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LOGISTICS MANAGEMENT IN A HEALTHCARE CONTEXT

Methodological development for describing and evaluating
a healthcare organisation as a logistics system

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2013

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ABSTRACT

This thesis tests whether logistics knowledge, theories and principles can be used to provide potential patient flow efficiency improvements. By emphasizing an ideal logistics system by means of its main features and then using these to evaluate two different healthcare organisations, it is assumed that knowledge regarding patient flows can be obtained and potentials for improvement highlighted. Hence, this licentiate thesis presents a *developed method intended for evaluating a healthcare organisation by means of a logistics system's main features*. The purpose rests on the assumption that effective management and real flow-efficient improvements can only be accomplished by viewing logistics as an integrated system.

Demographics, increased costs, strong technical and medical developments, new kinds of customer requirements, stressed staff and preventable adverse events are some of the challenges the Swedish healthcare system is currently facing. In addition, there is a constant demand on healthcare to be more cost-effective while fulfilling demands as regards waiting times, quality and availability. Experience from structural changes in other industries gives reason to be positive about the potential for long-term productivity leaps in the healthcare sector. The challenge is to simultaneously find successful application of efficient production and flexible adaptation to changing patients' demands and requirements. Taking advantage of the logistics expertise that already exists can be a way to meet these challenges. It can be assumed that logistics knowledge applied in healthcare can lead to lower costs, shorter waiting lists, better patient service, shorter treatment times and increased capacity. Nevertheless, flow-oriented design of healthcare delivery systems is novel and positions much currently isolated research on a conceptual level or within single wards (Wiger and Aronsson, 2012).

The research is part of a three-year project, "Lean and agile – logistics driven improvement in health and social care", funded by Vinnvård, a collaboration between the Department of Management and Engineering at Linköping University, Hässleholm Healthcare Organisation and the Medical Management Center at Karolinska Institutet in Stockholm. This thesis is partly a theoretical development of logistics models. This is done in order to create an ideal logistics system's main features and description aspects to describe a system to be able to evaluate it using these features. The two cases are used to test the adequacy of the developed method and its associated models and to identify potential for improvement towards a more flow-oriented business. Four series of interview sessions were conducted with a total of 23 respondents and 18 interviews and over 500 Excel files were collected from the business system.

It is suggested that a healthcare organisation can be evaluated by the developed logistics main features. These features, listed below, together provide a possibility to complement a healthcare organisation's ability to meet patient requirements by flow-efficiency and demonstrate logistical operational excellence.

1. A logistics system's purpose is to meet customer requirements by cost-effective delivery service through flow orientation by prioritising the total performance
2. A logistics system has a flow-oriented structure
3. A logistics system transforms orders into customer services in a flow-oriented process
4. A logistics system can control the transformation of input (demand) to output (customer service) and thus the cost of resources
5. A logistics system measures to capture the whole system's logistics performance, including total logistics costs, lead times and customer service
6. A logistics system has a strategy to meet demand
7. A logistics system uses logistics measurements as feedback to regulate its behaviour to reduce differences between actual and desired performance

The analysis of the two cases confirms the picture of an organisational design driven by medical specialties. This implies a possibility to change perspective to a more holistic view with the patient flow in focus. The fact that there are very few possibilities to control the transformation has partly to do with ownership of patient flows being less well-defined than clearly defined medical responsibilities within each specialty. It also has to do with the inability to distinguish between the uncertainty regarding unique patients on a low level of aggregation and at the higher level where there should be complete and explicit specifications of the end-product requirements and delivery requirements. The lack of demand strategies that support the total logistics performance ultimately leads to both clinics having to use a sacrificing work effort rather than working systematically to be able to meet the demand. At the case hospital, there is a lack of information aggregated from operational level about patient processes that is made available for strategic decision-making. Neither of the two cases measure on the basis of improving patient flow efficiency, especially not the total patient flow costs or the total logistics costs.

The major contribution is the analysis based on the logistics system's main features, which gives a more purposive understanding of what can be done to improve flow efficiency within a healthcare organisation to make healthcare organisations progress in their ability to be more flow-oriented. A further contribution is a more clearly defined field of healthcare logistics research and the stressed importance of the "new" research field of logistics management.

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Då är ”boken” färdigskriven och tryckt. Den blev ju riktigt fin. Men vissa dagar har den snarare kallats för den där dumma boken. Prestationens sötma är just söt för att det alltid hör till en ansträngning. Här har den till största del bestått av att tvingats till begränsning och fokusering. Att inse att min bok inte kommer att förändra världen, den är bara en liten, liten pusselbit. Tillika inse att varje mening betyder nått och att de alla dessutom ska sträva åt samma håll. Det finns ju så mycket att upptäcka och ju mer jag upptäckt desto mer har jag velat gräva och finna nytt. Graviditeten fick mig att sätt spiken i kistan. Bättre kniv mot strupen finns nog inte. Jag älskar dig lilla Jack, tack för att du kom!

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Linköping, maj 2013-05-08

TABLE OF CONTENT

1	INTRODUCTION	1
1.1	BACKGROUND.....	2
1.2	PURPOSE AND RESEARCH QUESTIONS.....	4
1.3	OUTLINE OF THE LICENTIATE THESIS.....	6
2	LOGISTICS RESEARCH IN A NEW CONTEXT	9
2.1	THE RELEVANCE OF THE RESEARCH	10
2.1.1	<i>Healthcare is substantial and complex</i>	<i>10</i>
2.1.2	<i>The main flow of patients</i>	<i>10</i>
2.1.3	<i>Healthcare, a special kind of service</i>	<i>11</i>
2.1.4	<i>The potential of logistics management in a healthcare context.....</i>	<i>13</i>
2.1.5	<i>Swedish healthcare.....</i>	<i>13</i>
2.2	A NEW APPROACH TO HEALTHCARE – THE NEED FOR LOGISTICS RESEARCH.....	14
2.2.1	<i>Managing complex systems</i>	<i>15</i>
2.2.2	<i>Measuring flow efficiency.....</i>	<i>15</i>
2.2.3	<i>Power of analogy – a learning opportunity.....</i>	<i>16</i>
2.2.4	<i>The whole system in focus</i>	<i>17</i>
2.3	A LOGISTICS OVERVIEW- LOGISTICS HISTORY AND DEVELOPMENT UP TO TODAY	18
3	RESEARCH APPROACH.....	21
3.1	RESEARCH DESIGN	22
3.2	RESEARCH METHODS	23
3.3	LITERATURE REVIEWS AND CHOICES	25
3.3.1	<i>Logistics literature in healthcare context</i>	<i>25</i>
3.3.2	<i>Systems approach</i>	<i>27</i>
3.3.3	<i>Basic logistics literature.....</i>	<i>27</i>
3.4	CASE STUDIES	28
3.4.1	<i>Selection and description of cases</i>	<i>28</i>
3.4.2	<i>The interviews</i>	<i>29</i>
3.4.3	<i>The observations.....</i>	<i>31</i>
3.4.4	<i>The scanning of the business system</i>	<i>31</i>
3.4.5	<i>Processing of the empirical data</i>	<i>31</i>
3.5	DEVELOPMENT OF THE THEORETICAL MODELS.....	32
3.5.1	<i>The main features of a logistics system – RQ1.....</i>	<i>33</i>
3.5.2	<i>The description aspects of a logistics system – RQ2.....</i>	<i>34</i>
3.6	THE RESEARCH PROJECT	35
4	LOGISTICS SYSTEMS.....	37
4.1	INTRODUCTION TO SYSTEMS	38
4.2	SYSTEM APPROACH	39
4.3	SYSTEMS APPROACH TO ORGANISATIONS.....	41
4.4	THE SYSTEMS APPROACH IN LOGISTICS.....	42

4.5	MODELLING LOGISTICS SYSTEMS.....	44
5	MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS.....	47
5.1	PURPOSEFUL.....	48
5.2	OPENED AND BOUNDED.....	49
5.3	INTERRELATED ELEMENTS	50
5.4	INPUT AND OUTPUT	52
5.5	CONTROLLED	57
5.6	ADAPTIVE	61
5.7	THEORETICAL SUMMARY, DESCRIPTION AND ANALYSIS MODEL.....	64
6	DESCRIPTION OF THE CASE HOSPITAL	69
6.1	INTRODUCTION.....	70
6.2	PURPOSES AT THE TWO CLINICS	70
6.3	BOUNDARY AND SURROUNDING	71
6.4	STRUCTURE	72
6.4.1	<i>Structure of the community healthcare clinic</i>	<i>72</i>
6.4.2	<i>Structure of the orthopaedic clinic</i>	<i>75</i>
6.5	TRANSFORMATION	78
6.5.1	<i>Care processes at the community healthcare clinic</i>	<i>79</i>
6.5.2	<i>Care processes at the orthopaedic clinic.....</i>	<i>81</i>
6.6	DEMAND	82
6.6.1	<i>Demand at both clinic departments</i>	<i>83</i>
6.7	CUSTOMER SERVICE	84
6.7.1	<i>The community healthcare clinic</i>	<i>84</i>
6.7.2	<i>The orthopaedic clinic</i>	<i>84</i>
6.8	CONTROL.....	85
6.8.1	<i>Planning at the community healthcare clinic.....</i>	<i>85</i>
6.8.2	<i>Planning at the orthopaedic clinic.....</i>	<i>86</i>
6.8.3	<i>Management</i>	<i>86</i>
6.9	PERFORMANCE.....	88
7	ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM	91
7.1	DESIGN.....	92
7.1.1	<i>Flow-oriented structure</i>	<i>92</i>
7.1.2	<i>Order and delivery driven transformation.....</i>	<i>96</i>
7.1.3	<i>Conclusions about the systems' design.....</i>	<i>100</i>
7.2	MANAGEMENT AND CONTROL.....	100
7.2.1	<i>Control of transformation - from patient demand to fulfilment.....</i>	<i>101</i>
7.2.2	<i>Measure of the total logistics performance.....</i>	<i>103</i>
7.2.3	<i>Strategy to meet demand</i>	<i>104</i>
7.2.4	<i>Adaption to desired performance</i>	<i>106</i>
7.2.5	<i>Conclusions about the system's management and control.....</i>	<i>106</i>

7.3	FULFILMENT OF LOGISTICS' PURPOSE AND PRIORITIES.....	107
8	CONCLUSIONS AND CONTRIBUTION	109
8.1	CONCLUDING DISCUSSION.....	110
8.1.1	<i>A logistics system's main features viable in a healthcare context.....</i>	<i>110</i>
8.1.2	<i>Great potential for healthcare organisations</i>	<i>113</i>
8.1.3	<i>The importance of objective.....</i>	<i>113</i>
8.1.4	<i>The economic governance has consequences</i>	<i>114</i>
8.1.5	<i>The measurements indicate the focus</i>	<i>114</i>
8.2	CONTRIBUTIONS	115
8.3	MANAGERIAL IMPLICATIONS	115
8.4	FUTURE RESEARCH	116
	REFERENCES	118

APPENDICES

APPENDIX I: Literature Review – Logistics Research In A Healthcare Context

APPENDIX II: Literature Review – Systems Approach

APPENDIX III: Literature Review – Logistics Systems

APPENDIX IV: Interview Guide – Session 1

APPENDIX V: Interview Guide – Session 2

APPENDIX VI: Interview Guide – Session 3

LIST OF FIGURES

Figure 1 Outline of the licentiate thesis.....	8
Figure 2 Value creation and co-creation in a supplier-customer relationship (Grönroos and Ravald, 2011)	12
Figure 3 The overall research design and its two parts.	23
Figure 4 The data collection process, both theoretical and empirical data	24
Figure 5 The method of the literature review, logistics literature in a healthcare context	26
Figure 6 Respondents' picture of his/her "reality".....	30
Figure 7 A spectrum of systems modelling approaches (Pidd, 2004).	33
Figure 8 A system is a set of elements and the relations among them	40
Figure 9 The systems approach used in Abrahamsson and Aronsson (1999).....	44
Figure 10 The typical order cycle components (Oskarsson et al., 2006)	55
Figure 11 Logistics missions cut across functional boundaries, consequently the same as for the performance measurements (Christopher, 2005).....	60
Figure 12 Process and function performance (Aronsson and Andersson, 2002)	61
Figure 13 An example of a decoupling point; a shift from a lean to an agile strategy (Christopher, 2005)	62
Figure 14 Analysis model, the purpose of a logistics system and the two main parts to achieve its objectives.....	67
Figure 15 The Community Healthcare Clinic as a system. A description of relationships between elements.....	73
Figure 16 General activities in a ward.....	75
Figure 17 The orthopaedic clinic as a system. A description of relationships between elements.....	76
Figure 18 Activities within the surgery department.....	78
Figure 19 Emergency department patient flow.....	79
Figure 20 General care process at the community healthcare clinic's outpatient department, scheduled visits.....	80
Figure 21 General care process at the orthopaedic clinic.....	82
Figure 22 The analysis model and the logic of this chapter	91
Figure 23 The three element groups at the community healthcare clinic.....	95
Figure 24 The three element groups at the orthopaedic clinic.....	95
Figure 25 The order process, the first part of the patient's order cycle.....	97
Figure 26 The second part of the patient's order cycle, the fulfilment process	97
Figure 27 The patient's order cycle	98
Figure 28 Instead of one extensive patient order cycle there is several small ones within it.....	99
Figure 29 Patient perspective (1), Care provider perspective (2) and Fulfilment of care perspective (3)	102
Figure 30 Division of found measurements	104
Figure 31 The evaluation model, fulfilment rate of the two healthcare cases' ability to live up to a logistics system's main features. (C = community healthcare clinic, O = orthopaedic clinic).....	108
Figure 32 General model of fulfilment of a logistics system's main features, the evaluation model	110

LIST OF TABLES

Table 1 Outline of the research questions and purpose in this thesis.....	6
Table 2 Similarities and differences between manufacturing and healthcare characteristics ..	13
Table 3 Research methods applied to the research questions and purpose	25
Table 4 Selection of respondents	31
Table 5 Definitions of system from a business and management perspective	39
Table 6 Organisation system's main features and their content	65
Table 7 A logistics system's main features and their content.....	66
Table 8 Description model, a logistics system's description aspects, the outcome of the description and questions to answer when describing the system.....	68
Table 9 General facts about the case hospital	70
Table 10 Measurements at the case hospital.....	89
Table 11 The units of the case hospital, their main tasks and associated elements	94

1 INTRODUCTION

This is a methodological thesis that practically interprets general logistics theories and the systems approach applied to the healthcare context. It is described, modelled, and exemplified how a hospital can be viewed as a logistics system. The thesis is the first step in making a proper logistics analysis of healthcare systems; it is a description of what a healthcare provider looks like when viewed with a pair of logistical glasses. Consequently, the intention is not to propose definitive solutions to problems as much as to promote a new mindset whereby they can more easily be solved.

“The scientific mind does not so much provide the right answers as ask the right questions.”

(Claude Levi-Strauss)

This chapter begins with a background that highlights and addresses the challenges currently facing Swedish healthcare and the starting point for the research. The background then leads into the purpose and the research questions followed by the main contents of this licentiate thesis. The relevance of the research and the need of logistics research and knowledge within the healthcare sector are also further motivated in chapter two.

