrain from implementing time blocks unless a whole new concept is created that effectively addresses the issues faced at UMCN.

To update patient ordering methods AMC is focussed on implementing bedside terminals to increase the ease at which patients can order their dinners. As AMC has no bedside terminals available, this can become a very large investment. Investing in a call centre, as seen at GV, might be a cheaper option. PinkRoccade is the company responsible for the IT at DZ and Gelre, and might make a suitable partner to gain insights in costs and benefits for a digital method. We recommend that AMC studies the effects of a digital system versus the effect of a call centre before implementing a digital system.

Last, we embrace AMC's development for an educative program to train food assistants and students into service employees. We observed that most hospitals are positive toward the implementation of such employees. As such, we expect a rising demand for such employees in the future. Maasstad uses service employees from Zorg Assist BV. This company trains their own employees and it might be possible for AMC to share knowledge with this company regarding their own training program.

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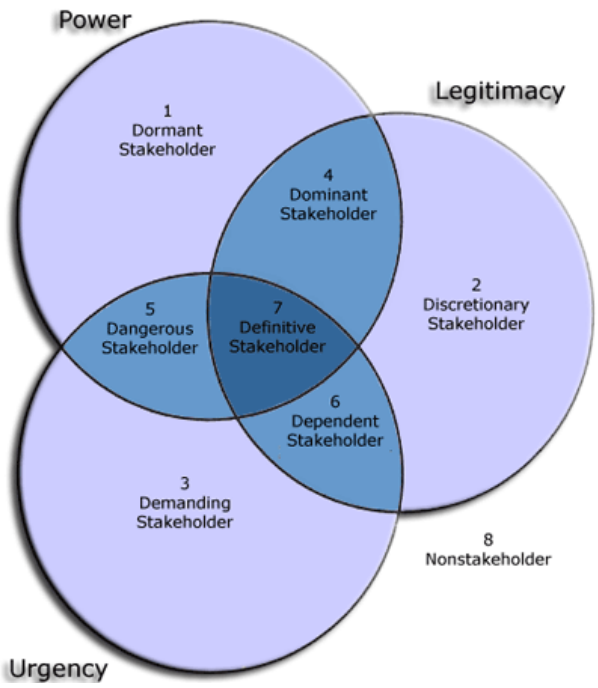
A. Appendix I: Stakeholder determination

Determination of stakeholder positions is done by using the typology of Mitchell, Agle & Wood (1997). This typology classes stakeholders based on the three key attributes power, legitimacy, and urgency.

Mr. M. van der Maat analyses the type of stakeholder based on the typology and add + and – signs to the different attributes. Together with our interpretation of his argumentation we connect the different stakeholders to one of the eight types of the typology.



Stakeholder		Power	Legitimacy	Urgency	Type of Stakeholder
Name	**Function**				
Mr. M. van der Maat	Manager Patient services	+	+	+	Definitive Stakeholder
Ms. F. Bakker	Staff advisor patient services	+/-	+/-	+/-	Discretionary Stakeholder
Mr. M. Boer	Manager logistics service centre	+	+	+/-	Dominant Stakeholder
Mr. I. Brandao	Project manager logistics directorate services	+/-	+-/	+/-	Dominant Stakeholder
Anonymous	Administrative Assistant at Basic Administration Directorate Services (BADS)	-	-	+/-	Demanding Stakeholder
Anonymous	Floor manager	+/-	+/-	+/-	Dependent Stakeholder

(Mitchell, Agle, & Wood, 1997)

Ms. F. Bakker is defined as discretionary stakeholder due to the advisory function she occupies in several project groups around the food in AMC. Mr. Boer and Brandao are both dominant stakeholders where Mr. Boer has a hierarchically higher status and has more power and legitimacy as Mr. Brandao. Where the latter has to reply to Mr. Boer. However, Mr. Brandao is as dedicated project leader of the project “SPA in the kitchen”, which is of high important for this specific topic. The administrative assistant is defined as demanding stakeholder, but due to the low power,

dependent on the other stakeholders. Changes in the logistic process will positively influence their function and therefore there is a certain urgency for a change. The floor manager is hierarchically below the other two managers and have less direct relations to the logistics of food. The floor managers undertake the burden of the current situation. For them it will thus be good when the problems are solved, however these are not their most top priority as they are more focused on the problems on operational level. This person was therefore identified as dependent stakeholder in this specific case.

B. Appendix II (Dutch)

a) II.1 Begeleidende mail

Beste medewerker van het AMC,

Wij zijn twee Master Industrial Engineering & Management studenten van de Universiteit Twente en doen onderzoek naar de voedingsservice in het AMC. Wij vragen u gaarne onderstaande tekst door te nemen ter voorbereiding op het interview wat binnenkort met u gehouden zal worden.

Aan ons is de taak voorgelegd om de huidige functies en processen rond de voedselvoorziening van de patiënten en zijn/haar mogelijke gasten in kaart te brengen. Dit zal het proces omvatten van distributeur tot aan het bord in handen van de patiënt. Nadat we dit inzicht in het proces hebben gemaakt zullen wij ons richten op verbeteringen in het proces, voor de patiënt, voor u, voor de organisatie. Hiervoor hebben wij echter uw hulp nodig.

Voor het vinden van verbeterpunten in het proces willen wij namelijk eerst weten hoe goed het proces in de huidige situatie functioneert. Dit zullen we doen aan de hand van Key Performance Indicators, ofwel KPI's. Wat? Zult u zich misschien afvragen. En vandaar dat we het hier zullen uitleggen, zodat u weet waar wij naar op zoek zijn en alvast met ons op een lijn zit.

KPI's zijn de indicatoren die volgens de stakeholders, in dit geval u, van belang zijn voor het meten van de prestaties van het proces. Via het interview met u willen wij een lijst van KPI's krijgen die wij dan in een nul-meting zullen opmeten. Hier staat de nul-meting eigenlijk gewoon voor de prestaties van het huidige systeem. Laat u vooral niet afschikken door het wordt opmeten. U kunt alles waarvan u denkt dat het belangrijk is om de prestatie ervan te weten op tafel leggen. Het zal daarna aan ons zijn om alle KPI's die we van u en uw collega's te ordenen en kwantificeerbaar te maken.

Enkele voorbeelden van KPI's: Patiënt tevredenheid, bezettingsgraad van de transport karren, tijd van centrale voorraad naar afdeling en voorraad grootte (centraal/decentraal)

De informatie die u met ons deelt zal naar wens anoniem of anders onder vermelding van uw naam terugkomen in ons eindverslag. Wat een advies rapport zal zijn voor het AMC, vanuit het IFC. En tevens voor ons zal gelden als ons master IE&M afstudeer verslag. Zoals net al naar voren kwam voeren wij dit onderzoek uit in opdracht van het IFC Almelo en de Universiteit Twente.

Alvast bedankt voor uw tijd.

Met vriendelijke groet,

Wendy Haas en Theo Lescure.

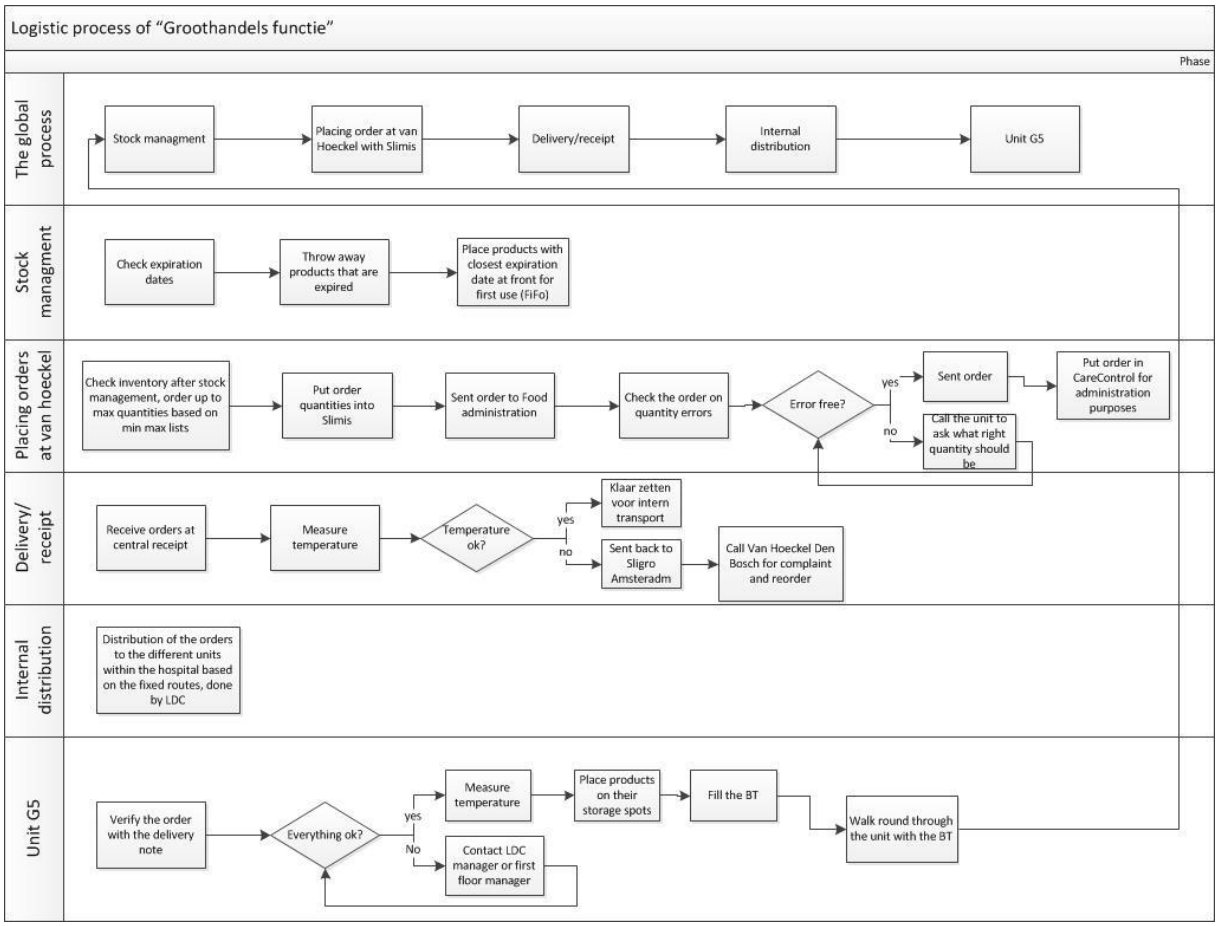
b) II.2 Interview

Aim of the interview is reaching at least three performance indicators as expected by each stakeholder. As interviewers we aimed to spread these performance indicators over at least two of the five basic performance objectives.

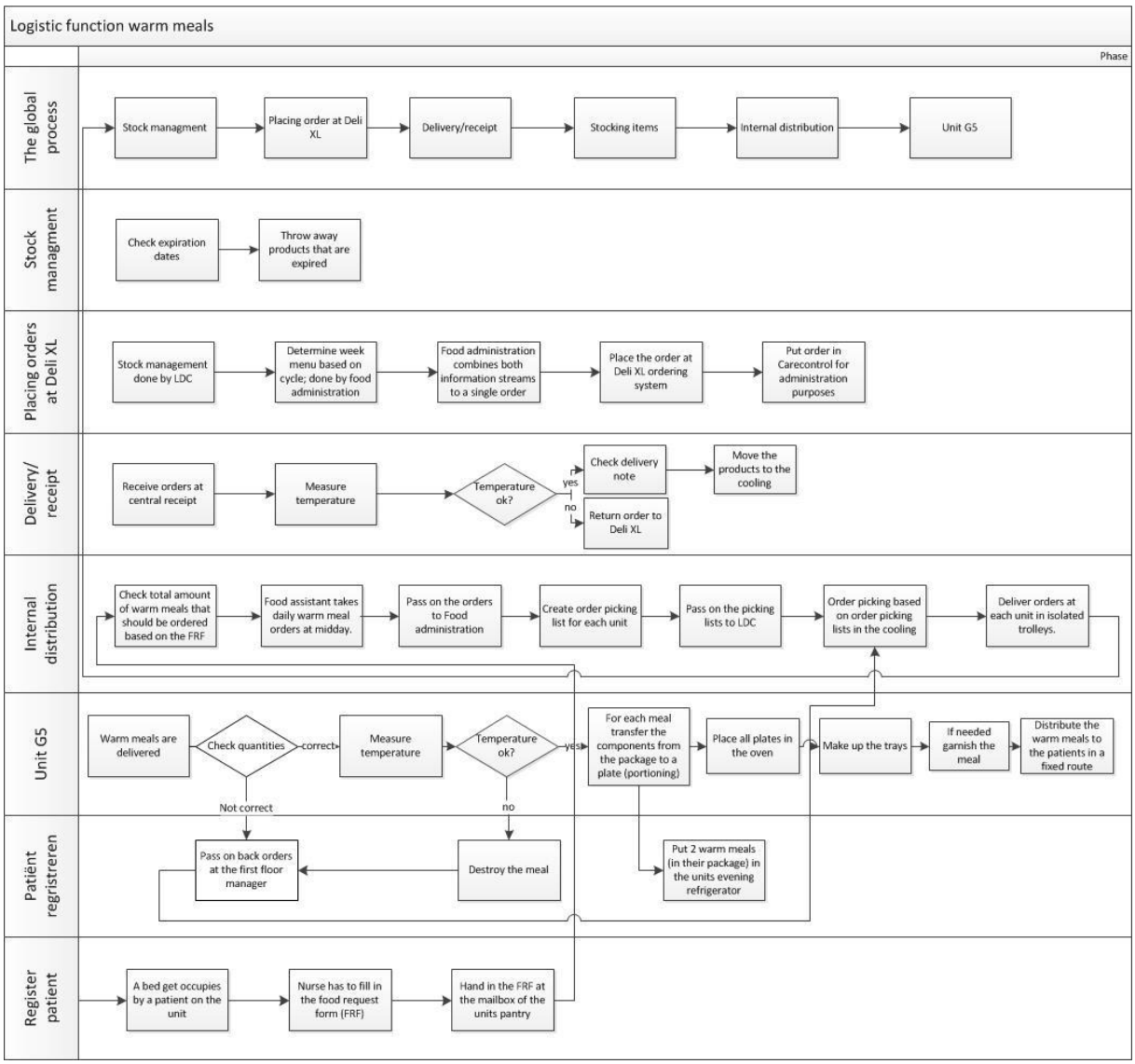
Introduction,
What is your name? (wat is uw naam?)_____
Do you wish to stay anonymous? (wenst u anoniem te blijven in the verslag?)_____
What is your function? (wat is uw functie?)
_____
_____
How does your function relate to the foodservice?(Hoe is uw functie gerelateerd aan de voedselservice?)
_____
_____
In what part of the food logistics are you involved? (Bij welk deel van de voedsellogistiek bent u betrokken?)
_____
_____
What is your score, based on a scale 1-10, for the food logistics in general? (Wat is uw score voor de huidige voedsellogistiek op een schaal van 1-10?) _____
On what do you base this score? (waarop is deze score gebaseerd?)
_____
What goes well/poor within the current logistic function? (wat gaat goed/niet goed in het huidige logistieke proces?)
_____
_____
What goes well/poor within the current logistic function you are involved in? (wat gaat goed/niet goed in het huidige logistieke proces in het gebied van uw betrokkenheid?)
_____
What goes well/poor in coordination with the other functions within the supply chain? (wat gaat goed/niet goed in de samenwerking met de andere schakels in het logistieke system?)
_____
_____
What are, from your point of view, the factors involved in measuring the food logistics function? (Wat zijn vanuit uw oogpunt gezien de factoren waarmee rekening moet worden gehouden voor het berekenen van de prestatie van de logistieke functies?)
_____
_____