INTRODUCTION

1.1 BACKGROUND

In almost every developed country the healthcare is facing several challenges. This has partly to do with an aging population leading to increased need for interventions, both treating and caring efforts as well as prevention (Socialstyrelsen, 2009). The number of 75 year olds and older in Sweden will increase by approximately 100% between 2010 and 2050 according to Statistics Sweden (Socialdepartementet, 2010). Furthermore, medical progress with expanded, advanced treatment options and new pharmaceuticals also increases the need for interventions. The costs of the Swedish healthcare are therefore expected to increase by about 80 percent by 2050 due to new treatment options, a higher level of ambition and number of patients (Socialdepartementet, 2010). Another challenge is the number of preventable adverse events. 3,000 people die every year because of deficiencies in Swedish healthcare (Vårdförbundet, 2011). Information and communication technology also provides patients, relatives and citizens access to medical knowledge and information regarding care units' performance and quality (Hallin and Siverbo, 2003). This strengthens the patients' position and increases their ability to act as active and aware customers. In addition, forecasts indicate that the demands and requirements on the healthcare sector will grow faster than the financing possibilities (NUTEK, 2007). This means higher demands as regards efficiency and effectiveness on healthcare organizations to develop their own organization in order to meet society's increasing demands.

Industrial development has resulted in productivity gains and economies of scale, but the same degree of efficiency and innovation has not been presented within the healthcare sector (NUTEK, 2007). A symptom of not properly functioning healthcare organizations is the limited time that physicians and nurses spend with their patients (Svenskt-Näringsliv, 2005). This is partly because of the lack of running organizational structure for how the patient's path through the chain of care should be controlled. Instead, too much time is spent on re-organizations, politically motivated or driven by short-run savings requirements. Another general call to handle these challenges, such as long waiting times, increased patient demands, and deficient accessibility, has been to increase the overall design capacity. Many studies, however, have shown that there is no correlation between organizational capacity and patient waiting time or between waiting time and level of patient demand (Silvester et al., 2004). The main reason is instead that resources are used inappropriately and that they are not adapted to variations that arise (Walley et al., 2006). The challenges the healthcare organisations are facing should rather, as a first step, be handled through understanding of its processes and systems, to be able to improve it and thereby make it better for patients, staff and funders (Arvidsson, 2007). However, increased resources can perhaps handle some of the disadvantages reported almost daily in the news but resources cannot increase in line with needs. Consequently, an increased need for medical care must be met with efficiency improvements in addition to medical development. The flow of patients through the care process and the associated flows of information, resources and materials, must then be improved so that more patients can be treated in less time while quality needs to be raised

INTRODUCTION

and secured (Parnaby and Towill, 2009, Aronsson et al., 2011, Meijboom et al., 2011, de Vries and Huijsman, 2011).

Although the traditional logistics research field is that of manufacturing and distribution companies, the healthcare can benefit from the lessons learned in the industrial sector (de Vries and Huijsman, 2011). As a research area, logistics and supply chain management in a healthcare context has attracted increased attention in recent years (Lillrank et al., 2011, Meijboom et al., 2011, Aronsson et al., 2011, de Vries and Huijsman, 2011, Parnaby and Towill, 2009). It is suggested that systematic logistical thinking can help to improve the well-known problems in healthcare such as access, quality, efficiency and effectiveness. This includes knowledge regarding process and flow orientation, flexibility, efficiency and enhanced customer service. Related objectives are to decrease lead times and costs and to increase customer service and throughput and the organisation's revenues and profits. However, flow-oriented design of healthcare delivery systems is novel and positions much currently isolated research on a conceptual level or within single wards (Wiger and Aronsson, 2012).

The “hard core” within the logistics discipline, what logistics knowledge is all about, can be formulated as follows:

“Directed towards the flow of materials, information and services; along the vertical and horizontal value chain (or supply chain) that seeks to coordinate the flow and is based on; system thinking (a holistic view), where; the unit of analysis essentially is the flow.”

(Arlbjørn and Halldorsson, 2002)

Hence, the “flow thinking” is a central element in the “hard core” of logistics and it is the substance and the context that determines what is meant by “flow” (Arlbjørn and Halldorsson, 2002). Furthermore, logistics is a system in itself, and the system approach is also a critical concept within logistics (Stock & Lambert, 2001). The systems approach includes creation of conditions to intertwine functions and processes towards effective systems and it embrace more than the meaning of process orientation. As early as the mid-1970s Gregson (1976) stated that logistics within a company could be represented as a system because it portrays a total pattern of phenomena whose components are interrelated. A logistics system as a model is simply a representation, in such a way that the relationship between inputs and outputs may be clearly seen (Christopher, 1971). Viewing an organisation or a supply chain as a logistics system is in this thesis the basis for controlling and managing to improve e.g. for redesigning flows, increasing efficiency, decreasing lead-times, improving accessibility and so on. There are many logistics tools to benefit from once the logistics system is known, such as parallel activities, postponement, backwards planning, activities that can be removed, investments in bottlenecks, process analysis, lead time analysis, etc. The underlying question is then how to view a healthcare organization to take advantage of logistics theories, concepts, rules, mindsets, principles, tools, models and solutions with the aim of understanding and improving flows' effectiveness and efficiency. Therefore, the logistics approach has to be more specific than viewing an organisation as a system to be able to apply a logistics approach to healthcare management and benefit from

INTRODUCTION

the discipline's development, The main features of a logistics system and how to describe it are thus critical, which is surprisingly scarcely mentioned in the literature. It is in this specific approach that the possibility to transform an already developed discipline into to a new context lies.

To summarize, demographics, increased costs, strong technical and medical developments, new kinds of customer requirements, stressed staff and preventable adverse events are some of the challenges the Swedish healthcare is currently facing. In addition, there is a constant demand on the healthcare to be more cost-effective while fulfilling demands as regards waiting times, quality and availability. Compared to other countries, however, Swedish healthcare is very cost-effective but there is nonetheless a significant potential for improvement (NUTEK, 2007). Experience from structural changes in other industries gives reason to be positive about the potential for long-term productivity leaps in the healthcare sector. The challenge is to simultaneously find successful application of efficient production and flexible adaptation to changing patients' demands and requirements. Taking advantage of the logistics expertise that already exists can be a way to meet these challenges. It can be assumed that logistics knowledge applied in healthcare can lead to lower costs, shorter waiting lists, better patient service, shorter treatment times and increased capacity. This licentiate thesis thus presents a methodological development to describe healthcare organization(s) by means of a logistics system's description aspects and evaluate it by means of a logistics system's main feature.

1.2 PURPOSE AND RESEARCH QUESTIONS

Based on the previous discussion, the purpose of this thesis is:

To develop a method intended for evaluating a healthcare organisation by means of a logistics system's main features

The purpose rests on the assumption that effective management and real flow-efficient improvements can only be accomplished by viewing logistics as an integrated system. By emphasizing an ideal logistics system by its main features and then evaluating healthcare organisations by means of these, it is assumed that knowledge regarding patient flows can be obtained and potentials for improvements highlighted. For this reason, the following research question appears to be unavoidable:

RQ 1: *What are the main features of a logistics system?*

This will be an elaboration from systems approach, organisational orientation of systems approach and core of logistics to the substance of a logistics system. The outcome of this research question is the analysis model which will be further used in the evaluation of a healthcare organisation.

The next research question is motivated by the following discussion. According to Van Gigch (1991), there are two ways to improve a system; *system improvement* ("the transformation or change that brings a system closer to standard or to normal operating

INTRODUCTION

condition”) and *system design* (“it demands a completely new outlook and approach in order to produce innovative solutions with the immense capability of bringing a cure for present-day ills”). The system design can be compared to the Quantum-leap Improvements presented in Abrahamsson and Aronsson (1999). Both systems improvement and systems design require a model of the real world in order to provide solutions and to be able to evaluate them (Van Gigch, 1991). As an conceptual model there can be different real world implementations of it in which the importance of each of these components, with respect to the others, can differ, this is called the power of abstraction (Caddy and Helou, 2007). A model for describing logistics systems will thus probably lead to different kinds of real-world examples of logistics systems in different businesses and contexts. The question of how to describe a logistics system is indeed critical. The second research question thus provides greater understanding of what aspects to consider when describing a general logistics system.

RQ 2: *What description aspects represent a logistics system?*

This will be an elaboration from both the substance of the main features of a logistics system (result from RQ1) and main features of an organisation towards description aspects for how to describe a logistics system. The outcome of this research question is the description model which will be further used to describe a healthcare organisation to be able to analyse it by means of a logistics system’s main features (RQ 1). The research questions, however, correspond to logistics in new contexts and are not associated with the specific context of healthcare.

However, according to Parnaby and Towill (2009), the healthcare delivery supply chain, i.e. to take care of patients in need, must rest on a systems approach. In this thesis, this is done from a logistics point of view, which means focusing on patient flows and the fact that individual elements and subsystems must fit together. The system must then be controlled to achieve the overall system purpose in the most effective way at the lowest overall cost, and with a minimum of complexity. As mentioned earlier, the first step towards benefiting from the logistics discipline’s development is to describe the studied object from a logistics point of view. The model of how to describe a logistics system (result from RQ2) is used to describe a healthcare organisation by means of a logistics system’s aspects. However, to be able to this, there has to be an understanding of the reality. Van Gigch (1991) expresses this very clearly: “Unless we understand the nature of reality, we cannot model successfully”. Therefore, the empirical world is in this thesis exemplified by two cases; two different types of clinic within a Swedish hospital. The cases will partly be used to test the adequateness of the developed method and its associated models, i.e. the outcome of RQ1 and RQ2, and hopefully, by the evaluation of the cases, also identify potential for improvement towards a more flow-oriented business. An outline of the research questions and the purpose is presented in Table 1.

INTRODUCTION

Table 1 Outline of the research questions and purpose in this thesis

	RQ1 <i>What are the main features of a logistics system?</i>	RQ2 <i>What description aspects represent a logistics system?</i>	Purpose <i>To develop a method intended for evaluating a healthcare organisation by means of a logistics system's main features</i>
Type of study	Theoretical	Theoretical	Case studies
Theoretical framework	The systems approach applied to the field of business, organisations and management. Core of logistics	System theory Basic principles of logistics Basic logistics literature	Logistics literature related to healthcare issues Healthcare literature related to logistics issues
Analysis	Developed from the definition of a system together with an organisational perspective, a synthesis is done by the core of logistics.	Based on the definition of a logistics system, basic principles of logistics are added along with basic logistics literature to create the model for describing a logistics system.	Based on the model for describing a logistics system and healthcare conditions the cases are described. Further, analyses based on the main features of a logistics system.
Partial conclusion	Main features of a logistics system Analysis model to evaluate a system's fulfilment of logistics' main features	A model for describing a logistics system, i.e. description model	Two example of how healthcare organisations can be evaluated by fulfilment rate of logistics system's main features.
Concluded in	Chapter 5	Chapter 5	Chapter 8

The research presented in this thesis obviously has two aspects; logistics research in a new context and an aim to contribute to a needing sector. The relevance and motivation of the research, from both a logistics research and a healthcare perspective, is further described and elaborated in chapter 2.

1.3 OUTLINE OF THE LICENTIATE THESIS

Chapter one - Introduction

The thesis begins with a background that highlights and addresses the challenges currently facing Swedish healthcare. This background then leads into the purpose and the research questions of this thesis. The outline is illustrated in Figure 1 below.

Chapter two – Logistics research in a new context

Since there is an extra need to motivate the relevance of the research in this thesis due to the new context of logistics studies. Likewise, there is an extra call to motivate the need of logistics research and knowledge within the healthcare sector. This chapter therefore motivates the study by presenting the relevance of the research, the need for logistics research in the healthcare context and a short overview of the history of logistics.

INTRODUCTION

Chapter three – Research approach

This chapter describes the methodology of this study. It includes sections such as research design, research method and data collection. The relevant research methods in this thesis are literature reviews and case study including interviews, business systems scanning and observations. For each of these methods, a detailed description is provided in order to inform the reader how these methods have been applied in this study.

Chapter four – Logistics systems

This chapter presents one part of the frame of references. The emphasis is on how systems are described and characterised, e.g. description aspects to describe systems and general system features. It begins with a brief presentation of literature concerning the systems approach in general, from an organisational point of view and the systems approach within logistics. The chapter ends in the base for further development of a logistics system's main features. This chapter also presents a short history over the development of the system approach.

Chapter five – Main features and description aspects of logistics systems

The fifth chapter presents the theoretical models used in this thesis and their development, i.e. the logistics system's main features and description aspects. It is an elaboration with selected main features of an organization viewed as a system and linked to the logistics literature focusing on areas central to “good” logistics management. The chapter ends with a summary of a logistics system's main features and how to describe a logistics system to be able to analyse it by means of the formulated main features, i.e. the analysis and the description model.

Chapter six – Description of the case hospital

In this chapter, two different healthcare organisations (both included in the case hospital) are described by means of the description aspects developed in previous chapter.

Chapter seven – Analysis- The case hospital as a logistics system

The seventh chapter presents an analysis based on the case description in the preceding chapter. The two different care organisations are evaluated by means of the main features of a logistics system and rated based on how well they can fulfil the main features.

Chapter eight – Conclusions and contribution

The final chapter presents the main conclusions from this study, the adequateness of the developed method and its associated models, i.e. the outcome of RQ1 and RQ2, and also the identified improvement potentials towards a more flow oriented business. The contributions and a discussion of the results are presented as well as suggestions for further research.

INTRODUCTION

Figure 1 Outline of the licentiate thesis

2 LOGISTICS RESEARCH IN A NEW CONTEXT

There is an extra need to motivate the relevance of the research in this thesis due to the new context of logistics studies. Likewise, there is an extra call to motivate the need for logistics research and knowledge within the healthcare sector. This chapter therefore presents the relevance of research from a logistics research perspective, the first part. In addition, the second part presents the need and opportunity for the healthcare sector to develop towards flow orientation via knowledge from the field of logistics.

2.1 THE RELEVANCE OF THE RESEARCH

Much research and development of knowledge, of how to provide effective ways to organize and manage businesses, has over the past decades been focused on successful companies in an industry and trade context. This is noted by Ellram et al. (2004) who stress that in academia there is a concentration on using examples, models, research and anecdotes obtained from the manufacturing sector. The operations, supply chain, and marketing literature have also been criticized for their manufacturing-centric focus (Ellram et al., 2004). In addition, Berry and Bendapudi (2007) encourage service operations, management, and marketing academics to become more involved by for example covering healthcare service issues in focused research programmes and education. Despite this criticism and encouragement, the logistics management research field has only recently turned its attention to the important change and improvement opportunities in healthcare organisations (Wiger and Aronsson, 2012). The following quote encourages more emphasis on service as context.

“Universities should also give attention to the service sector and service supply management in educating future practitioners and in conducting research. The area of service supply management affords great research opportunities”

(Ellram et al., 2007)

2.1.1 Healthcare is substantial and complex

Many countries spend a lot of their available capital on their national healthcare. In 2003 Swedish healthcare cost more than SEK 225 billion. This is a significant proportion - 9.2% - of Sweden's total GDP (Sveriges Kommuner och Landsting, 2005). This is one of the reasons why the healthcare sector is relevant to study with a view to improving its efficiency. The healthcare sector is also a major industry in terms of number of employees. The fourth largest employer in the world is a healthcare organization, the NHS (National Health Service) in the United Kingdom (NHS, 2011). Only the Chinese People's Liberation Army, the Wal-Mart supermarket chain and the Indian Railways directly employ more people. A third reason of interest is complexity. Clinical methods used in healthcare and disease cure can be “easily” understood but when they are combined into institutions and broadened into social systems, their management becomes surprisingly convoluted (Glouberman and Mintzberg, 2001).

2.1.2 The main flow of patients

The concept of logistics management is flow-oriented (Christopher, 2005). Despite the fact that the flow of goods is the traditional unit of analysis this is not the situation in a healthcare context (Aronsson et al., 2011, Lillrank et al., 2011). This because the ‘core service’ that provides benefits to the customer is instead treatment, cure, or care (Baltacioglu et al., 2007). The quote below stresses a patient-focus by the flow of patients.

“The core process of healthcare organisations is concerned with the flow of patients who need treatment, while the flows of material are secondary”

(Vissers and Beech, 2005)

Consequently, the patient flow is central to an organization's capacity to provide service; other operations are supportive of creating conditions for an efficient patient flow.

"Focus on patient flow is to make healthcare delivery both effective and efficient."

(Parnaby and Towill, 2008).

The Council of Supply Chain Management Professionals (CSCMP) is a worldwide professional association, with over 8,500 members from 67 countries, with the mission to develop and disseminate research and knowledge of supply chain management (CSCMP, 2011). One of the most academically cited and established definition of logistics management is the one from this association:

"Logistics management is an integrating function, which coordinates and optimizes all logistics activities, as well as integrates logistics activities with other functions including marketing, sales manufacturing, finance, and information technology."

(CSCMP, 2011)

One of few definitions of healthcare logistics is Arvidsson's (2007) attempt to translate the logistics management definition above:

"Healthcare Logistics includes effectively planning, fulfilling and controlling all activities of the patient path through the healthcare, from request to completion of the care commitment to satisfy the patient's care needs and preferences. It also includes the flow of information that is needed for the patient's care chain to work."

Independent translated from Arvidsson (2007)

2.1.3 Healthcare, a special kind of service

Service supply chain management has become a concept in recent years and elaborated conceptually in a service context (Ellram et al., 2004), conceptually in a healthcare context (Baltacioglu et al., 2007), and as a survey in the municipal sector (Arlbjørn et al., 2011). A hospital, health centre or geriatric care is a special kind of service organization, a resource-oriented service organization (Visser and Beech, 2005). Healthcare production characteristics are closer to production of services than manufacturing industry production operations. For instance, health professionals always make a judgment as a basis for decisions on further treatment. Manufacturing or service industries strive to meet their customers' demands without asking if it is necessary to have the product or service. Berry and Bendapudi (2007) call these reluctant services, customers need but may not want. There are some others notable dissimilarities between healthcare and other services. The customers, i.e. the patients, are sick, they are relinquish privacy, they need "whole person" service and they are at risk (Berry and Bendapudi, 2007).

In general, there are three characteristics of services: (1) services are more likely to consist of linked activities (intangible) than goods (tangible); (2) services are produced and consumed at least partly at the same time; (3) the customer participates at least partly in the service production process (Grönroos, 2007). This is evolved further by Grönroos and Ravald (2011) who argue for a split customer's process of value creation; one part open and the

other closed, see Figure 2. The open part is where the interaction takes place and the supplier can access the customer process of value creation. A joint value creation with the customer is then possible. The opposite is true in the closed part; the supplier is not co-creator of value or present as a subject. The supplier's process is also divided into two parts; a production phase aiming at facilitating value creation and an interaction phase.

Figure 2 Value creation and co-creation in a supplier-customer relationship (Grönroos and Ravald, 2011)

Pure services are also labour intensive, difficult to resell, difficult to automate, not able to be stored and transported due to simultaneous production and consumption, are often perishable (unused capacity is capacity lost forever), and have a quality dimension that is difficult to evaluate (Arlbjörn and Halldorsson, 2002). Vissers and Beech (2005) listed the major differences between a healthcare (e.g. a hospital) and a manufacturing environment. As mentioned earlier, the core process of healthcare organizations is concerned with the flow of patients instead of material, which is secondary. There is also much less price-performance interaction than in most production environments. Product specifications are often subjective and vague compared to manufacturing's production control approaches that presuppose complete and explicit specifications of end-product requirements and delivery requirements. Furthermore, healthcare organizations do not have a simple line of command; instead there are many different interest groups (management, medical specialists, nursing staff, and paramedics) that each have ideas about what should be targets for production performance. The educational status in healthcare is generally very high and many key operators in the core process are highly trained medical professionals. Due to the service orientation, care is not a commodity that can be stocked. Table 2 summarizes the similarities and differences between manufacturing and healthcare organizations.

Table 2 Similarities and differences between manufacturing and healthcare characteristics
(Visser and Beech, 2005)

Characteristics	Manufacturing	Healthcare
Object	Material flow	Patient flow
Specification of end-product requirements	Up-front specified	Subjective and fuzzy
Means of production	Equipment and staff	Equipment and staff
Buffers	Stock or lead-times	Waiting times and lead-times
Financial goal	Profit	Cost control
Market environment	Market competition	Limited market competition

2.1.4 The potential of logistics management in a healthcare context

Aronsson et al. (2011) show that supply chain management has potential to work well as a philosophy for a patient flow focus. Likewise, Towill and Christopher (2005) argue for the “power of analogy”. They show that material flow concepts developed and used successfully for commercial products and services can equally well form the architectural infrastructure of effective healthcare delivery systems with a patient flow focus. It is a matter of planning and organizing resources so that bottlenecks and their associated queues can be minimized and resources given higher priority to be used in the active patient time (Silvester et al., 2004). Towill and Christopher (2005) (originally in Towill and Christopher, 2003) believe that:

“... there is evidence indicating a number of opportunities where new thinking in commercial and industrial logistics and supply chain management are being transformed into healthcare deliver to good effect”

The field of healthcare logistics is still in its infancy and few articles have so far been published in traditional logistics journals (Wiger and Aronsson, 2012). On the other hand, *Supply Chain Management: An International Journal* recently published a special issue on supply chain management in health services (Issue 3, 2011). The editor also concluded that the health sector can benefit from the lessons learned in the industrial sector (de Vries and Huijsman, 2011).

As mentioned earlier, healthcare has several differences compared to industrial activities; it is a special kind of service. This means that it is not possible to just copy the industrial knowledge; it must be adapted and developed into a unique knowledge that is specific to the health sector. Ellram et al. (2004) exemplify this by defining Service SCM suited to service organisations in a way that differentiates it from traditional SCM because of the inherent differences in services. A contextual adaptation along with a systems approach are thus critical to get the full effect out of these industrial improvement opportunities that face the healthcare sector today (Aronsson et al., 2011).

2.1.5 Swedish healthcare

This thesis’s case hospital is part of the Swedish public sector. Compared to other countries, the whole Swedish healthcare system is highly decentralized (Sveriges Kommuner och

Landsting, 2005). The main part is managed and financed in their respective areas by 20 county councils and 290 municipalities. The main responsibility for health policy on a national level lies with the Swedish Government and Parliament. The Swedish Health Service Act (1982:763) states that the main goal of healthcare is good health and care on equal terms for the entire population. Care shall also be provided with respect for all human beings and human dignity. Those who are most in need of health care should be given priority access to care (Sveriges_Riksdag, 1982). All counties can contract private providers, who deliver approximately 10% of all healthcare in Sweden (Sveriges Kommuner och Landsting, 2005). Privately funded healthcare, however, is marginal; only a few per mile of the total cost of healthcare.

2.2 A NEW APPROACH TO HEALTHCARE – THE NEED FOR LOGISTICS RESEARCH

As in the previous section, there is an extra call to motivate the need for logistics research and knowledge in healthcare. The following sections are therefore dedicated to this issue.

Healthcare systems are one of the most complex systems known to contemporary society. In particular, hospitals are considered to be particularly complicated organizations (Glouberman and Mintzberg, 2001). No country seems to be satisfied with the current state of its healthcare system. Many countries try to deal with their problems through repeated reforms. “A major trouble with many hospital systems is that they often lack reliable design mechanisms for the vital step of integrating the individual elements into a coherent and effective organizational whole” (Parnaby and Towill, 2009). Alongside the healthcare sector’s evolvments towards more process oriented business models, interest in healthcare logistics management has increased. This can be illustrated by the increase literature on using industrial processes or applied business concepts in the healthcare delivery systems (Wiger and Aronsson, 2012). This is probably an indication that some researchers have discovered the potential of using already developed knowledge in a new context. Further, a flow-oriented organisation is based on knowledge of what drives costs and time in the overall supply chain (Abrahamsson and Karlöf, 2011). This of course impacts on the possibility to reduce the total costs of the organisation while improving customer service.

Increasing revenue (by selling more or increase margins) or reducing costs are the two most obvious options for a company to increase its profits. Effectiveness, efficiency and competitive advantages are key words in the logistics management field. Companies either have a cost advantage, a value advantage or both. Competition between companies and businesses pushes organisations to create competitive advantages. These firms’ development has contributed to create theories, models and mindsets. This thesis takes the standpoint that this knowledge can be used to develop of non-profit organizations even if they often have other incentives than profit-making organizations. In most cases in Sweden, a healthcare organization cannot increase its revenue but it can reduce its costs.

2.2.1 Managing complex systems

Coordinating activities in a healthcare organisation can be difficult. The difficulties can partly be traced to the complexity caused by the large number of related and interdependent activities in the organisation. Complexity also increases if the effects of certain actions are separated from their cause in time and space. “By all accounts, complexity is the result of the multiplicity and intricacy of man’s interaction with the systems” (Van Gigch, 1991). Within healthcare organisations responsibilities are often functionally divided or a fact when patients are moved between different healthcare settings. This increases the complexity. Understanding the interdependencies and the complex causal relationships within a healthcare organisation is crucial to successful management of the organisation. A common mental model for a new approach can only be formed after the members have been given sufficient knowledge and understanding of the underlying ideas along with a possibility for dialogue on the topic (Senge, 2006). Like a business organisation, a healthcare organisation is a system of interrelated parts working in conjunction with each other in order to accomplish a number of goals. This is one of the main statements in systems theory; that no single function can act independently of another in a system. Systems theory has its origins in the political science/sociology discipline and is used as logistics applications in for example cost trade-offs, logistics engineering and supply chain management (Stock, 1997). It was during the 1970s that the systems approach had its breakthrough, but a great deal of research using a systems orientation certainly took place as early as the 1960s and even before that (Arbnor and Bjerke, 1997). It was also during this time that this approach within the logistics field was highlighted (see for example Gregson (1976), Christopher (1971), Geisler and Steger (1963)). Nowadays this view is more or less built-in or impliedly in the logistics research. Stock & Lambert (2001) emphasize this by stating that the system approach is a critical concept within logistics management. Logistics is also a system in itself (Stock and Lambert, 2001). The systems approach is clearly dominant in both qualitative and quantitative logistics studies, compared to the analytic and actors approaches. This is shown by Vafidis (2007) in his doctoral dissertation on Finnish and Swedish logistics doctoral dissertations published between 1994 and 2003.

2.2.2 Measuring flow efficiency

More attention to and time and money for performance management, measurement and evaluation are allocated to the public sector (McAdam et al., 2005). Many healthcare organisations have implemented performance measurement systems, for example Balanced Scorecard. The healthcare sector differs from manufacturing and distribution industries in that precision and safety are very high due to the fact that the healthcare sector handles human lives. The healthcare system is considered to be complex and challenging to measure (Dey et al., 2008, Dey et al., 2006). However, many things are measured and measurements are used in healthcare with an emphasis on medical outcomes and quality (see for example Dulugacz (2006), and SKL and Socialstyrelsen (2011)). The focus is thus on the end results. But measurements should fully capture the logic of the underlying logistic system (Aronsson and Andersson, 2002). It is also essential to measure the right things at the right time in a supply chain to improve the business outcome related to the organisation’s stated objectives (Kaplan, 1990).

International and national organisations, like WHO, OECD and SALAR (Swedish Association of Local Authorities and Regions), are constantly working to measure health from a social perspective. The health-related result responds to long and short term effectible circumstances (Janlöv et al., 2009). Arah and Westert (2005) state that socioeconomic factors, like living and working conditions, and environmental factors are significant for a person's health status. Some of these performance measurements are typical quality indexes, for example avoidable mortality per 100,000 inhabitants or the proportion of diabetic patients with antihypertensive drug procedure. As described previously, the measurements used in the logistics field traditionally operate on a lower level than both the international and national level. From a logistics point of view, the socioeconomic factors can be seen more as context. To summarise, the focus in the healthcare sector is at a strategic level with quality indexes for the end results, but scarcely to facilitate or support the work methods to get there. The measurements provide a poor picture of patient flows due to the end result orientation. Measurements to control and monitor efforts to achieve the desired quality may be lacking. The business's specific quality measurements are not to be used as decision-making support or follow-ups or to control the business at a management level.

2.2.3 Power of analogy – a learning opportunity

Newer disciplines seem to be developed from the usage of concepts, definitions, theories, rules and principles from other disciplines (Stock, 1997). This is also the case in logistics research, which has its roots in theories borrowed from more established disciplines, e.g. accounting, computing, economics, management, marketing, mathematics, philosophy, political science, psychology and sociology (Stock, 1997). Another example is SCM, which also has approaches from different disciplines (Arlbjørn et al., 2011).

Towill and Christopher (2005) argue for the “power of analogy”, i.e. mapping the unfamiliar “messes” onto an established model. They show that material flow concepts developed and successfully used for commercial products and services can equally well form the architectural infrastructure of effective healthcare delivery systems. Moreover, if a problem can be tackled by a knowledge base built up from another discipline where it is possible to describe the problem scenario using a “model” familiar to the contemplated discipline, then a wide range of proven solutions become available. Examples of this can be found in the literature, but not published strictly in logistics or SCM journals. Rahimnia and Moghadasian (2010) explore a combination of the two strategies Lean and Agile; of how supply chain *leagility* can be applied in hospitals by applying the decoupling point concept in a healthcare delivery system. Another example is the theory of *swift and even flow* which is used to analyse the internal service supply chain of a preoperative surgical services department in Fredendall et al. (2009). Another example can be found in Chow-Chua and Goh's (2000) paper concerning quality improvement methods, viz. *business process re-engineering* (BPR) and *continuous improvement* (CI). They evaluate which of the two (or both) is better for process improvement in hospitals. As a further example, Parnaby and Towill (2009) study the implementation of cellular operations to provide seamless patient flows in a healthcare delivery process.

LOGISTICS RESEARCH IN A NEW CONTEXT

“... scholars determine that there is no reason to reinvent the wheel and therefore, search out those things which can or might apply to their respective area of study”.

(Stock, 1997)

Scholars use the power of analogy and also businesses. (Ellram et al., 2004) highlight that different businesses can benefit from applying best practice from other businesses. The three benefits of applying “borrowed” theories to logistics, presented in Stock’s (1997) article, are also suitable when logistics theory is to be translated to a healthcare context:

1. “Learning from the experience of others;
2. advances in knowledge and understanding, which might not have occurred otherwise, or perhaps taken longer, could occur more quickly; and
3. the inclusion of theories from other disciplines further enhances the linkages between logistics and those disciplines.”

These benefits came primarily because scholars in logistics research have different perspectives than traditional medical management or organizations research in that context (due to varying backgrounds, orientation and or environmental impacts).

2.2.4 The whole system in focus

Several methods, models, principles, philosophies, etc. originating in the manufacturing industry are being introduced as improvement efforts in the healthcare sector, e.g. Balance Score Card, Breakthrough, Total Quality Management, Six Sigma and Lean (see for example Hellström et al. (2011)). Some of these are used as “quick fix” concepts focusing on orderliness and used as practical and operational toolboxes. The conceptualisation and focusing on a lower level of abstraction has contributed to their being taken out of their original context. As a consequence, the overall system performance has been overlooked. To be able to organize for quick response and flexibility in an efficient way where cooperative efforts by the supply chain members should synchronize and converge operational capabilities into a unified whole, a systems approach is necessary (Aronsson et al., 2011).

A system is a network of related functions or activities and has to be understood as a whole. The object is to operate the whole system effectively and not just the individual parts (Langley et al., 2008). This approach is generally absent in healthcare organizations, in particular the desire to improve at functional levels. Without considering the impact of decisions on the larger system, sub-optimization often occurs (Stock & Lambert, 2001). Increasing the efficiency of a unique patient flow or a production flow is one thing, but the question should rather be what it means for the system’s performance as a whole and how the entire system will be influenced when utilisation of resources such as physicians or operating theatres is optimised. The patient flow of a particular care group is rarely isolated; it is rather included in a network with other patient flows, and to prioritize one patient group over another group’s health needs is not always accepted. One example is the objective as regards hip and knee arthroplasty patients:

“osteoarthritis patients shall receive optimal treatment through the entire care chain by following the medical AM”

(independent translation, (Hässleholmssjukhusorganisation, 2007))

There is a constant risk of sub-optimization of functions, resources or specific flows when the studied system's boundaries are too narrow. The system must be viewed as a whole to understand the opportunities for improvement (Stock & Lambert, 2001). A key question is how to design an organization that can handle several unique patient flows in a structured and standardized manner since there are a number of different patient flows within healthcare organizations.