C. Appendix III:

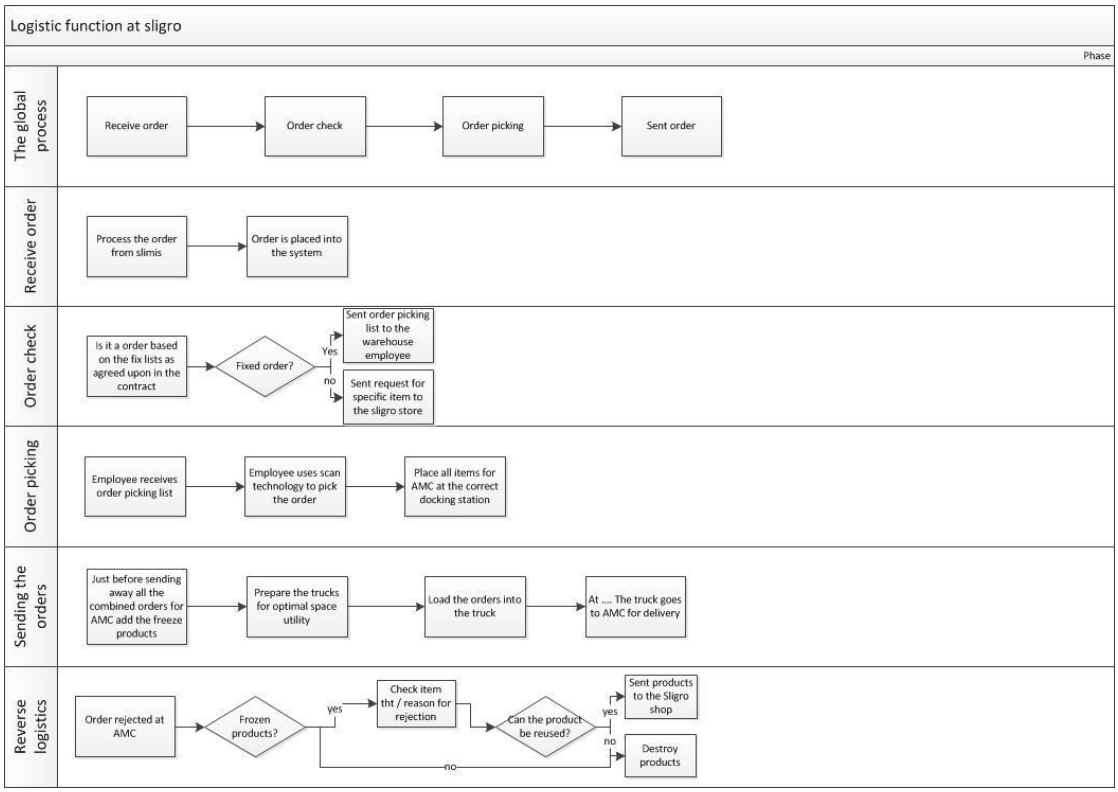
a) III.1 Wholesale logistic process.