“System problems” require “system solutions”, which means that we must aim at solving the larger system problems with solutions that not only satisfy the subsystems' objectives but also provide for the global system's survival”

(Van Gigh, 1991)

The function of logistics in economy in organizations interface with marketing, total cost analysis, and logistics strategy is built on a systems approach, which is a key to understanding the role of logistics (Stock & Lambert, 2001). Hence, one way of designing cost-effective but also time-flexible healthcare systems is to apply an interdisciplinary systems approach, where the production processes and flow of patients are in focus (Aronsson et al., 2011).

2.3 A LOGISTICS OVERVIEW- LOGISTICS HISTORY AND DEVELOPMENT UP TO TODAY

This section presents a short overview of the logistics discipline's development and logistics history with focus on business and logistics management. There must be an awareness of the inevitable bias that enters into the construction of any historical record. However, the following quote justifies this recap:

“To understand the important role of logistics management in today's business enterprise, it is worthwhile to examine its historical development”

(Stock and Lambert, 2001)

The quote from Stock and Lambert (2001) highlights the importance of having an orientation of the logistics roots. The earliest form of organized trade which was a kind of logistics activity and is by that, literally, thousands of years old (Grant et al., 2006, Stock and Lambert, 2001). However, it is said that logistics owes its origins to the military, where the term *logistics* encompasses supply items (food, fuel, spare parts) as well as personnel (Langley et al., 2008). As an area of study, logistics first began to gain attention in the early 1900's (Grant et al., 2006, Stock and Lambert, 2001). It was in the distribution of farm products, as a way to support the organization's business strategy and as a way of providing time and place utility.

During the Second World War logistics began to receive increased recognition and emphasis (Grant et al., 2006) and also further developed and refined (Stock and Lambert, 2001).

LOGISTICS RESEARCH IN A NEW CONTEXT

However, the first dedicated logistics texts began to appear in the early 1960s (Grant et al., 2006). In 1963, the National Council of Physical Distribution Management was formed (renamed the Council of Logistics Management in 1985 and in 2004 the Council of Supply Chain Management Professionals) “to develop the theory and understanding of the [logistics] process, promote the art and science of managing [logistics] systems and to foster professional dialogue and development in the field operating exclusively without profit and in cooperation with other organizations and institutions (Stock and Lambert, 2001).

The potential of the systems concept was indicated by a number of studies, especially within physical distribution, during the 1950s and 1960s (Langley et al., 2008). One example is a 1956 study of the economics of air freight that added this new dimension to the field of logistics: the concept of total cost analysis (Stock and Lambert, 2001). The focus of physical distribution was also on the total systems cost and analysing trade-off scenarios to arrive at the best or lowest system cost (Langley et al., 2008). Langley et al. (2008) stated that the rationale for logistics management was precisely the underlying logic of the systems or total cost concept. During the remainder of the 1960s and all the way into the 1980s, a multitude of textbooks, articles, monographs, journals, and conferences followed, dedicated to the subject of logistics management (Stock and Lambert, 2001).

The exploration of the link between accounting and logistics begun during the 1970s and one of the earliest writings was Michaels Schiff's *Accounting and control in Physical Distribution Management*, published in 1972 (Accounting and control in physical distribution management, Chicago: National Council of Physical Distribution Management, 1972). The study was influential in the establishment of the awareness that accounting and financial information are vital to logistics activities (Stock and Lambert, 2001). Costs related to customer service are fundamental in logistics and logistics management, and the first detailed exploration of the topic of customer service was published in 1976 by La Londe and Zinszer (LaLonde and Zinszer, 1976). Their landmark study, and other studies on that issue, have since then continued to influence the logistics profession (Stock and Lambert, 2001).

A new term associated with logistics arose in the beginning of the 1980s, the *supply chain management* concept (Langley et al., 2008, Stock and Lambert, 2001). In recent decades, computer technology and globalization have had a major influence on logistics and contributed to the development of logistics management and also caused organisations to become more interested in the field of logistics management. During the 1990s, the great interest in process orientation led to a wide range of literature in the field and has since then been a fundamental principle of business development (Rentzhog, 1998).

In early 2011, one of the most respected logistics journals, *Journal of Supply Chain Management*, had a special topic forum on service supply chains. The motive is that “services play a dominant role in most developed economies, but are underrepresented in academic research agenda”(Sampson and Spring). The interest of this call is not in studies centred on the provision of goods in service sectors, but in settings focused on the provision of service between organizations.

LOGISTICS RESEARCH IN A NEW CONTEXT

This licentiate thesis is intended for a service context from an industrial perspective by systems approach and flow-orientation. The healthcare context is both substantial and complex with potential as research area within logistics management. A contextual adaptation is thus needed. The patient flow is in focus in this thesis when studying the special kind of service as the healthcare sector is. This chapter also provide the picture of that healthcare organisations are complex to manage as systems and that there is a learning opportunity by the power of analogy.

3 RESEARCH APPROACH

This chapter begins with the research design and methods followed by the literary basis and case studies and ends with the development of the theoretical models. It is written to explain the motives behind different choices that have been made and provide an understanding of the development of this research but also prior research which provided a solid base for this thesis.

RESEARCH APPROACH

3.1 RESEARCH DESIGN

The research in this thesis is based on the researcher's conviction that it is extremely unnecessary to reinvent the wheel. There is so much knowledge in this highly developed world so why not use it!? Over the years the field of logistics has been and continues to be strongly influenced by other disciplines (Stock, 1997). This thesis's basic research design is the reverse; to bring already known logistics knowledge into a new context to and thus avoid reinventing the wheel. The unfamiliar "messes" has then to be described and modelled in a transferable way (i.e. established model), then the problem could be tackled from the knowledge base from other research fields, e.g. the field of logistics (Towill and Christopher, 2005).

The type of research that is to be conducted influences the data to be collected and hence the research design. The research design is the logic behind the combination of collected data and the type of research question that is of interest to the researcher. The type of research should thus be clarified before the decision on the most appropriate research design or data collection method (Yin, 2009). This thesis has two distinct parts, see Figure 3. The first is purely theoretical, where the knowledge in the field of logistics that would be applied in the new context of healthcare is defined. The focus is on what main features a logistics system has and how to describe such a system. Little was known about what type of logistics knowledge is suitable for contexts other than the traditional one of manufacturing and distributing companies. This research is based on the idea that the theory of logistics has a core in the systems approach. The first part of the research is thus deductive; exploring the word of theories, compiling the information and structuring it depending on its content. The content is also analysed to make the outcome to contribute to the logistics field of system theory. However, the selection of theories and literature as well as the gathering of information from these sources are selective. A researcher with a systems approach search for a problem solution that works in practice, which makes it pragmatic in nature (Arbnor and Bjerke, 1997). The objective is not to search for an absolute truth. The world cannot be understood fully, it can nevertheless be modelled or a theory of reality formulated made to seek solutions that supposedly apply to the real world (Van Gigh, 1991). Hence, the essentials in the sprawling field of logistics management to be able to apply knowledge to new contexts are explored in the first part of this thesis. This part answers the two research questions and provides the foundation for the rest of the research.

The preferred method when using a systems approach is case studies, both quantitative and qualitative (Arbnor and Bjerke, 1997). Consequently, the second part of this thesis is that of a case study, focusing on how to describe healthcare organisations by means of logistics description aspects and to evaluate these systems by means of a logistics system's main features. Van Gigh (1991) states that researchers must remain practically minded, and that their role is to solve problems and offer constructive and lasting solutions. In a systems approach, the researcher's task is to create an understanding of a given part of the world, to identify the system's parts, links, goals and feedback mechanisms in order to improve the

RESEARCH APPROACH

system (Gammelgaard, 2004). For that reason, Gammelgaard (2004) concludes that theory in the systems approach is contextual rather than universal. Two different healthcare organisations are therefore used to test and create understanding about applying logistics knowledge to a new context. This part of the research is thus descriptive and explanatory, describing the reality from a logistics point of view and analysing it to see how well healthcare organisations fulfil the main features of a logistics system. This explanatory part of the research provides a picture of the contribution from the logistics management field to other contexts.

When the purpose is answered a system analysis has in fact been performed according to Arbnor and Bjerke's (1997) definition of *system analysis*; "System analysis means to depict a real system in a systems model without changing the real system, and to make clear to oneself the internal and external factors influencing this system". In other words, systems analysis has both a descriptive and an explanatory (possibly understanding) purpose and is as much a question of *synthesis* as of analysis. This model is then the basis for *System construction*; to depict a potential real systems model for constructing a new real system, for example when redesigning flows to make them more efficient. Both analysis and construction of systems are parts of developing new *systems theories*, where system models and producer-product relations are valid for more than one real case. (Arbnor and Bjerke, 1997). However, this study has no ambition to develop systems theory. Its contribution is to use the systems approach concretely to find real-world problems and potential for flow efficiency.

Figure 3 The overall research design and its two parts.

3.2 RESEARCH METHODS

In this thesis, two different research methods have been used; literature reviews and case studies of two different healthcare organisations. As illustrated above the research design is divided into two chronological parts. However, the data needed for the research is collected in a totally different order. In contrast to the deductive approach, as in the first part of the research, the empirical data was collected first. This is a consequence of the choice of doing research within a new field. The field of healthcare logistics is in its infancy, which required a basic understanding of the context before the actual research was designed. Consequently, the study began before the actual study for the thesis. The research design of this thesis therefore takes its starting point in initial insights based on prior theoretical logistics

RESEARCH APPROACH

knowledge followed by observations, interviews and scanning of the business system at the case hospital. Four series of interview sessions were conducted with a total of 23 respondents and 18 interviews and over 500 Excel files were collected from the business system. A more detailed description of the empirical data collection is presented later. Several literature reviews is also conducted in order to build up a knowledge base with the aim of finding interesting inputs and research issues to be able to design the research. A total of three structured or more iterative literature reviews are accomplished; logistics research in a healthcare context, along with systems approach and basic logistics research. An overview of the data collection process is presented in Figure 4 and the theoretical data collection is described in more detail in the next section.

Theoretical world

Empirical world

Figure 4 The data collection process, both theoretical and empirical data

As illustrated above (Figure 4), the data collection began in the empirical world but the first research method applied to this licentiate thesis was literature reviews. This method has been used during the whole research process. The reason for the literature reviews in this thesis was partly to obtain basic knowledge about what has been done in the field and partly to answer the two research questions. This was followed by case studies, along with the results of additional literature reviews. The use of these two methods was to be able to apply the theoretical outcome from the research questions to an empirical context. Table 3 below shows which of the research methods are applied to which research question and purpose.

RESEARCH APPROACH

Table 3 Research methods applied to the research questions and purpose

	Literature review	Case study
RQ 1	System theory and basic logistics literature	
RQ 2	System theory and basic logistics literature	
Purpose	Logistics research in a healthcare context	Interviews, observations, and scanning business database

3.3 LITERATURE REVIEWS AND CHOICES

Literature studies were made in order to build a knowledge base concerning logistics management research in a healthcare context and the systems approach in organisational and logistics research. Literature reviews have the potential to play a role in creating and building bodies of knowledge and also forming policy and practice and play a critical role in doctoral theses (Tranfield et al., 2003). Therefore, these studies were needed throughout the whole thesis. Choices of and searches for basic logistics literature were needed for the frame of reference. The literature reviews and choices are further presented below.

3.3.1 Logistics literature in healthcare context

This thesis concerns logistics in new contexts and especially in a healthcare framework. The objective of the first literature review was to identify the healthcare field in the logistics and supply chain management literature. The literature review was initially conducted by means of a thorough review of seven SCM/logistics management journals:

- *International Journal of Logistics Management*
- *International Journal of Logistics: Research & Applications*
- *Journal of Business Logistics*
- *Journal of Purchasing and Supply Management*
- *Journal of Supply Chain Management*
- *Supply Chain management: An International Journal*
- *International Journal of Physical Distribution & Logistics Management*

All articles from the last six years were scanned on the 21st of April 2011 and 13th of February 2012, see Appendix I for more details. Articles announcing a healthcare context in either the title or in the keywords, e.g. healthcare, health services, hospital or patient, were classified as patient or physical products flow oriented. The division is inspired by De Vries and Huijsman's (2011) grouping of considered elements of exchange within supply chain management in health services. It could be concluded that the logistics and supply chain management field has taken an interest in the healthcare sector and its issues. The choice to only include title and keywords in the scanning process is based on the fact that the context is rather new; it is therefore expected to be announced already in these article elements. References concerning physical product flows, e.g. purchasing for hospitals, material handling in healthcare services or medical supplies, were not of interest; they are however

RESEARCH APPROACH

included in Appendix I, as *physical products flow*. The reason for excluding physical flow articles is that they support flows to the main flow. Furthermore, the sourcing and distribution of products in a health care setting are basically not that different from other industries.

The “snowball approach” (going through references of papers already included) was thereafter used to trace the six articles’ references. All references that either included a “healthcare word” (e.g. healthcare, health services, hospital or patient) in the title or were published in a “healthcare related journal” (e.g. Journal of Health Care Quality Assurance, Journal of Health Organization and Management, or The International Journal of Health Planning and Management) were then examined. A total of 118 (of 281) references were healthcare related. Only articles published in academic journals were included in the final reading, thus excluding books, reports, unreviewed conference papers and newspaper articles. Linköping University’s library services, Google and Google Scholar were used to trace the references, although not all references could be found through the available search paths. Six articles were identified as relevant in the first search phase and twenty references were included as a result of the second phase. An illustration of the literature review method is presented in Figure 5 below.

Figure 5 The method of the literature review, logistics literature in a healthcare context

This literature review resulted in a paper presented at the NOFOMA Conference 2012 Turku, Finland (Wiger and Aronsson, 2012). Naturally the results have also been used throughout the whole research process, especially in the introductory chapter and to explain the relevance of the research. The review concludes that interest has increased in logistics research in a healthcare context but it is still in its infancy.

The useful method of literature search presented above is a result of other search methods that have been tested in the past which did not capture any useful literature. Using keyword search methods on business databases resulted in an unworkable number of hits. This was due to the combination of the word logistics, flow or supply chain together with terms connected to a healthcare context. It resulted in capturing predominantly types of articles on

RESEARCH APPROACH

medicine and biology, e.g. logistic regression, blood flow, humanitarian logistics and distribution of pharmaceuticals. It can thus be concluded that the field of healthcare logistics is not defined. The second search phase showed that the articles in the reference list were published in a wide range of journals. The review of references suggest that there are publications that deal with logistics related issues, and patient flow issues but not connected to the research field of logistics and supply chain management.

3.3.2 Systems approach

This thesis concerns logistics systems and it is assumed that the systems approach is core within logistics research. The second literature review was necessary to develop a framework which was used for the development of the theoretical models; the main features of a logistics system and description aspects of a logistics system. The *systems approach* is used as an umbrella concept in this thesis and includes other systems issues such as systems thinking, systems theory, systems analysis and systems critical thinking.

Literature on systems approach directed at the field of business, organizations and management was studied during a PhD course in systems approach literature. More was learned about a total of 15 researchers and their most distinguished work in the field of systems approach. Appendix II provides a more detailed picture of which researchers and the studied literature. The course was held in spring 2012. The literature was utilised for finding more literature in the field, by looking up references in the course literature, to learn more about description components and features of organisations as systems. The basic knowledge concerning systems approach introducing in chapter 4 is also collected from this literature.

When the course began, the researcher based the systems description aspect used in this thesis on Churchman's (1979) five basic considerations which must be kept in mind when thinking about the meaning of a system. These basic considerations do not cover all descriptions aspects to make a system description; they aims more to help managers in systems thinking. That finding made the search for a more suitable and explicit framework more intensive. This resulted in Ackoff (1971), Van Gigch (1991), Von Bertalanffy (1950a) and Checkland (1981) in particular being used as basic references in the framework of general organisations as systems. The framework of the more specified logistics systems was developed by iterative literature searches concerning description aspects, what a logistic system is and/or the core of logistics systems; see Appendix III for more details.

3.3.3 Basic logistics literature

Literature regarding basic logistics research was a natural choice since this literature concerns the fundamentals of logistics and supply chain management. The reason is that this thesis captures a new research field of logistics where the main focus is to transfer already acknowledged knowledge to new contexts. The literature was used primarily to develop the theoretical models, main features of a logistics system and description aspects of such a system. In other words, it was used to find knowledge about the connection between general systems and the specific theoretical models of logistics systems. These models are presented

RESEARCH APPROACH

in chapter 5 and are specific for logistics systems in none specific contexts, which corresponds to the two research questions.

Suitable literature related to fundamental logistics and supply chain management was chosen on the premises of basic, elementary, and comprehensive educational books. Consequently, thick and in particular American books from the late 1900s and early 2000s were selected. This literature was to a great extent basic literature and very well known to researchers in the field of logistics management. This refers to a very wide field of literature. In this thesis the literature chosen is relevant to the concept of order and delivery cycle, flow oriented structure, management control, the concept of total cost analysis, and logistics performance measurements.

3.4 CASE STUDIES

This thesis aims to contribute to the sector of healthcare and the field of logistics by transfer logistics knowledge to new contexts. The nature of this research therefore made it an easy choice to use a case study approach.

3.4.1 Selection and description of cases

The case organisation in this thesis is the hospital in Hässleholm, which is a part of Hässleholm's hospital organisation (Hässleholms sjukhusorganisation). They operate in four towns in Skåne (a province in the south of Sweden) and have about 500 employees and a turnover of just over SEK 600 million (Hässleholmssjukhusorganisation, 2013). They have responsibility for all internal medicine, orthopaedics, psychiatry, diagnostic imaging and rehabilitation in Hässleholm's catchment area (70,000 inhabitants) and for all orthopaedics and psychiatry in Kristianstad catchment area (100 000 inhabitants) and main responsibility for orthopaedic artificial joint surgery and highly specialized psychiatry in half of Skåne (500,000 inhabitants). Hässleholm hospital is the largest part of the organisation and the organization operates the entire hospital. The case hospital is represented by two different care organisations and thus the two used cases.

The case hospital has not been chosen by the researcher herself. However, the research group behind the corporation with the hospital organization has, of course, chosen its partner with care. The case organisation has in the past pursued a long-term, dedicated improvement. The work done has thereafter been evaluated by members of the research group and the results obtained were considered to be of high-quality, see for example Carlsson (2003) and Carlsson and Sarv (2001). A further reason for the cooperation was the possibility to get access to unique empirical data. The researchers were able to access well-documented and versatile data covering a decade, but also had full access to prospective studies. Another reason was the organisation production results, especially within knee and joint plastic surgery, which were significantly better than comparable hospitals.

3.4.2 The interviews

The empirical data, as mentioned earlier, were collected before the actual research design of this thesis was set. The intention of the data was partly to get a sense of the new context, to learn more about the healthcare sector's mechanisms, and to be able to create a cost accounting patient flow oriented model. To build that model, both knowledge of the patient flow at the hospital and an understanding of how the costs were linked to these flows were needed. An early version of the model was presented in a paper presented at the EurOMA Conference in Cambridge in the UK (Wiger and Aronsson, 2011). However, even if the intention of the data collection had a somewhat different purpose than the focus of this thesis, the data needed is by nature broader and more comprehensive than needed for this study. Nevertheless, regardless of advancements in modelling, the object's behaviour must be understood (Pidd, 2004). A basic understanding of the whole and the parts of the case hospital are therefore essential. Consequently, more empirical data than necessary for the purpose of this licentiate is collected and it has given the author a good understanding of and insights into the hospital's business. Most of the collected data has been used to give the author a holistic view of the case hospital, details about all functions, duties and planning and control mechanisms, patient flows, follow-up work, measurements, etc. It is thus hard to distinguish the exact method collecting the data used in this thesis. This will be observed, for example, in the reported interview questions.

Respondents and interview questions

In order to capture the whole business of the case hospital a total of four interview sessions were held with managers at every level as well as administrators. The first (1) session was a group interview with the hospital manager and three clinical department managers. Several members of the research group were present at this interview, which lasted for three hours and was recorded and transcribed. The questions focused on control, planning, coordination, tools and methods, responsibilities, measurement, flexibility, follow-up, and etcetera. All respondents had access to the questions before the interviews and all details about the questions can be found in Appendix IV.

The second (2) interview session was performed with unit managers, schedulers, and administrators linked to the clinical operations. The author and another researcher were present at these interviews, which were recorded, and notes were also taken. Interviews with a respondent lasted about 1 hour and for the last lasted about 1.5 hours. The focus was on forming a picture of the organisation and its activities. Respondents were asked to sketch their view of reality from a patient flow perspective on a large piece of paper. This helped and supported the discussion during the interview as all present had identical pictures of the business before their eyes. An example of a business sketch is shown in Figure 6. All respondents attending this session and the questions are to be found in Appendix V. All respondents also had access to the questions before the interviews.

RESEARCH APPROACH

Figure 6 Respondents' picture of his/her "reality"

The third (3) interview session was held, similar to the second but with only the author present with the respondents. All interviews were however individual this time. Additional questions regarding interview session 2 and questions concerning resources and time allocation for activities and tasks were in focus at this session. Further details about the questions and respondents of this session can be found in Appendix VI. An overview of the respondents (sessions 1-3), their professions and the total number of professionals is shown in Table 4.

The respondents were selected on the basis of manager and key employees for the business. This was done in consultation with individuals involved in the research project with

RESEARCH APPROACH

extensive knowledge of the case hospital's business. The respondents' professions represent a breadth that covers large parts of the business from different perspectives. The hospital manager and the clinic managers are, in this case, all physicians, working both as executives and clinically at the case hospital. The unit managers are for the most part nurses. The care administrative staffs usually have a central position and follow the patient process through information but also through contact with patients. The physicians' schedulers also have a great deal of knowledge about the business due to their central planning role. The process owner is not always stated, but physicians are considered to be closest to having this role.

Table 4 Selection of respondents

	Hospital Manager	Clinic Manager	Unit Manager	Physicians' Schedulers	Administrative Employees
Respondents (Total)	1 (1)	3 (3)	6 (20)	2 (2)	8

The final interview session (4) was conducted via e-mail and phone. Another nine individuals were spontaneously interviewed in order to obtain information that needed to complete from previous interview sessions.

3.4.3 The observations

Several observations have been conducted in order to “get to know” the case hospitals' business and employees. By observing activities in different parts of the hospital while being shown round the author was able to create an overall framework, which was a great help in sorting information during the interviews and to be able to ask additional questions or make clarifications. All kinds of activities, e.g. surgery unit, emergency department, wards, outpatient care, and planning, were visited and opportunities to ask spontaneous questions were always given. On every tour one or more employees guided the researcher(s), which made it possible to gain more contacts in the form of their colleagues and obtain specific information about the units.

3.4.4 The scanning of the business system

One of the case organisation's business systems was also scanned and the information was compiled and structured depending on its content. The business system consists of information on production, occupancy, costs, employees, patient lead time etcetera. Over 500 Excel files were collected with raw data from their business system, for example employee costs, production, number of hospital beds and occupancy, laboratory and X-ray costs, number of referrals, and number of outpatient visits.

3.4.5 Processing of the empirical data

All empirical data has been processed to create a holistic view and knowledge about the details of the case hospitals business. All answers from the respondents have been processed and grouped by mapping activities and general descriptions of the business and its parts. Based on respondents' pictures the author has reworked them by adding facts found during other interviews. All empirical data processing was intended to create an overall and objective picture of the business.

RESEARCH APPROACH

3.5 DEVELOPMENT OF THE THEORETICAL MODELS

This thesis focuses on how to evaluate healthcare organisations by means of the main features of a logistics system. The logistics systems concept is used in the field of logistics and supply chain management but little was known about the specificity and uniqueness of a logistics system. The first research question therefore relates to how to describe a logistics system and thereby provide the description model used to describe the two healthcare cases. The second research question provides a logistics system's main features and thus the analysis model used to evaluate the two cases' fulfilment of the purpose of a logistics system. The development of these two models is further described in the next section. However, some key concepts need to be explained in order to clarify the focus of the study, i.e. logistics, systems, objectives of logistics systems, and models.

Logistics

The term *logistics* has a central role in this thesis. The Council of Supply Chain Management Professionals (CSCMP) logistics management defines logistics management as follows.

Logistics management is that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements.

(CSCMP, 2012)

This definition refers to the management of logistics and provides an idea of the meaning of the concept of logistics. The concept is further elaborated and explored when the theoretical models are developed, see chapter 5. However, in the literature the terms logistics (management) and supply chain management are sometimes separated and sometimes used interchangeably. The models that this thesis aims to develop are meant to be applied on businesses or organisations that typically are a part of a greater supply chain. Hence, the term logistics is used in this thesis but it should be noted that the term supply chain management might be used in the original source.

Systems

Several terms are used around the concept of systems, for example systems approach, system theory, systems analysis, systems thinking, and system construction. Some researchers make a distinction between these but most do not, which means that the terms are used synonymously. In this thesis, a distinction is made where the *systems approach* is used as an umbrella concept. It is a way of viewing the world that helps us cope with its complexity. The system approach is also a way of depict, explain, and understand the “real” world (Arbnor and Bjerke, 1997). More about system terms in chapter 4.

Objective of logistics systems

This thesis takes a stance in that the overall objective of the logistics system is to reduce overall costs, shorten lead times, balance flows and deliver the required level of customer

RESEARCH APPROACH

service. Consequently, there needs to be a balance between customer service and total cost to reap the greatest benefit from flow orientation.

Models

There are many ways to build models for situations in which irregularities and novelty dominate. Pidd (2004) demonstrates different ways to explore this spectrum of approaches, see Figure 7. On one hand, models can be used to support routine decision making, including automation of decision making and routine decision support. On the other hand, models can be used to support people who are thinking through difficult issues either by presenting possible system designs and changes or insights for debate. Models in this thesis fall into the latter.

A logistics system is here considered to be soft. This because the idea is to support debate explicating insights and worldviews, the system is then considered as soft (Pidd, 2004). A soft system is traditionally a system in which the number of factors affecting its elements and the relationships between them are so complex that it is not possible to turn them into a mathematical model which calculates an optimum. The star in Figure 7 represents the aim of the models developed in this thesis.

Figure 7 A spectrum of systems modelling approaches (Pidd, 2004).

3.5.1 The main features of a logistics system – RQ1

The first research question concerns the development of a logistics system's main features. This is a purely theoretical study based on the literature presented in sub-chapter 3.3.2 (systems approach) and 3.3.3 (basic logistics literature). This is done to be able to evaluate the degree of characteristics of a logistics system, i.e. this thesis' analysis model. The base from which to answer this research question is presented below.

Further, a system model is a generalisation of the reality. The whole is in focus, but you cannot see everything. The question, though, is what does a researcher see when he or she studies a logistics system's main features? The answer is that the objective differs depending on the viewer. Ackoff (1971) describes this as the system and its environment being *objective*

RESEARCH APPROACH

things to a researcher but also *subjective* because the particular configuration of elements that form both is dictated by the interests of the researcher.

“Not even science and scientists, in all their wisdom, are agreed about the nature of reality”
(Van Gigch, 1991)

Consequently, the main features of a logistics system are formed by the author’s ability to shape the subjective perception of the essence of logistics into something objective that can represent adequacy with regard to the purpose of this thesis. The author’s ambition has always been to develop features that should provide a sufficiently comprehensive picture of a logistics system to be able to perform useful analyses.

However, using systems to model reality has two kinds of creators of knowledge: those who believe that reality in itself *is* system-like and that the task therefore is to reproduce it as such, and “on the other hand, there are those who see no reason to take a definite position for or against the way reality is ultimately constructed, but nevertheless find it useful, interesting, or both, to reproduce it *as if* it behaved like systems” (Arbnor and Bjerke, 1997). The author of this thesis finds it both interesting and, hopefully, useful to reproduce logistics as if it behaved like an ideal system by means of established logistics theory. If the conclusions show usefulness in reproducing logistics as an ideal logistics system, the question of whether reality is or is not system-like becomes a non-issue.

3.5.2 The description aspects of a logistics system – RQ2

The second research question concerns the development of description aspects for logistics systems. This is also a purely theoretical study based on the same literature as in RQ1. It can be noted that both research questions are generic to context and their theoretical contribution is therefore not solely related to a healthcare context. Unlike RQ1, which represents “good” logistics, requires the description aspects only a representation for what needs to be described in order to perform proper analysis. The base from which to answer this research question is presented below.

The aim of this research question is to present a description model to use for describing the reality sufficiently as a base for analysing it by means of the features developed in RQ1. Moreover, a simplified representation of the reality in order to understand it and predict or impact its future behaviour is made using a model (Arbnor and Bjerke, 1997, Van Gigch, 1991). The model is the representation of the entities concerned and it can therefore have multiple views, both horizontally along the flow and vertically from strategic to operative activities. The description model in this thesis is used to describe the reality, which itself then becomes a model. Furthermore, the description can always be conducted more or less in detail depending on the purpose of the description (Aronsson, 2000). No model of a system will include all features of the “real world” of concern, hence inclusions and exclusions have to be done depending on the intentions of the modeller. The delimitation cannot be true or false but it can be more or less complete for its aim. Thus, the description of the real system should be complete enough for the researcher to feel that it is explained or understood in relevant aspects (Arbnor and Bjerke, 1997). The answer to this, if the developed description

RESEARCH APPROACH

aspects provide an adequate picture of the reality, represented by the description of the two healthcare organisations, will be represented by the conclusions. By critically examining the usability of the description aspects, by their providing the desired basis for the analysis, the question of whether they are more or less adequate for their aim can be answered.

Further, a logistics system naturally has people who perform activities but the system's structure is not dependent on specific individuals. Therefore, there is no need for a description from an actor's perspective or intentions. Katz and Kahn (1966b) express this as the organisation's functions or goals not being regarded as the intentions of the organisation's leaders or members, but as the results which represent the ability that allows the system to maintain the same type of output. Consequently, and as mentioned earlier, it is the flow that is the focus of the analysis. It is assumed that systems are unpopulated, i.e. have no players, but implied that someone has to perform the system's tasks.

3.6 THE RESEARCH PROJECT

This research is part of a three-year project, "Lean and agile – logistics driven improvement in health and social care", funded by Vinnvård, a collaboration between the Department of Management and Engineering at Linköping University, Hässleholm Healthcare Organisation and the Medical Management Center at Karolinska Institutet in Stockholm, and aims to clarify how and under what circumstances a healthcare organisation can develop dynamic efficiency by applying logistics models and methods from industry. This means both adapting flexibly to changes in demand and external businesses conditions, and improving resource utilisation, performance and quality. Based on the results achieved by industry, the intention is to apply logistics concepts, approaches and methods to initiate, monitor, analyse and conceptualise how adaptability and efficiency can be achieved simultaneously in healthcare (Brommels, 2008).