b) III.2 Warm meals logistic process

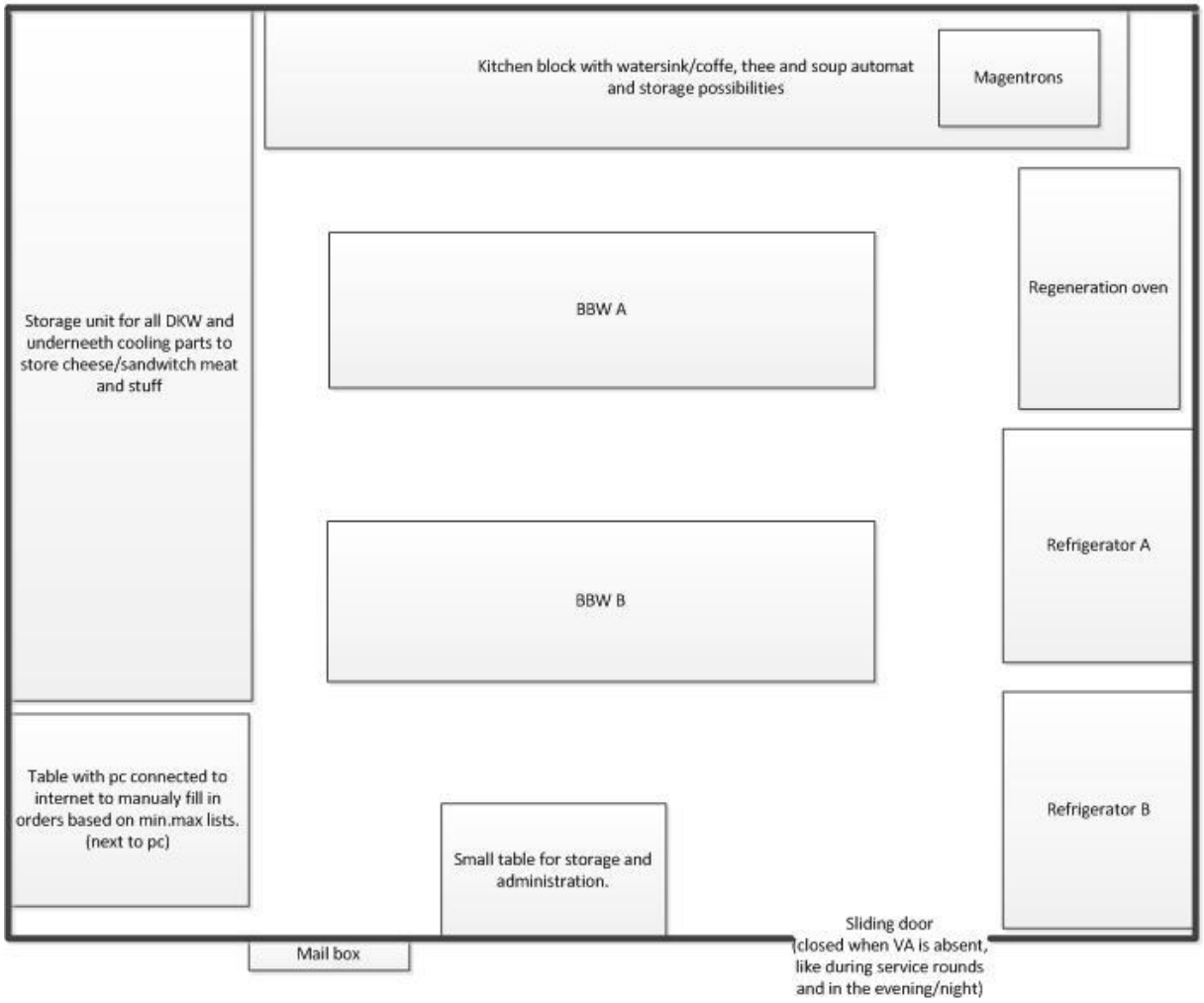


c) III.3 Logistic process at Sligro



d) III.4 Pantry layout.

Kitchen Layout.



D. Appendix IV: KPIs

Further elaboration of the KPIs.

Quality	
Employee satisfaction	*The implementation of improvements in the food logistics of AMC should have at least no negative effects on the employee satisfaction*.
	S: Several subjects include like travel distance, order lead time, work pressure; M: Travel distance: Where is the depot and what does this do with the walking distance. Order lead time: how long does it take for an item to arrive at the pantry after it is ordered. Work pressure: how many meals does a FA have to prepare for the unit. A: Employee satisfaction should be kept in mind to create support for improvements. R: Changes in food logistics could mean changes in job tasks for different employees. It is unknown how employees react on these changes. Therefore the goal is not set too high but negative effects were unacceptable. T: It is difficult to set a deadline for long time goals. Therefore it would be advised to measure the satisfaction within three to five months after implementation. So employees get used to the new situation and first flaws were solved.
Customer satisfaction	*The customer satisfaction score should be improved with 10% within three to five months after implementation of improvements in the food logistics of AMC.*
	S: Looking at the aspects product, behaviour of employees and environment. M: Based on responds to survey, as conducted by IFC. Order lead times are also important here. How long it takes from a product to arrive the patient after he ordered it. A: Customer satisfaction should be kept in mind to remain an attractive hospital within the catchment. R: Changes in food logistics are mainly meant to improve the customer satisfaction. T: After implementation of improvements the results in improved customer satisfaction should be quick noticeable since it direct affects the foodservice for patients.
Discrepancy between demand and assortment	*At least 80% of the patients should be reasonable satisfied with the choice of the assortment*
	S: Based on the patient treated at unit G5, split up in the assortment of bread meals, warm meals and snacks. M: Based on responds to survey, as conducted by IFC A: Patient satisfaction should be kept in mind to stimulated nutrition intake. R: To offer hospitality it is important that AMC is aware of their efficiency of the assortment. T: Evaluation by do the same survey again will make clear if discrepancy between demand and assortment reduced.

Speed	
Cycle times: the duration a process takes from beginning till end	*The cycle times will at least not be longer as in the current situation.*
	S: distribution times of food to patient / food to section etc. M: Timing it / historical data A: Cycle times were expected as important for patients, therefore logistic changes should be aware of an increase of cycle times. R: Reduce cycle times will have a positive influence on the patient satisfaction. T: Measuring by a time study within three till six months after implementation.
Time efficiency of employee tasks	*Employees spent 80% of their work time on their actual job.*
	S: Employees, from floor managers to food assistants, spent more time than wanted on tasks where they are not hired for M: Use a ratio of time spend on their actual job to total work time. Measured per employee individually for several related jobs, like food assistant, first floor employee and logistic employees. A: It is important to set clear boundaries between the different jobs, so employees knows each responsibility and can focus on that specific tasks. If some task went wrong it is important that this will be known by management instead of having this task being taken over by another. Methods should be standardized and not dependent of the employee whom is working that specific day. R: Be more time efficient will lead to an efficient process of food logistics. T: Within three to five months after implementation of improvements the time efficiency of the several employees should be improved.

Dependability	
Amount of unavailable products from assortment	*After implementation of improvements in food logistics of AMC the amount of unavailable products form assortment should be less than 5%.*
	S: The amount of times a FA of G5 has to say no to a patient because the nutrition he/she wants is unavailable (out of stock) incl. the amount of times and time in minutes a FA have to shop at another unit with positive vs. negative result. M: Counting. A: AMC want to providing the best hospitality for patients and an optimal amount of nutrition to the patient to speed up their recovery and prevent complications. Therefore the amount of unavailable products should be reduced to a minimum. R: Score high on this KPI will contribute to the goal of AMC as mentioned above. T: Within three months after implementation the logistic function should work well so than this KPI could be evaluated.
Amount of complete and on time intern deliveries	*The amount of complete and on time internal deliveries should be 95%.*
	S: We will look at the G5 Unit and divide the late and incomplete deliveries that arrive there by the total amount of deliveries arriving at this unit. M: counting/historical data. A: This would be a condition in order to let the logistic function work well. R: Employees need to rely on correct deliveries. Patients want to receive their food on indicated times.

	T: Within three to five months after implementation of improvements this percentage should be reached.
Time fluctuations in service rounds	*95% of the time fluctuations in service rounds and arrivals at the pantry should be within 2 standard deviation of the mean.*
	S: We look at the time fluctuations in start and end time of the service rounds (so breakfast/lunch/warm meals). Where it is important to search for the differences between the expected and the actual time. Including the time deviation in delivery arrivals at the pantries (intern transport). M: Time study (measure differences). Measure the mean deviation of promised arrivals per month. A: All employees together should take care of a low fluctuation in time to work as efficient as possible with positive effects on the customer satisfaction. R: Low fluctuations will make sure patients receive their orders when they expect them and thus keep patients satisfaction positive. T: Each month after implementation this value should be measured in order to know were defects occur and were to make adjustments.

Flexibility	
Flexibility in product and service	*The logistic function of food within AMC should be able to adapt for quick changes or one time requests.*
	S: We try to find how well the system reacts on unexpected events; How well does it respond to demand for products not currently in the assortment. How well is the system able to serve warm meals during irregularly times. Last is the system open for breakfast at later times. More customer demand operating (pull vs. push). M: Measure times needed to complete a unusual product wish, etc. A: AMC want to providing the best hospitality for patients. Being flexible is one of the requirements the hospital should fulfil to meet the current demand of patients. R: Sometimes there are people in need of warm meals outside the usual warm meal times. To offer the correct hospitality it thus is important that AMC can manipulate the system a bit and make this happen. T: This should be available at all times.

Costs	
Amount of thrown away products	*The amount of thrown away products should become no higher as in the situation before*
	S: A pie chart of all thrown away food based on expiration date, defect machinery or non-eaten by the patient. M: Counting using historical data. Having different ratios based on the pie chart as mentioned. After implementation of improvements regularly counting the waste during one month. A: Improvements in the food logistics should lead to a more efficient material planning so waste should at least be no more. R: Thrown away products lead to high costs. These costs should be saved here. T: The implementation should have direct influence on this aspect.
Amount of food consumption by others than patients	*There should be no food consumed by others than patients, until AMC decide to offer this service for a small fee. At that time the prices should be beneficial for AMC.*

	S: Split up in one ration for DKW and one ratio for warm meals. Then we can see how much of DKW and warm meals are not consumed by the intended group. M: Counting by first floor employee A: This has always been a grey area, everyone knows it happens, but there were previously no actions to prevent this while it costs AMC a lot of money. This should be an aspect of waste where to save a lot of money. R: Waste leads to high costs. These costs should be saved here. T: This could be count since the day after implementation and evaluated regularly.
Costs per patient per unit	*The integral cost per patient per unit should be at least the same. Improvements should not increase this costs.*
	S: How much does the food service for a patient cost? M:Using historical data to calculate the ration integral cost price per patient. Based on this we can compare units. Within three to five months after implementation the new ratio could be calculated and should be reduced in comparison with the old situation. A: Finding best practice of units. R: Learn from each other and analyse the differences for continues improvements. T: After three till five months after implementation the ratio costs per patient per unit should be calculated and evaluated.

E. Appendix V: Health Care framework documentary

Medical planning

1. AMC tries to improve their food service continuous. They want to be a hospital with an excellent food service. Therefore they invest in many research on this topic. The dietetic is responsible for the nutrition and developments on their discipline. However, the experience of patients are not only based on the product, but on the whole service including product, behaviour and environment. Therefore in 2012 AMC invite IFC to research the hospitality of the foodservice in AMC. Besides, they invest in an intern LSS project (Lean Six Sigma) focussing on the cost differences between hospital units and the way of ordering goods. As continuation of that project they start with SPA in the Kitchen (Scan, Plan, Replenish) to research the improvement opportunities when using scan batches by ordering food as already is done by ordering medical disposables. A student of facility management research the possibilities of a service employee instead of a food assistant for continuity in care and efficiency. Finally University students of Applied Mathematics research the inventory control of medical disposables in AMC. These researches are done separately focussing on a part of the whole food logistics. Our research could be a good addition to create a whole overview of the current situation and the problems on the different managerial areas on different levels. This framework will be a starting point for that.

   Within AMC multiple IT systems are used. Slimis for ordering at van Hoeckel, Food application Emadows for storing patient data, CareControl for the hospitals own administration and Bestel-XL, ordering system for Deli XL.

   Bottlenecks: All AMC IT systems work individually from each other and good integration misses. This is a cause for extra handling when looking at billing and ordering. The environment where the patients eat is not in line with the wishes of patients. AMC uses a push system for food services. To optimize the hospitality in AMC a pull system for food service would be more suitable.

2. To minimize the discrepancy between the product and patients' wishes there is a special assortment commission who evaluate the assortment and implement new products based on interviews with patients and the current trends in nutrition. The assortment commission consist of at least a floor manager, a delegated person of the supplier, a dietician and someone from the client board academic hospitals (CRAZ). Since last winter they start with a

four seasons cycle where the supply of warm meals change four times a year with season related products. A special test panel tries the new supply on forehand and determine the menus for the upcoming period. Even so, during holidays there is special attention to the menu determined by this commission.

Bottlenecks: While this group of people introduce many new items to the assortment. It is not really clear how the effectiveness of the current assortment is and which products were used so seldom that they could better be removed or substituted for another item with a higher demand. So the range of products could be wide, the effectiveness of the current assortment should be evaluated.

3. Nurses have to fill in a food request form within 24 hours after admission of the patient. This form is a guidance for the suitable products for that patient. The food administration is responsible for the product information of all meals in the hospital. Together with the dieticians they made an digital overview of which products are suitable for which kind of patients. Based on this knowledge together with the information on the a food request form a food assistant knows which products are suitable and which products are inappropriate for a specific patient. Each change in nutrition should be mentioned by a nurse on a newly hand written form. Incorrect or too late passing this information can have big consequences for the patient.

Bottlenecks: The completion of a food request form is not always in time or complete. This should have a higher priority by nurses.

4. In case there is no food request form the food assistant should consult the responsible nurse to ask what food would be suitable for that patient. Next to that some patients need assistance with eating. In principle it is not the responsibility of a food assistant. However, in practice some assistants take this responsibility or spend time on searching a nurse who can help the patient before their meal is cold.

Bottlenecks: This is a structural problem on the ward and dependent of the food assistant and nurse it have consequences for the patient. Since 40% of the food assistants are flex workers, whom know the patients probably less, there should be a structural solution for this.

Resource capacity planning

5. AMC has plans to renovate the hospital within the upcoming five years. A new food concept is one of the improvements to be realized by means of this renovation. The layout and investment on this concept are dependent on the service level AMC want to realize. These aspects were determined by management based on mission statement, vision and policy.

6. AMC chose to work with one food assistant per ward per shift (with a maximum capacity of 32 patients). There are two shifts a day (from 7.15 - 14.30 and from 7.45 – 14.45). Most food assistants only work during the day or in de evening, in new contracts they should be more flexible and should be able to do both shifts. A first employee facilities floor management is responsible for the foodservices and cleaning of a few hospital wards together. At AMC the manager patient services is responsible for the overall resource capacity planning.

   The workforce for the pantries is scheduled by the first floor employees in cooperation with the floor manager. The food assistants have a fixed schedule every two weeks. When not all needed services are filled they either consult a staffing agency 'Tence' ,which delivers the flex workers for AMC, or AMC flex workers ("werkwinkel" AMC). The flex workers of the "werkwinkel" AMC consist of a fixed pool of employees working a fixed amount of hours a week per cluster. The scheduling of these employees is done by the floor manager / FFE aimed to create some continuity in employees on the different wards. In case of Tence employees this is not always possible, they work with a lot of different employees and send much different employees to the different wards. This is still a discussion point between Tence and AMC.

   The first floor employee, who facilities floor management knows a day and noon/evening shifts. This because this employee has to handle operational online in case of incidents. This could be a backorder of warm meals or anticipate on unexpected demand. From a hierarchically point of view above the first employee a floor manager operates. Each floor manager manages the first employees of a few different units. This way of working was introduced a year ago, aimed at improving the management of departments. The maintenance of the BBW is periodically organised. However, employees of the work floor experiences that the BBW is often broken and leave the ward for a long time due to reparation.

Bottlenecks: Increasing time spent on indirect patient care. Low time efficiency.

7. The staffing of food assistants is standardized. Each two hospital wards have one pantry together. On each pantry work two food assistants. The assistants work together but are both responsible for one ward on the unit (south or north ward). Some food assistants works only in the morning, some only in the evening, others doing both. 40% of the assistants are flex workers. These flex workers are either available from the staffing agency Tence, or from the werkwinkel AMC. The flex workers from the "werkwinkel" are familiar with one or a few hospital wards where they work a fixed amount of hours a week per cluster. The continuity of Tence employees is less, since this agency send a lot of different employees to work on different wards.