4 LOGISTICS SYSTEMS

This chapter addresses logistics systems from the base of organisations as systems. The systems issue is processed by Systems Approach, System Thinking, & Systems Theory, directed to the field of business, organizations and management. The emphasis is on how systems are described and characterised, e.g. general system features and description aspects to describe systems. It starts in general system, then organisations as systems and ends in the more specified logistics systems. According to Arbnor and Bjerke (1997) there is a distinction in the systems approach between objective reality (reality itself, i.e. real systems) and representations/reproductions of this reality (i.e. systems models). This thesis therefore focuses on systems models, to represent logistics as a system by means of its main features and description aspects. This chapter also gives a short history of the development of the system approach.

4.1 INTRODUCTION TO SYSTEMS

There are many fields where general properties of systems are studied, e.g. general systems theory, systems dynamics, cybernetics, thermodynamics and complex systems. It was during the 1970s that the term *system thinking* and the development of systems theories had their breakthrough in a number of different academic activities as well as in industry, everyday language and the media (Arbnor and Bjerke, 1997). However, research using a systems orientation was certainly going on as early as the 1960s and even before that. One of those who had the greatest influence on the origins of the general system theory movement is Von Bertalanffy (1950a, 1950b). The quote below exemplifies the shift in thinking that he represented.

“in the past centuries, science tried to explain phenomena by reducing them to interplay of elementary units which could be investigated independently of each other. In contemporary modern science, we find in all fields conceptions of what is rather vaguely termed ‘wholeness’”
(Von Bertalanffy, 1950a)

Ackoff (1973) explains the “system” evolution, which ended in what he calls the Systems Age, through the previous phase, the Machine Age. The step from the Machine Age to the Systems Age did not take place over night; the beginning in the 1940s was just the beginning. The Systems Age was a respond to the Machine Age’s two basic ideas of the nature of the world and its way of seeking understanding of it. The first is *reductionism*, which consists of the belief that everything can be reduced, decomposed or disassembled into ultimately simple elements. This gave rise to the analytical way of thinking about the world. The parts that could be explained were disassembled down to the independent, invisible parts of which it was composed and then the behaviour of these parts were explained and finally aggregated into an explanation of the whole. If the analyst succeeded in decomposing a problem he faced into simpler problems that were independent of each other. The solution to the problem was the sum of the solutions to its independent parts to an aggregated whole. This made it possible to divide the labour of seeking to understand the world into a number of virtually independent disciplines. The other basic idea of the Machine Age was *mechanism*, where all phenomena were believed to be explained by *cause-effect*. The cause was taken to be sufficient for its effect, and consequently the quest for cause was environment-free. The prevailing view of the world was *deterministic* and *mechanistic*. Science found no need for teleological concepts, such as functions, goals, purposes, choice and free will when explaining any natural phenomenon. This was also the time of mass production and assembly lines, which affected the nature of work left for men to do, each man and machine performing one or a small number of elementary tasks repetitively. So, the more machines came to be used as substitutes for men working, the more men were made to behave like machines.

The System Age was the time when the analytical mode of thought was supplemented by the doctrines of expansionism, teleology, and a new synthetic (or systems) mode of thought.

LOGISTICS SYSTEMS

Expansionism is the doctrine where all objects and events, and all experiences of them are parts of larger wholes. This new way of viewing the world turned attention from ultimate elements to a whole with interrelated parts, a system. According to Ackoff, it arose through philosophers and mathematicians, and after the biologist Ludwig von Bertalanffy's famous book (1968) it has been widely recognised as science's new organising concept.

To summarise, the first step in building systems theory arose when a need arose for the parts to be related to the wholes. The next step was when wholes had to be related to their environments. This led to open-system models, such as that introduced by Von Bertalanffy (1950b, Emery and Trist, 1965). It was developed to overcome some of the perceived shortcomings of previous approaches and it offers an alternative methodology which can cope with solving some of the problems of complexity (Van Gigch, 1991).

Nowadays, the word *system* exists in many contexts, e.g. solar system, education system, computer system, and steering system. All these systems have common principles which are applicable to all kind of systems. However, when systems are studied in detail, there are differences in their contributory elements, behaviour, patterns and so forth. In this context the word *systems* is used to refer specifically to organisations.

4.2 SYSTEM APPROACH

There are many similar definitions used in business and management contexts of what a system is, see Table 5. Emerging from these definitions is the common theme that a system is composed of elements or components and that these elements are combined to form an integrated whole. Figure 8 illustrates a very simple system, its elements and the relationships between them.

Table 5 Definitions of system from a business and management perspective

Author	Definitions
Johnson et al. (1964)	<i>"A system is an organized or complex whole; an assemblage or combination of things or parts forming a complex or unitary whole"</i>
Ackoff (1974)	<i>"A system is a set of two or more elements of any kind and can be divided into parts."</i>
Churchman (1979)	<i>"Systems are made up of sets of components that work together for the overall objective of the whole" and "a system is a set of parts coordinated to accomplish a set of goals"</i>
Van Gigch (1991)	<i>"A system is an assembly or set of related elements"</i>
Arbnoor and Bjerke (1997)	<i>"A system is a set of components and the relations among them"</i>

A system is also made of other smaller systems called sub-systems. Every component in a system is a potential system of its own and every system is a potential element in a larger system (Arbnoor and Bjerke, 1997). These sub-systems are strongly non-separable from the system as a whole and are thus interactive. This means that when each part of a system performs as well as possible the system as a whole seldom performs optimally. Consequently, a system's performance depends critically on how the parts in the system fit and work together and not merely on how well each performs independently. Performance

LOGISTICS SYSTEMS

is also dependent on how the system is related to its environment (the larger system of which it is a part) and to other systems in that environment. It is therefore desirable to evaluate the performance of a system by evaluating its functioning as a part of the larger system that contains it.

Figure 8 A system is a set of elements and the relations among them

System is not a discipline in itself but a meta-discipline whose subject matter can be applied within virtually any other discipline (Checkland, 1981). It can also be seen as a practical philosophy of system management and a methodology of change (Van Gigch, 1991).

An approach is a way of going about tackling a problem (Checkland, 1981). Ackoff (1973) explains it as when system mode of thought is applied to systems problems it is called the systems approach. According to Arbnor and Bjerke (1997) the systems approach is a way of depict, explain, and understand the “real” world. It consists of a system language and a shape of the world that the systems researcher intends to depict, explain, and understand. *Systems theory* is trans-disciplinary theories of systems in general and their related principles can be applied to all types of systems. *General systems theory* is elaborated by among others (Von Bertalanffy, 1972, Von Bertalanffy, 1950a, Kast and Rosenzweig, 1972), from an organisational or management perspective in for example (Kast and Rosenzweig, 1972, Johnson et al., 1964) and from a SCM perspective in e.g. (Caddy and Helou, 2007). According to Arbnor and Bjerke (1997), systems theory contains models and/or producer–product relationships valid for more than one real case.

Modern systems theory is a development of general systems theory and has several similarities to the “old” systems theory. Generally though, modern system theory is considered to be more concrete because researchers make explicit what types of real systems they refer to (Arbnor and Bjerke, 1997). Related to this, organisations studied as systems are now described more as social phenomena that have an ability to learn and have a culture. *System thinking* is the conceptual cornerstone that underlies the substance in Senge’s (Senge, 2006) famous organisation textbook. He refers to system thinking as a discipline for seeing wholes, a framework for seeing interrelationships rather than things. It offers a language for how to think when dealing with complexity, interdependence and problems that have no simple local cause. The focus is on the shift in thinking, from seeing parts to seeing wholes, the *process of understanding* how things influence one another within a whole. It implies thinking about the world outside ourselves and doing so by means of the concept system (Checkland, 1981). Systems analysis requires knowledge of the features that subsystems can perform, and

LOGISTICS SYSTEMS

without this knowledge it is very difficult to determine what the overall system really coordinates and governs (Emery, 1972).

4.3 SYSTEMS APPROACH TO ORGANISATIONS

The systems approach with its associated concepts and mental models by which an organisation can be described and related to the outside world and with the principles of consistency, equilibrium and change, through which an organisation's adaptability and change can be identified, is an essential tool for researchers, organisations' leaders and workers in organisations. Ackoff (1971) defines an organisations as follows:

"An organization is a purposeful system that contains at least two purposeful elements which have a common purpose relative to which the system has a functional division of labour; its functionally distinct subset can respond to each other's behaviour through observation or communication; and at least one subset has a system-control function."

(Ackoff, 1971)

Organisations are man-made systems which are made for a purpose that is achieved by the delivery of outputs. The elements must then be related, they must be designed to work as a coherent entity. The input to one function is formed by output from others when functions act together to achieve overall company objectives (Gregson, 1976). This means that actions of one department can affect the performance of others in contributing towards overall company objectives. For an organisation a goal (a preferred outcome in a particular situation) can be obtained within a specified time and the objective (a preferred outcome in a particular situation) can be attained over a longer time period (Ackoff, 1971). Furthermore, an organisation's behaviour (reactions, responses or actions to something) and the outcome of behaviour are both variable and chosen (Ackoff, 1971). The interest lies in both antecedents and consequences of the organisation's behaviour. A systems approach within an organisation implies integration which enables sub-systems to relate to each other in the most effective way and ensure that internal contradictions in the corporate activity are minimised (Christopher, 1971). The adoption of a systems approach to an organisation implies the following point:

- The whole is primary, and the parts are secondary.
- Integration is the condition of the interrelatedness of the many parts within one.
- The parts so constitute an indissoluble whole that no parts can be affected without affecting all other parts.
- Parts play their role in light of the purpose of the whole that exists.
- The nature of a part and its function is derived from its position in the whole, and its behaviour is regulated by the whole-to-part relationship.
- The system is any system or complex or configuration of energy and behaves like a single piece no matter how complex.
- Everything should start with the whole as a premise and the parts and their relationships should evolve.

LOGISTICS SYSTEMS

To summarise, an organisation viewed as a system is purposeful and the behaviour and outcome of that organisation are variable and chosen along with the fact that the parts affect and are affected by all other parts, and it is controlled. Within the system, all functions or activities have to be understood in terms of how they affect, and are affected by, other elements and activities with which they interact. Hence the sum, or outcome of a series of activities, is greater than its individual parts. When studying actions in isolation, the understanding of the system as a whole or how such action affects or is affected by other activities disappear. This is in line with Christopher's (1971) statement on the system view of organisations:

"The systems view of corporate activity is essentially an integrative orientation; the company is viewed as a series of sub-systems, organized on functional or company-wide mission lines, which interface with each other to achieve stated objectives"

(Christopher, 1971)

4.4 THE SYSTEMS APPROACH IN LOGISTICS

The systems approach is evident within the logistics and the supply chain management discipline. The approach is treated both explicitly and implicitly in logistics articles and textbooks. Sanders (2007) claims that SCM has a systems view because all activities and functions that are needed to bring a product or service to market are considered. Arlbjørn and Halldorsson (2002) use the term *hard core* to explain what is unchangeable and to illustrate what the knowledge within logistics is all about. They formulate it as "directed towards the flow of materials, information and services; along the vertical and horizontal value chain (or supply chain) that seeks to; coordinate the flows and is based on system thinking (a holistic view) where the unit of analysis essential is the flow". Mentzer et al. (2001) see SCM as a management philosophy and state that SCM has a systems approach to viewing the supply chain as a whole to manage the total flow. Ellram and Cooper (1990) express this as "supply chain management is a systems approach to viewing the channel as a whole rather than a set of fragmented parts". Bechtel and Jayaram (1997) also emphasise that systems thinking is the most mentioned underpinning philosophy in the SCM literature. The systems approach is also the underlying premise in the conceptual framework of logistics management when Novack et al. (1992) present their guide to developing the logistics discipline.

These statements are all from the 1990s or later but the systems approach was present and described more clearly in less recent publications. One example is Bowersox (1978), who is especially clear: "The systems approach was and remains the cornerstone of the integrated logistical concept". In their review of the evolution of logistics thinking, Kent and Flint (1997) state that it was during the 1970s that the integrating and systems view was the most dominant theme as a logistics framework to guide researchers. Further, Gripsrud et al. (2006) stated that the dominant underlying theory of business logistics changed from the neo-classical economics to the systems theory in the 1970s. This development of the systems approach in the logistics and supply chain management literature is quite logical given the

LOGISTICS SYSTEMS

overall development of the systems view which took place during the 1960s and 1970s. One example is Heskett et al. (1973) in (Gomes and Mentzer, 1988), who make the following observations concerning logistics systems:

1. A logistics system possesses multiple interrelated parts.
2. The performance of one part affects and is affected by that of others; consequently, to analyse any subcomponent in isolation constitutes a serious methodological error.
3. The alteration of certain subcomponents generates more change in system behaviour than others.
4. Overall system performance is dependent upon “balance” achieved between the subcomponents.
5. The weakest member often dictates the upper bounds of a system’s performance.
6. Optimum system performance is often not dependent upon the optimal performance of each subcomponent, but requires balance and coordination between them.

In Christopher’s (1971) article, about the need for a systems approach in distribution planning with a cost-effectiveness orientation to the problem, he adds a number of characteristics to the basic components of a logistics system. These characteristics were identified by Geisler and Steger (1963):

1. A logistics system contains many interacting elements.
2. A logistics system contains elements affected by randomness, unpredictability, risk, etc.
3. A logistics system includes activities whose performance is affected by time lags. The lag is between the decision to act and the completion of the action.
4. A logistics system requires resources.
5. A logistics system requires policies, rules, and problem-solving capabilities for its operation.
6. A logistics system employs information and data.
7. A logistics system embodies component organisation.
8. A logistics system has objectives.
9. A logistics system has mutual impacts with other systems.

It can be concluded that several researchers claim that the systems approach is core to logistics and some have observed features of logistics systems. However, Abrahamsson and Aronsson (1999) use a systems approach when measuring logistics structure. They illustrate the systems approach within logistics as input, output, cost of transformation, and profit, see Figure 9. Still, the system cannot be seen as a “black box”, they emphasise the importance of understanding the existing structure of the system under study. This is to be able to explain why the cost of transformations is as it is when the purpose is to understand the cost of transformation for the system as a whole.

LOGISTICS SYSTEMS

Figure 9 The systems approach used in Abrahamsson and Aronsson (1999)

If the systems approach has been added to the logistics discipline or if the discipline has been developed along with this approach or if the discipline has been born and raised within that approach is not of interest. From the discussion above, it can just be concluded that in the discipline of logistics the systems approach is central.

To summarise, some researchers use systems language and concepts with a systems foundation and some state the underpinnings of a systems approach in logistics. All of these are a ways of viewing the world in a holistic perspective. The question, though, is what you see with that perspective when you look at a demand-driven delivery service system. The whole is in focus, but you cannot see everything. The object differs depending on the viewer. Ackoff (1971) describes this as: the system and its environment are *objective* things to a researcher but it is also *subjective* because the particular configuration of elements that form both is dictated by the interests of the researcher. The next section therefore provides some basic insights about how to model logistics systems.

4.5 MODELLING LOGISTICS SYSTEMS

What a systems model might contain is determined by the *use* for which the model is intended and by the *level of detail* desired. A model intended for reproducing (for descriptive purposes), can include a number of factors of reality but in a model to be used primarily for steering, several potential factors *may* be omitted (or even *must* be excluded) so the model is not too complicated to use (Arbnor and Bjerke, 1997). However, logistics is a system in itself, and the system approach is a crucial concept in logistics (Stock & Lambert, 2001). Nonetheless, it seems that a logistics system is a very complex but vaguely defined “concept” or sentiment, and that there appears to be no overall picture of what features such a system has or how it can be described. A first step is to indicate the positions of all elements and interactions in the system and consider all characteristics of the system, then a system state can be indicated, i.e. a system can be represented as a model (Arbnor and Bjerke, 1997). However, this is not enough to be able to answer the two research questions in this thesis.