   Each pantry have two BBWs. One BBW per ward. Other materials in a pantry are: one regeneration furnace, four refrigerators, one computer, two magnetrons, two coffee bars, one big storage facility against the wall which was used as preparation desk in the past. Food assistants walk six fixed times a day a fixed route at the unit: for breakfast, lunch, dinner and three rounds to offer some drinks and snacks. At 12 O'clock the lunch will be served, warm meals were served in the evening. There is no possibility for patients to eat a warm meal in the afternoon. There are no rules where to start this route, near the pantry or at the end, but most assistants have some regularity for themselves. Each service round the BBW is used and after each round this BBW will be replenished. For the dinner another trolley is used for taking the serving trays separately from the BBW. So this round will be done by two assistants together.

   The kitchen, as of 2012, is closed after the working hours of the food assistants since there was many consumption by others than patients. After the working hours of the food assistants nurses can take food from the night fridge. Nurses have set a list of products which should be in the night fridge. The food assistant replenish this fridge daily based on the same mentioned list the nurse have. This list differs per unit but is not dependent of the bed occupancy. Each morning the fridge will be emptied by a food assistant. The products, which expire, will be thrown away, other products will be stored back in the BBW. This process takes a lot of time during rush hour for food assistants. This handling therefore reduces the time efficiency of the food assistants. Yet it is repeated each day.

Bottlenecks: The night refrigerator. Flaws in ordering process. Cycle times (from ordering by patient till order delivery). Too many control moments. Decentralized dishwashing. Fluctuation in delivery at the bed. Expertise of employees

8. Cooperation between units by means of tracking if the products missing in your pantry are in stock on another unit and exchange these units to fulfil the wishes of patients. As mentioned is there a first floor employee available to realize backorders of warm meal or realize exchange of units from the BBW.

   Bottleneck: An overview of products in stock on the different pantries is missing. An clear up to date overview would prevent a time inefficient process to tracking missing products.

Material planning

9. The storage design of AMC is a combination of centralized and decentralized stock. Warm meals are centralized in a fridge at the basement near the general goods receipt. Wholesale products are stored decentralized. The supplier delivers cross-docked trolleys per hospital ward. AMC chose for decentralized storage for wholesale products as it is a very big building with 95 kilometres of walk able aisle (Boer, 2013).

   Bottlenecks: Decentralized stock (unit pantries). Much cooling space is unoccupied

10. The supplier is selected based on European tendering. AMC uses different suppliers for bread, , wholesale products and warm meals. Bread is daily ordered except for Sundays. Wholesale products are delivered by cross-docking. For wholesale products the appointment is to order four times a week, on Tuesdays, Thursdays, Fridays and Saturdays. These orders should always be placed before 11.00 O'clock. Delivery of these wholesale product orders happens three times a week, on Mondays, Wednesdays and Fridays. Assortment of wholesale products is set by assortment commission. Warm meals are ordered daily, delivery is two days later in the morning at the central receipt after which the meals are transported and stored in the central refrigerator by LDC. With the exception of the Fridays, order placed on Fridays are delivered on Tuesdays. On Mondays there are no warm meal deliveries, these happen from Tuesdays until Saturdays there are deliveries. AMC work with a menu card, which change four times a year. Each day the patient have a choice of five different warm meals, 2 salads or a sandwich. There is no variation in portion size possible without creating

waste costs for AMC. The contact with suppliers to made agreements about ordering process, delivery time, frequency and method of delivery is the responsibility of the management. Each stakeholder have an own role in this process, from advice up too concrete appointments but together they are responsible for the whole process. The purchasing department of AMC is only concerned in the tendering process.

Bottlenecks: Portion sizes Time between ordering and serving. Waste before / after serving.

11. Wholesale products and bread are ordered by a food assistant based on common sense. A min. / max. overview, based on historical data of food consumption, acts as a guidance for this. However current observations and interviews learns that this ordering process is partly depending on the experiences of a food assistant. Therefore the high amount of flex workers looks like a cause of inefficient order sizes.

    All intern distribution from general receiving to hospital ward pantries is the responsibility of distribution employees of the logistic centre. Food assistants have to store these goods in the pantry, based on the FIFO (first in first out) principle. After each fixed round on the ward the food assistant replenish the BBW with stock from the pantry.
    Ordering of warm meals is done by the food administration. Order sizes of warm meal products are not based on bed occupancy since these meals are ordered once a week. They order based on a min. /max. stock. This min./max. stock is based on historical data of food consumption. However, there is such a high flexibility in warm meal consumption that they decide to set this min./max. stock as a directive. The food administration is free to change this list, with min./max. Values, based on common sense. After each season the amount of food waste, which is caused by too much warm meals in stock, will be evaluated. When more than 5% of the warm meals were thrown away because of expiring the THT the min./max. list will be updated. Current waste is about 3,5%. For meal components and soups the consumption is more variable which make the ordering process more difficult due to higher difficulty in demand prediction. The product waste of these articles is higher than 5%. This high amount of waste is accepted for these products.

    Due to the long THT the flexibility in consumption does not directly lead to waste. Besides, the food administration make some trade-offs in ordering warm meals. This could be the trade-off between salads and typical winter food depending of the weather forecast. The daily order of warm meals done by the food assistant is based on bed occupancy, the extra

needed meals for the night refrigerator and the amount of meals still in stock, which are the leftovers from the day before with passable tht. After the lunch, food assistants record the warm meal orders of patients and send this order to the food administration. The administration send this data to the logistic centre to make them able to print a pick list. Finally the warehouse employee receives an order pick list and picks the meals from the central fridge in isolated trolleys dedicated to the specific units within the hospital by distribution team.

Food assistants have to prepare, regenerate and garnish warm meals before serving them to the patients. These activities take a lot time. The regenerate oven has a maximum batch size of 16 meals with a preparation time of 35 minutes.

Bottlenecks: Poor usage of min/max lists. Usage of common sense. Time between ordering and serving. Many actions in preparing warm meals. Loss by distribution to others as patients. Large number of deliveries each day. Flaws in intern distribution. Usage of other aids(like cutlery/ serving plates)

12. During the day a lot of time is spent on anticipating. It already start in the morning where usually the deliveries to the pantries by the LSC are not on the time as indicated. This means that FAs gain a lot of work pressure because they have to store all products from the delivery and then run around the ward to still have breakfast in time for all patients, meaning no social time can be spent with the patients downgrading the hospitality. Whenever there is a shortage of warm meals within a pantry the FA searches for a desired warm meal on another pantry. Again meaning they are not available for their own ward if needed. Responses on demand for wholesale items out of stock is very slim, as they are not really anticipating on this. Sometimes there is not a shortage but an oversupply, for example because of a typing error. In some cases the products will be send back to the supplier, however the HACCP rules make this mostly not possible. The communication on this issue is between the responsible employee of the BADS and the supplier.

Bottlenecks: Do not want to sell a "no" to patients

Financial planning

13. On a long term there are investments plans to optimize the food service in AMC. Logistic improvements could be useful to save money which could be invest in the quality of hospitality.