When studying organisations and the management of organisations it is, according to the systems approach, necessary to consider all the complex patterns and interactions that shape

LOGISTICS SYSTEMS

an organisation (Bruzelius and Skärvad, 2008). As a consequence, the way in which different parts of the organisation, such as divisions, units, groups, employees and equipment are interrelated and the way the organisation is dependent on its environment, must be identified, described and understood. In the same way, Abrahamsson and Karlöf's (2011) basic message is that the part should not be changed before it is known how the whole is affected and that the whole should not be changed without knowledge of how the parts operate.

Churchman (1979) outlines five basic considerations that must be kept in mind when thinking about the meaning of a system: the system's environment, the resources of the system, the components of the system, and the management of the system. Churchman (1979) aims more to help managers in systems thinking (to have a systems approach to organisations) and in the next step to be able to perform a systems analysis. The basis of his book is of course systems theory but it is not the explicit contribution. This means that his five basic considerations do not cover all descriptions aspects to make a system description. For example, there is no consideration of how to capture the interrelation between the systems components, i.e. the structure of the system, or what the system produces.

Van Gigch (1991) is clearer in his description of a system. He presents twelve system concepts that characterise a system: elements, conversion process, input and resources, outputs, environment, purpose and function, attributes, goals and objectives, components programs and missions, management agents and decision makers, structure, and state and flows. Even if he is more interested in computer simulations of systems, his concepts are more explicit than Churchman's (1979). The question still remains of what to include when describing a logistics system. Christopher (1971) uses inputs, process, output, feedback-control and restrictions to model a logistics system. He refers to the general parameters of any system and that they have these five basic components.

To summarise, models, principles, and laws exist that apply to generalised organisational systems, irrespective of their particular kind, the nature of their component elements, and the relationships or 'forces' between them. The aim of the description thus has to be decided before the "reality" is modelled along with the decision on what level the description should be at. The intention of this thesis is to present a method to evaluate a healthcare organisation by means of a logistics system's main features. Consequently, the description aspects that are going to be used to describe the case hospital's main features have to cover and perform a model of the cases that can provide a usable base for the aim of this thesis. The basis for further development of a logistics system's main features is in this thesis concluded from the systems theory of how an organisation acts and its main components. The main features of an organisation viewed as a system is at least that it is *purposeful, opened and bounden, consists of interrelated elements, has input and output, and is controlled and adaptive*. These main features are chosen as features of an organisation viewed as a system. It is first and foremost based on Ackoff's (1971) framework of a system's key concepts and terms. He especially focuses on organisation, but the roots can also be derived from how general systems work, i.e. system within systems in physics, control engineering and biology. Besides Ackhoff, a cornerstone of this framework is also Van Gigch (1991), but also additional systems theory is used. These

LOGISTICS SYSTEMS

features are the basis for the further elaboration by means of the development of a logistics system's main features and these features' resulting description aspects of such system. This is presented in the next chapter.

5 MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

The system approach is in a philosophical manner widely problematized. In logistics research, the systems approach is fundamental but few researchers apply the systems approach concretely and distinctly to their research. Seldom do the grounds, theories and definitions report on what the systems approach is driven by. This thesis attempts to define a logistics system by discussing a logistics system's main features. This is done to be able to develop a descriptive model but also to evaluate the degree of characteristics of a logistics system in a healthcare context.

*The following subchapter elaborates the chosen main features of an organisation viewed as a system, i.e. that it is **purposeful, opened and bounden, consists of interrelated elements, has input and output, and is controlled and adaptive**. These features are valid for many systems, but do not help to highlight the uniqueness of logistics systems. Therefore, linked to the main features of an organisation, basic logistics literature focusing on areas central for "good" logistics management is added. The chapter ends with a summary of a logistics system's main features and how to describe a logistics system to be able to analyse it by means of the formulated main features, i.e. an analysis and a description model.*

5.1 PURPOSEFUL

A main feature of an organisation, according to systems theory, and used in this thesis as the basis for developing unique main features and description aspects for a logistics system, is that an organisation is *purposeful*.

An organisation divides labour in order to reach its goal, where the labour can be divided by function (activities), space and time (Ackoff, 1971). Traditionally, the flow within organisations is organised by functional units (e.g. purchasing, production, distribution) which are measured only at a functional level without flow coordination between the units (Abrahamsson and Karlöf, 2011). The flow is then regarded as transactions rather than a continuous flow, i.e. a transaction-oriented business. Rather, a flow orientation is the key element in terms of logistics systems. A logistics system must include the entire flow through the organisation.

Organisations are purposeful (Ackoff, 1971). They have meaning through having an aim. Furthermore, logistics exists within an organisation or organisations. Consequently, by this logic, a logistics system has to be purposeful. Furthermore, according to Arlbjørn and Halldorsson (2002) the flow is the core of logistics. Logistics is therefore about cost-efficient flows and a logistics system should be flow-oriented with an objective to be cost-effective when producing customer service. Christopher (2005) makes this very clear when he says that logistics management is a flow-oriented concept. One of the major goals of an organisation should also be to reduce the total cost of logistics activities rather than focus on each activity in isolation (Stock and Lambert, 2001). This thesis takes the stance that the overall objective of the logistics system is to reduce overall costs, shorten lead times, balance flows and deliver the required level of customer service. Consequently, there needs to be a balance between customer service and total cost to give the greatest benefit.

To achieve the logistics system's purpose the basis of the systems approach, having a holistic view which is also core in logistics, must be taken into account. The focus of a logistics system is therefore the integration of internal company functions where the performance of the system as a whole is always more important than the performance or productivity of each individual function (Abrahamsson and Karlöf, 2011).

From the above considerations it is possible to argue that one feature which makes a logistics system unique, linked to that organisation's being purposeful, is as follows:

Feature 1:

A logistics system's purpose is to meet customer requirements by cost-effective delivery service through flow orientation by prioritising total performance

This main feature of a logistics system has implications about what needs to be described to be able to analyse whether a system fulfils this feature. One obvious description aspect is thus to describe the *purpose* of the system. Since nothing is done in a logistics system without

reason, the following description aspect is to be considered. An important question to answer in relation to this is *what is the purpose of the system?*

Description aspect I: Purpose

5.2 OPENED AND BOUNDED

Another main feature of an organisation, according to systems theory, and used in this thesis as the basis for developing description aspects for logistics system is that an organisation is *opened and bounded*.

An opened system is open for exchange of material (or energy) with its environment (Emery, 1972). Consequently, an open system has an environment that consists of all variables that can affect its state (Ackoff, 1971). Furthermore, organisations are systems that are endowed with conversion processes by which elements in the system change state (Van Gigch, 1991), i.e. open systems. Business theory is usually interested in open systems because researchers must explain and put components in a context in order to understand them (Arbnor and Bjerke, 1997). Furthermore, organisations are living systems and in that sense open systems and should therefore be analysed as that which leads to the need to define its environment (Emery, 1972). Hence, organisations have dynamic interplay with its environment, e.g. customer, competitors, labour organisations, suppliers, and government (Johnson et al., 1964). A more general definition of *environment* is created by Arbnor and Bjerke (1997), "...the factors that are important to the system to consider but are beyond its control.... what lies outside the "boundary" of a system". Therefore, variables which affect irrelevant properties of the system are not part of its environment.

Following the above logic, a logistics system is also affected by its environment. Since it is not meaningful to include everything around the system, only the specific factors affecting the defined system should be included. The system's boundary defines the system and has to be handled critically. The boundary limits the object and hence which system is analysed followed by which system the solution addresses. Disturbances (e.g. changes in conditions of doing business such as technological development or deregulation), constraints (e.g. laws) and uncertainties (e.g. unpredictable demand) are all factors affecting the system and most often treated as fixed constraints. The system boundary can logically be extended to include certain of these factors, resulting in these being considered modifiable. For investigations of industrial systems, the system's boundaries lie around the flow and the economic systems within which it operates, because little effect is expected beyond it (Gomes and Mentzer, 1988).

System boundaries are imperative when studying open (living) systems – systems that interact with other systems. The boundaries determine which systems are to be left outside the decision-maker's jurisdiction (regarded as "givens") (Van Gigch, 1991). The boundary is completely indefinite in the observer's eye. It all depends on which question to answer or which analysis it is intended for. Hence, the delimitation cannot be true or false but it can be more or less useful in connection with the purpose of the study. The defined system can of

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

course be further divided into subsystems. Consequently, regardless of where the system boundaries are set, interactions with the environment cannot be ignored, lest the solutions adopted become meaningless (Van Gigch, 1991). Hence, the given constraints and the surroundings' effect on the system also have to be described. For a logistics system this may involve the context in which the system operates, laws, culture, market, uncertainties (more about uncertainties in section 5.6), etc

From the above considerations it is possible to argue that the definition of the system is a very important aspect to consider when making an analysis of a logistics system. Important questions to answer in relation to this are *what is included in the studied logistics system, where is the system boundary and what in the surrounding affects the system, i.e. what is excluded?* Hence, in a logistics system the following description aspect needs to be considered:

Description aspect II: Boundary and surrounding

5.3 INTERRELATED ELEMENTS

The next main feature of an organisation used in this thesis as the basis for developing unique main features of a logistics system and description aspects is that an organisation, according to systems theory, consists of *interrelated elements*.

As stated earlier, all systems consist of interrelated elements and the same applies to organisations. Each of a system's elements is directly or indirectly connected to every other element (Ackoff, 1971). "The notion of structure relates to the form of the relationships that bind the elements of the set together" (Van Gigch, 1991). Furthermore, a system's functions and the effectiveness with which they are carried out depend on the type and form of interrelationships between the system's elements (Van Gigch, 1991). Consequently, the structure of the elements depends on the relation between the elements and affects the total performance of the system. This it is in itself an important factor for explaining the magnitude of outcome. In addition, the structure of the elements can of course be simple or complex, depending on the number and type of interrelationships among the parts of the system (Van Gigch, 1991). This is illustrated by the following quote from Mintzberg (1983) in which he defines the structure of an organisation.

"The structure of an organization can be defined simply as the sum total of ways in which its labour is divided into distinct tasks and then its coordination is achieved among these tasks."

(Mintzberg, 1983)

Complex systems involve hierarchies that are ordered levels of elements (Van Gigch, 1991). Like other complex systems, a logistics system consists of a set of interrelated elements. An element means in Latin (*elementum*), basic ingredient, part, component, or unit (part of a whole), which in this thesis is translated into main tasks, groups of activities or activities that directly or indirectly support the flow in focus (the function of subsystems). It is important to highlight that element is not the same as organisational unit; they are functions that have different tasks (task logic). How an organisation has chosen to organise themselves is

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

another logic. Like other systems, the elements can also be divided or grouped into subsystems, which are systems in themselves and thus parts of a larger system.

One of the main reasons for creating organisational units is the need for specialised knowledge and skills (Mintntzberg 1976). This means that the task of the interrelated elements of that system is close to the function of the unit. Moreover, a function oriented organisation is based on personnel and entities performing similar tasks that require similar skills and equipment which are grouped into one unit. As a consequence, units perform activities that belong to different processes. In Aronsson's (2000) opinion, this points to the fact that units are specialised. Specialised units perform specialised functions. However, the functional and processual division are interdependent and as a consequence both perspectives have to be taken into account (Aronsson, 2000).

The supply chain view of designing and hence structuring systems is that the processual perspective should govern the design of the elements (Aronsson, 2000). The interrelation prioritises the internal coordination between elements¹ along the flow. Since logistics management is a flow-oriented concept (Christopher, 2005). Furthermore, the aim of a flow-oriented structure is to reduce costs in terms of utilisation, economies of scale and scope, and the handling of uncertainties (Aronsson, 2000). The structure must thus be described, analysed and understood both in its entirety and in its parts in order to be able to permanently improve it. It might then be useful to examine the various elements characteristics. One way of doing it is to divide them into *core*, *control* and *supporting* elements (Bruzeliuss and Skärvad, 2008). Due to the fact that a logistics system is flow-oriented, the elements connected directly to the flow are *core elements*. It is these elements that transform input to output, i.e. the actual production of the system. The *control elements* plan, determine and control the operational work, provide guidelines and principles, and also decide how resources shall be allocated. Timetabling, executive duties, business planning and strategic work are all examples of work within control elements. The core elements and the control elements often need elements to support them, e.g. administration. The *supporting elements* receive assignments from the core elements or control elements and can never be the trigger for generating production in other units.

From the above discussion it is possible to argue that the second main feature of a logistics system, which makes such a system unique, linked to the organisation consisting of interrelated elements, is as follows:

Feature 2:

A logistics system has a flow-oriented structure

¹ The term element is in this thesis used to underline the fact that the theoretical basis is system theory, i.e. a system is a set of interrelated elements. This is however close to the concept of functions, as in task division and not organizational units, within organizations.

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

To be able to analyse if a system fulfils this second main feature, the structure of the system has to be described. The definitions of logistics and supply chain management imply that various types of flows are subject to examination. The functional perspective is necessary to be able to describe how the order and delivery processes are structured and how the different activities are grouped together (Aronsson, 2000). The description of the structure monitors the division of labour and responsibilities. The level of abstraction of the system described decides what are to be considered elements and what are to be considered sub-functions and activities within an element. Rather than describing how a process is structured, the functional picture gives a description of how resources are organised and how responsibilities are divided between functions (Aronsson, 2000). The focus of structure within a logistics system is therefore on operative organisation rather than organisational organisation.

It is fundamental to indicate the positions of different elements and relations at a given time when describing the real world or part of it as a system (Arbnor and Bjerke, 1997). Abrahamsson and Aronsson (1999) also stress the importance of knowing how included elements within a logistics system are related to each other. The structure of the logistics system represents the functional perspective and provides a picture of how functions are related to each other. It can be said that functions carry out the same types of operation for different types of product whereas processes, flows or chains represent a series of different operations (undertaken in different units) for the same type of product. To capture a system's structure, some areas to describe are how functions are related to other functions and a description either by what activities the function consists of or by a description of the functions' responsibilities (Aronsson, 2000).

From the above considerations it can be argued that the structure of a logistics system is the interrelated elements where the elements and their primary tasks are connected directly or indirectly to one or several flows performed by resources and organised by units. They are related directly or indirectly to each other through the main flow, by information or by sharing resources. Moreover, within a logistics system, output from one element is often input to another in terms of materials, orders or directives. Important questions to answer in relation to this are *what are the elements of the system, what are their main tasks, activities and responsibilities, and how are the elements related to each other?* Hence, in a logistics system the following description aspect is to be considered:

Description aspect III: Structure

5.4 INPUT AND OUTPUT

The next main feature of an organisation used in this thesis as the basis to develop unique main features and description aspects of a logistics system is that an organisation, according to systems theory, has both *input* and *output*.

As mentioned earlier, an open system is open for exchanges of material (or energy) with its environment (Emery, 1972). Von Bertalanffy (1950a) calls a system opened when the system

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

has input from its environment and thus output from the system to its environment. Furthermore, input to the system is changed by means of a transformation process into output, which constitutes the result (Van Gigh, 1991). According to the definition of logistics management (CSCMP, 2012), logistics aims to meet customer requirements and extends from the point of origin to the point of consumption. Consequently, the output can then be seen as customer service which is also the case in this thesis. Since the logistics system's aim is to meet customer requirements the point of origin should be the customer order and thus the input to the system. The customer order is then transformed into customer service in the logistics system. Customer requirements are also in general concerned with the total time from order to delivery (Stock and Lambert, 2001). A more efficient supply chain can be achieved by means of integration between order and delivery cycles by sharing information and decisions taken about pipeline capacity and the process perspective should be addressed before the functional perspective so that the flow focus can be upheld (Aronsson, 2000). The transformation in a logistics system is thus driven by customer order (input) and the delivery of it (customer service, i.e. output) in a flow-oriented process.