14. AMC has a lot of suppliers and thus also a lot of contracts. These contracts usually set prices for parties undergoing them, therefore finding a good contract to have the best quality/price ratio is something that takes time. Sometimes going for a bit cheaper does not pay off. As head of the service department admitted that they increased the budget for buying bread to get better quality as the currently used bread was unwanted by most patients and thus even though it was cheaper, the bread was opposing the policy of patient welfare by letting them eat as much as possible for speedy recoveries.

    Bottlenecks: High personnel costs. Low time efficiency

15. The costs of food logistics could be split up in personal and materials, where materials could be further split up in raw materials, logistic costs and overhead (the costs of gas, water, light and electricity usage). The losses of food, before or after serving to the patient, are high unnecessary costs. The administration of invoices, control of deliveries and archiving of orders is a responsibility of the LDC, the FA and the BADS together. For example for warm meals the FA orders the meals, this order will be send to the BADS, the BADS check these order, make an order pick list and send this to the warehouse workers. Then these employees pick the warm meals in the fridge and cross docking these in separate isolated trolleys per unit. When all warm meals are picked and double checked, one of the warehouse workers walks to the BADS to make the order definitive. The BADS scan all the orders and if correct, they fulfil the order in their IT system Care Control. When the order is not correct, for example when a warm meal is out of stock, they send the bill for control to the BADS so they can adjust it. Then a new overview is printed. The warehouse employee pick these new form, walk back to the fridge and add these new forms to the isolation trolleys. This way of working will however change as of 13-05-2013 from which point on the order pickers will be equipped with scanners and the picking lists will thus be digitally approved from these scanners saving lot of walking and processing time. Finally the isolated trolleys will be sorted per tower and transported by three LDC employees. Each tower have a fork lift used to transport all trolleys per tower in one lift. The LDC employee store the trolley at the unit panty without contacting the FA. After 15 minutes all trolleys are

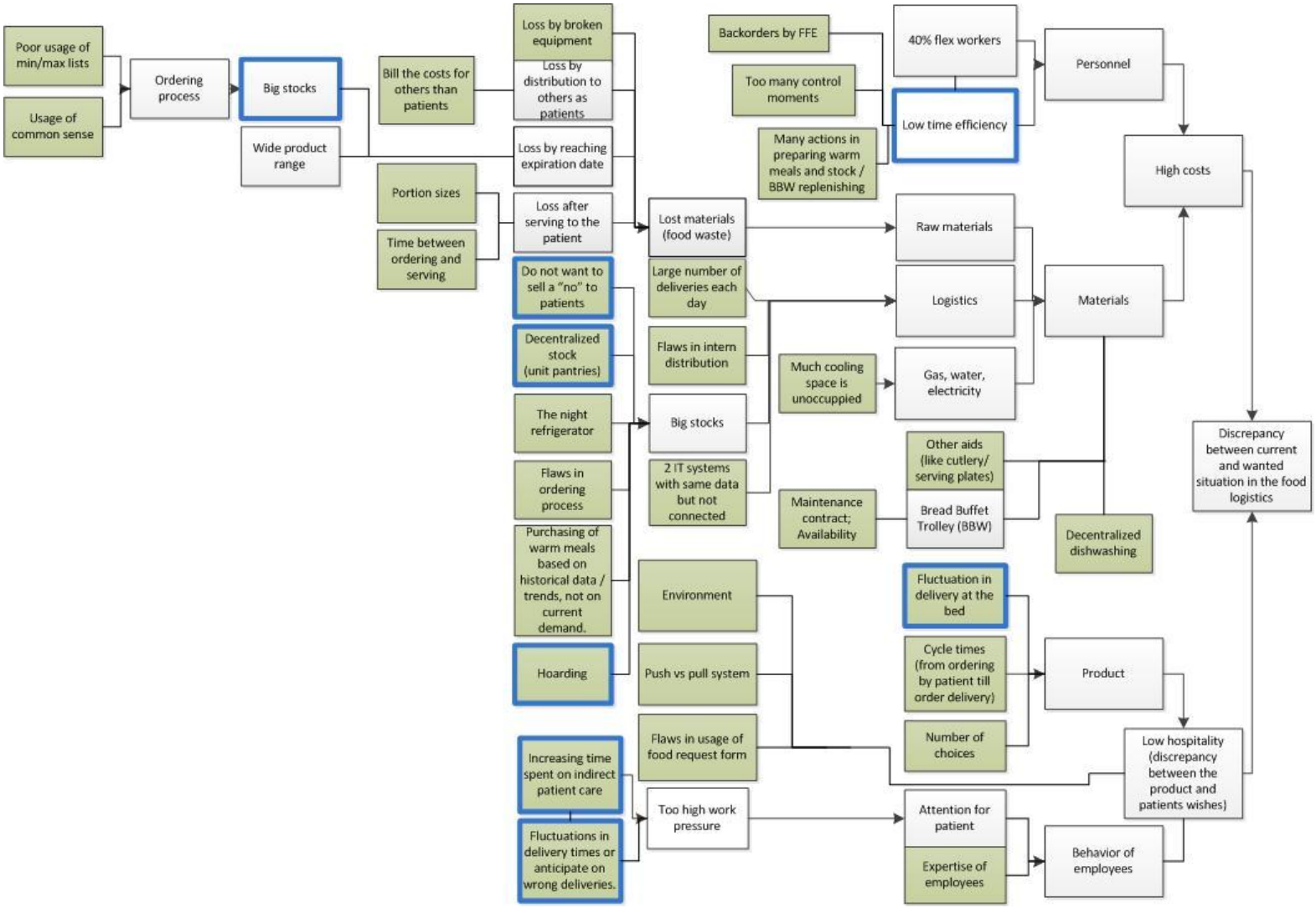
distributed to the hospital. Each FA have to check the delivered meals by the form. When there are wrong deliveries the FA calls the BADS to correct the order.

16. A part of the food is used by others than patients, like nurses, other health care workers and guests. These users have to pay for this service, so the invoice of these costs should be send to the BADS which calculate these cost to the cost centre of the specific ward. The nurses fill in an general request ticket for food consumption outside of the normal BBW rounds. On this tickets the name of consumer of the requested food is filled in for billing. The nurse brings the filled in request ticket to the kitchen where she gives it to the food assistant. Around noon the first floor employee collects all these tickets and brings them to the BADS. The BADS will from that point on be in charge of billing the right costs to the patient that had family visiting and eating food form the pantries instead of the restaurant.

    Bottlenecks: Low control of these ghost costs. While small numbers they can add up if taken together.

F. Appendix VI: Problem Cluster

As method to answer research question 2 we provide a structured overview of the bottlenecks in the current situation regarding AMC's food logistics. The problems defined with the blue borders are the focus of our further research. At least these aspects are evaluated when looking at the problem whether to hold or arrange the product on a centralized or decentralized way.



G. Appendix VII: Watsons benchmark activities compared with Van Hoorn's steps

	Stage 1: Plan
Van Hoorn	**Activities to be undertaken**
1. Choice and setting boundaries for the process to benchmark	Identify business strategic intent and core competencies (SWOT).
	Select key business process
	Select the specific process
	Gain participation of the process owner
	Select a benchmarking team leader and participants
	Identify the customer profiles and expectations
4. Mapping in detail the process to be benchmarked.	Analyze process flow and performance measures
	Define process inputs and outputs
	Document and flow chart the process
	Understand and measure critical success factors
5. Defining the measurements and key performance indicators	Select critical success factors to benchmark
	Develop the company selection criteria
	Establish the data collection method
	Develop a preliminary questionnaire

	Stage 2: Do
Van Hoorn	**Activities to be undertake**
	Collect internal process data
2. Choosing the benchmark partners	Identify potential benchmarking partners
	Research companies for appropriate comparisons
	Select whom to benchmark and establish partnership sharing conditions
	Gain cooperation and participation of the targeted partners
3. Choosing the themes of the minor researches	Conduct secondary research
	Plant the data collection
	Develop a final survey or interview guide
6. Doing the measures	Conduct primary research
	Monitor process performance and analyze performance gaps
	Make on-site observations to clarify and verify previous observations
	Conduct a post-site-visit debriefing with team members to record observations
	Synthesize on-site observations into a documented trip report.

	Step 3: Check
Van Hoorn	**Activities to be undertake**
7. Analyzing the results	Organize and graphically present the data for identification of performance gaps
	Normalize performance to a common measurement base
	Compare current performance against benchmark
	Identify performance gaps and determine their root causes
	Project the performance three to five years into the future
	Develop “best practices” case studies
	Isolate process enablers that correlate to process improvements
	Evaluate the nature of the process enablers to determine their adaptability to the company culture

	Step 4: Act
Van Hoorn	**Activities to be undertake**
8. Create and implements the improvements found	Set goals to meet and then exceed the performance gap
	Select best practices and enablers for consideration
	Modify process enablers to match the company culture and organizational structure
	Enhance these enablers based on team observations for integrating process improvements
	Develop a formal action plan for implementing improvements
	Commit the resources required for implementation
	Gain acceptance support commitment and ownership for required changes
	Implement the plan
	Celebrate the results of the benchmarking project
	Monitor and report improvement progress
	Identify opportunities for future benchmarking
	Recalibrate the measure regularly and seek understanding when change is observed

H. Appendix VIII: Interview for benchmarking food logistics of hospitals (Dutch)

Wat is uw naam?

Wat is uw functie?

Over welk deel van de voedingslogistiek bent u het meest tevreden en waarom?

Wat is het grootste knelpunt waar u tegenaan loopt kijkend naar uw voedingslogistiek?

Totale afstand aan gangenstelsel, mits dit bekend is?

Aantal bedden?

Aantal verplegingsafdelingen?

Meerdere locaties?

Opslag:

Op welke manier zijn de producten (gekoeld/diepvries/DKW/brood) opgeslagen? (Centraal vs Decentraal)

Op welk(e) tijdstip(en) worden de voedingsproducten geleverd?

Wie is verantwoordelijk voor het inruimen van de goederen in de voorraadkasten?

(mogelijk: Hoeveel tijd wordt er aan het inruimen van goederen besteed per dag/week?)

Hoe zit het met de BBW's (verantwoordelijk voor inruimen)?

Wat zou volgens u nog verbeterd kunnen worden aan de manier van opslag?

Wat is het percentage derving in uw ziekenhuis en hanteert u hiervoor een norm?

Bestelproces:

Hoe besteld de patiënt zijn/haar maaltijd?

Hoeveel actoren zijn betrokken bij het extern bestellen, dus van de leverancier?

Hoeveel tijd wordt er aan het bestelproces besteed per dag/week?

Aan de hand waarvan wordt er bepaald wanneer moet worden bijbesteld? (Min/max; 2 bin; directe orders of een ander systeem?)

Zijn er nog verbeteringen mogelijk in uw huidige bestelsysteem?

Werkt u met software die dit proces ondersteunt?

Goederenontvangst:

Wie is uw leverancier?

Op welke wijze ontvangt u de producten (gekoeld/diepvries/DKW/brood)?

hoe vaak per week?

Wat bevalt u aan de leverancier en de manier waarop deze levert?

Wordt er veel lucht vervoerd door de leverancier?

Wat zou volgens u nog verbeterd kunnen worden aan de manier van aanlevering/ontvangst?

Hoe gaat u om met de HACCP regels bij de goederen ontvangst is er een centrale koeling voor tijdelijke opslag of gaat alles gelijk naar de opslag ruimtes zonder dat er gevaar dreigt voor te hoog oplopende temperaturen (~20-30 minuten)?

Werkt u met software, die het proces van goederenontvangst ondersteunt, inboeken van orders etc?

Interne distributie (naar de afdelingskeukens (mits aanwezig)

Hoe ziet de interne distributie eruit; van opslag naar pantry? (outsourced?)

Wie doet dit?

(Mogelijk: Hoeveel tijd is hiermee gemoeid?)

Wat zou volgens u nog verbeterd kunnen worden aan de interne distributie?

Van pantry/opslag naar patiënt:

Zijn er vaste rondes? Of kunnen patiënten zelf aangeven wanneer ze willen Ontbijten, lunchen, dineren?

Hoe vaak lopen de VA's een ronde per dag?

Zijn de BBW's optimaal voor deze rondes of zou u hiervoor liever een ander middel inzetten?

Hoeveel bedden worden door een Service medewerker verzorgt?

Maakt u gebruik van servicemedewerkers?

Zo ja, Ondervindt u hier voordelen van?

Reverse logistics:

Hoe is de afwas geregeld? Centraal vs Decentraal.

Waarom is het zo geregeld; komt het door de layout of was het een bewuste keuze?

Zouden er voordelen te behalen zijn het op de tegengestelde manier te regelen?

Wordt er veel voedsel dat niet opgegeten wordt weggegooid ?

Warme maaltijd

Produceert u nog zelf? Zo ja, hoeveel procent van de productie?

Werkt u met een centrale keuken of decentraal?

Portioneert u zelf (centraal of decentraal)? / werkt u met bulkverpakkingen of met individueel

verpakte maaltijden?

Met welk voedingsconcept werkt u (meals on weals, roomservice, gekoppelde keuken/assemblage keuken etc)?

Derving van de warme maaltijden?

KPI's

De volgende KPI's zijn door het AMC naar voren gebracht. Zou u deze KPI's kunnen ordenen op mate van belangrijkheid. Door een totaal van 100 punten te verdelen over de KPI's.

Performance objectives	KPIs	Verdeling
Quality	Employee satisfaction	
	Customer satisfaction	
	Discrepancy between demand and assortment	
Speed	Cycle times	
	Time efficiency of employees tasks	
Dependability	Amount of unavailable product from the assortment	
	Amount of complete and on time intern deliveries	
	Time fluctuations in service rounds	
Flexibility	Flexibility in product and service	
Costs	Amount of thrown away products	
	Amount of food consumed by others than patients	
	Costs per patient per unit	

Vindt u dat er nog een of meerdere KPI's missen? Zo ja welke zou u er nog bij hebben gezet?

Kent uw programma van prestatie metingen? Zo ja welke prestatie worden dan gemeten en op welke manier gebeurd dat?