A process is seen as a standardised series of repetitive activities that transform input into a result. Since the process creates the result, the process should primarily be optimised, controlled and improved, and not the functions (Rentzhog, 1998). However, according to Abrahamsson and Aronsson (1999) it is the total system that should be in focus when measuring logistics performance. Consequently, processes should be in line with the total systems objective. The supply chain view of designing systems is that the processual perspective should govern the design of the functions (Aronsson, 2000). However, one definition of a process is:

“Any activity or group of activities that takes an input, adds value to it, and provides an output to an internal or external customer. Processes use an organisation’s resources to provide definitive results”

(Harrington, 1991)

This type of process definition focuses on *how* input transforms to output. Rentzhog's (1998) definition focuses more on the identification of activities to interconnect them in a flow structure and also emphasises the iterative nature of the process.

“A process is a chain of activities which in a recurring flow creates value for a customer”

(Rentzhog, 1998)

To these definitions with a focus on *how* and *repetition*, Egnell (1994) adds that a process must have a specific beginning and end.

“A process consists of a series of activities with a specific start and end, and with the help of an organization’s resources, recurringly refine a measurable item from a supplier to a predetermined measurable results”

(Egnell, 1994)

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

From a logistics perspective a process begins with a customer order, external or internal, and concludes with the demand having been met. (Oskarsson et al., 2006) include all these definitions in the requirements for a process, but they also add some valuable insights.

- A process is a chain of activities with a specific beginning and end.
- A process is both intended and repetitive.
- A process has distinct goals, defined steps that are involved, and expected outcomes.
- A process includes several activities, often both administrative and operative, and is cross-functional.

This means that the transformation of orders into customer services can be predictable, has a distinct beginning and end, is intended, is repetitive, and has defined steps and an expected outcome. Furthermore, from the above considerations it is possible to argue that an additional feature that makes a logistics system unique, linked to the organisation being opened and bounded, is as follows:

Feature 3:

A logistics system transforms orders into customer services in a flow-oriented process

A logistics system produces something through a flow-oriented transformation, i.e. the transformation represents a process perspective. Consequently, the description of the transformation should explain how the main flow changes through the system's activities. To achieve the organisational goals the transformation can be described at different levels, from main activities (e.g. in traditional logistics described by sourcing, production and delivery) to detailed activities (e.g. picking or order handling).

However, the transformation within the logistics system is an aspect to consider when describing such an order and delivery driven process. One way of describing it is by means of the customer order cycle. It starts with the placement of an order and ends when that order has been filled. The customer order cycle has an integrating role which connects the customer with the organisations as the supplier. The perspective is of activities and as a consequence the structure (functional perspective) behind these activities' taking place is invisible. The customer order cycle exists in all parts of the organisation, for both external and internal customers. Figure 10 shows the customer order cycle six components in which the customer places an order which is received by the provider who then fills the order and delivers it. The first part of the order process consists of administrative activities whereas the second is a fulfilment phase. A key to manage the customer order cycle is information technology to provide and support communication that links customer and supplier together (Stock and Lambert, 2001).

Figure 10 The typical order cycle components (Oskarsson et al., 2006)

From the above considerations it can be argued that the transformation within a logistics system starts with an order from an external or internal customer and ends when the order is filled. It is a cross-functional and flow-oriented process. The transformation is here described by the customer order cycle. Important questions to answer in relation to this are *which is the main flow's process, how are the transformations carried out, and how does the system's customer order cycle operate?* In a logistics system the following description aspect therefore has to be considered:

Description aspect IV: Transformation

Depending on the circumstances, what is considered to be the input and output may vary. The difference between input and resources can be slight and is also dependent on point of view and circumstance (Van Gigch, 1991). The purpose of this thesis requires both input and output to be defined. The input begins the transformation and the logistics' production is based on what is demanded by the customer. Consequently, input to a logistics system is in this thesis the demand. From the definition of logistics management (CSCMP, 2012) where logistics extends from point of origin to point of consumption which is done in order to meet customers' requirements, the output can be seen as customer service. To provide customers with the level and quality of service that they require is the entire purpose of logistics management and supply chain management, and to do so at less cost to the total supply chain (Christopher, 2005). This is also in line with Lambert et al. (1998) and Stock and Lambert (2001). Accordingly, the underlying principle of logistics systems recognises the importance of customer service (Langley et al., 2008).

However, a logistics system's transformation is based on what is demanded. Hence, the demand has to be described by its characteristics and mapped for the system to operate predictably. The demand can be seen as "fixed", handled as surroundings, or seen as

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

effectible, e.g. by marketing, and handled as a part of the system. It is important to specify whether or not they come under the control of the system designer (Van Gigch, 1991).

The demand has to be managed by balancing the organisation's capability against the customer's requirements (Stock and Lambert, 2001). Demand which enters the system (not a part of the system) cannot be controlled. However, within the system production planning has control of the demand and is thus controllable and self-inflicted. Consequently, there is a benefit in separating external demand (a given factor) and internal demand (a part of the system). Demand can also be further divided into dependent and independent demand. Dependent demand is directly related to, or derives from, the demand for another function or activity within the logistics system and the other way around (Christopher, 2005). Independent demand is when it is not a function of demand for other function or activities. This distinction is crucial when planning for the transformation of demand to fulfilled order. The independent demand can be forecast using traditional methods but the dependent demand must be calculated because of the requirement for interaction with the next level in the logistics chain.

From the above discussion it is possible to argue that the next description aspect to consider to be able to evaluate a logistics system is the aspect of demand. An important question to answer in relation to this is *what type of demand (input) enters the logistics system?*

Description aspect V: Demand

Customer service represents the output of the logistics system (Stock and Lambert, 2001). For this reason, that the demand is transformed by the logistic system to customer service, the customer service also has to be described. The customer service is an important aspect since it is not possible to make defined decisions concerning logistics issues without determining the customer service objectives (Stock and Lambert, 2001). In a broad sense, "customer service is the measure of how well the logistics system is performing in providing time and place utility for a product or service" (Lambert et al., 1998). Langley et al. (2008) use this definition of customer service:

"Customer service is a process for providing competitive advantage and adding benefits to the supply chain in order to maximize the total value to the ultimate customer."

(Langley et al., 2008)

Customer service is not to be confused with the concept of customer satisfaction, which is an even broader concept that encompasses customer service (Lambert et al., 1998). Customer service is in the hands of the organisation that deliver the product or service. Customer satisfaction, on the other hand, is the customer's perspective and is not the focus in the description of a logistics system (in this thesis). However, no two customers will ever be exactly the same in terms of their service requirements but it will often be the case that customers fall into groups or 'segments' that are characterised by a broad similarity of service needs, so called 'service segments' (Christopher, 2005).

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

From the above discussion it can be argued that the input to a logistics system can be raw material which is transformed into customer products or, in a somewhat broader perspective, customer demand that is transformed into customer service. The flow in focus depends on what input is chosen and the output also depends on the transformation within the system, which is also chosen. It is thus dependent on the observer's perspective. Consequently, the next description aspect to consider to be able to evaluate a logistics system is the aspect of customer service. Important questions to answer in relation to this is *what does the logistics system produce in terms of customer service (output) and which different types of customer segments are to be satisfied?*

Description aspect VI: Customer service

5.5 CONTROLLED

Another main feature of an organisation, according to systems theory, and used in this thesis as the base to develop unique main features of a logistics system and description aspects is that an organisation is *controlled*.

The behaviour of the system and the outcome of the behaviour are both variable and chosen, Ackoff (1971). Consequently, there is a choice to make, and the system must therefore be controlled so that it does not become a drifting ship on a stormy sea. This is done by one or more purposeful elements which are responsible for choosing from among different courses of action, i.e. the organisation is controlled (Ackoff, 1971). The transformation process changes the input into the output, which then forms the result (Van Gigh, 1991). As the logistics system is an opened system it also has input that transforms to output with the assistance of resources. The transformation requires resources, e.g. personnel, buildings, materials and equipment. One way to describe resources is to count them as costs (Van Gigh, 1991). Resources can be defined as objects that are used in the transformation, but not transformed or consumed by production (such as materials). It then follows the logic of that activity consumes resources that in turn drive costs, as in activity based costing. It then becomes a measure of cost of the transformation.

However, it is through effective business logistics management that a firm fully controls numerous customer service elements (Langley et al., 2008) and this must be controlled against predetermined standards (Christopher, 2005). Grant et al. (2006) also highlight the importance of standard performance of customer service. Customer service consists of many activities that in the end meet customers. Christopher (2005) and Stock and Lambert (2001) use three perspectives to capture the whole spectrum of customer service; pre-transaction, transaction, and post-transaction. The pre-transaction element concerns the organisation's ability to give the customer a clear picture of what service to expect. The transaction element refers to the actual delivery. Finally, the post-transaction relates to the organisation's ability to provide spare parts and handle complaints and product returns.

The above discussion indicates that a logistics system has the ability to choose behaviour and output. Consequently, a logistics system can control the transformation of demand to

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

customer service and the cost of that transformation. Another main feature that makes a logistics system unique, linked to an organisation being controlled, is as follows:

Feature 4:

A logistics system can control the transformation of input (demand) to output (customer service) and thus the cost of resources

To be able to evaluate a system's ability to control its transformation, the systems control function has to be described. Ackoff (1971) states that at least one element has a system control function. Control includes responsibility for continually adjusting the organisation's current and potential capacity to the current and potential demand from the environment (Emery, 1972). The control instruments continuously sense the environment outside and inside the organisation by which management tries to capture changes that may be disturbances and adjust activities in the system so that the discrepancies are eliminated and the system equilibrium is maintained. Prerequisites are thus that the control elements scan and capture disturbances in time and that adequate resources are in place to prevent the disturbance having a negative impact on the system. The system thus needs support to be able to be controlled and managed. A major influence on logistics and a contributing part to logistics management development is computer technology since logistics management needs to process large amounts of data due to the embedded holistic view. IT is now fundamental both as a control and communication tool to develop a company's logistics (Stock and Lambert, 2001). This indicates that a proper IT system is probably an important part in organisations' control on a daily basis, to link customer and supplier and in efforts to improve flow efficiency.

The above section indicates that the next description aspect to consider, being able to evaluate a logistics system, is control. This aspect also includes planning and management of the system. Important questions to answer in relation to this are *how are resources planned and managed to meet demand* and *how is the system managed?*

Description aspect VII: Control

To be able to choose a course of action, the control elements need information, i.e. feedback (Checkland, 1981). This can be compared with a regulator, i.e. the feedback is used to modify and in that way reduce the differences between actual and desired performance. By having control instruments continuously sense the environment outside and inside the organisation management tries to capture changes that may cause disturbance. This is primarily done by the principle of negative feedback (Checkland, 1981). That is the same principle as for general open systems (Katz and Kahn, 1966a). Prerequisites are thus that the control elements scan and capture the disturbances in time. The adjustment that must follow after the control elements have captured the disturbance in the system, to be able to reduce the disruptions is presented in the next part of this chapter. The control feature is intended for awareness and the adaptation more too handling and taking action based on the feedback.

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

Logistics management requires monitoring and evaluating the performance of the supply chain regularly and frequently since the business environment is dynamic by nature (Lambert et al., 1998). Effective management and real cost savings can only be achieved by viewing logistics as an integrated system and minimising its total cost given the firm's customer service objectives (Stock and Lambert, 2001). Consequently, feedback on performance measurements is needed, which is also underlined by Bowersox et al. (1995) where performance measurement is identified as one of four key areas to achieve world-class performance in logistics. The control aspect can be operationalised as the best performance metrics for measuring logistics success (Stock and Lambert, 2001).

Most organisations have performance measurements or metrics in place to control, analyse and evaluate their efficiency and progress over different periods of time (Langley et al., 2008). Those measure or metrics can be used for setting baseline performance objectives or expected outcomes, e.g., orders filled and shipped per day. Quantitative descriptions are also a common way to describe a logistics system and to make its relationship between input and output understandable (Christopher, 1971). Furthermore, it is an advantage to measure on a structural level and document it to evaluate the total effectiveness of a logistics system as a whole (Abrahamsson and Aronsson, 1999). As an extension, the potential in quantum-leap improvements can then be fully explored.

Good performance measures and key performance indicators (KPIs) give the logistics system more advantages than control over total logistics costs and customer service. (KPIs are a few strategic metrics for managing a firm's logistics (Langley et al., 2008).) According to Gunasekaran and Kobu (2007) "it will facilitate a more open and transparent communication between people, leading to a co-operative, supported work and hence improved organisational performance". Parker (2000) points out some other reasons for organisations to measure performance, e.g. to identify success or where problems such as bottlenecks, waste, etc. exist and where improvements are necessary. Other reasons mentioned include: to help the organisation to understand its processes and to confirm what they know or reveal what they do not know and to ensure that decisions are based on facts and to check if planned improvements actually materialised. Furthermore, measurement is a tool to develop businesses for the better, for example through benchmarking against best practice, to know what to focus on or identify areas for improvement. Measurement allows the improvement projects to be based on facts and knowledge about the reality. The reason is that not everyone has the same view of reality and general opinions should be met with facts. Measuring or using performance measurements within an organisation are merely a tool for more effective management and not ends in themselves. Measurements do not tell why things happened or what to do about it; the results just indicate what happened. Performance measures are also embedded with politics, emotions and several other behavioural issues (Gunasekaran and Kobu, 2007). Measurement has strong control effects, which means that it can lead to manipulation and undesirable behaviour. What is measured gets done is therefore not always true. The desired impact of measuring may not always be achieved, leading to the question of what is the "right" measure to achieve proper control. Consequently, performance measures need to be connected to a strategic context, because of

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

the way they influence what people do. Moreover, to achieve overall organisational or logistics objectives, lower-level measures must connect directly to the high-level performance measures of the organisation or the logistics (Langley et al., 2008). In order to make an organisation effective, the performance measurement outcome must be able to make the transition from measurements to management and as long as the logic behind the logistics system itself is not fully understood, designing a measurement system for a logistics system will remain a problem.

Since the character of logistics cuts across traditional company organisation functions with cost impacts on most of those functions the measurements have to capture the performance along the flow as well as the performance of the functions. Christopher (2005) illustrates that the logistics mission cuts across functional boundaries, see Figure 11.

Figure 11 Logistics missions cut across functional boundaries, consequently the same as for the performance measurements (Christopher, 2005)

Hence, within a logistics system measurements are chosen to give information about the state of the logistics system to capture the whole system's performance. Accordingly, additional main feature that make a logistics system unique, linked to an organisation being controlled, is as follows:

Feature 5:

A logistics system measures to capture the whole system's logistics performance, including total logistics costs, lead times and customer service

Since measuring performance is a multi-dimensional problem and there is not one measurement that can capture the whole complexity of the underlying logistics system (Mentzer, 1991) Aronsson and Andersson (2002) suggests a division based on the purpose of the KPIs. The division is based on whether the measurement's purpose is to measure process or functional performance, see Figure 12. Furthermore, they also combined that division with the engineering approach by focusing on physical measurements or the financial approach on financial KPIs. The division between physical and financial KPIs is based on the type of measurement system used to capture data. Neely et al.(1995) state that

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

it is important to define where the data is gathered from. Process performance measures the output of physical and administrative processes, primarily the order and delivery process, i.e. the transformation within the logistics system. Representative measures are lead times, delivery service and cash to cash, whereas functional performance measures within a function, the input to a function or between functions. This means that these measures, unlike the process performance measures, often have a unit perspective. Typical measures are costs, productivity and utilisation, i.e. measures from of the structural perspective within the logistics system. Aronsson and Andersson (2002) argue that it is necessary to use measurements from all of these four groups to fully capture the underlying logistic system. This thesis therefore uses the division of KPI pursuant to Figure 12 to analyse whether the system under study fulfils the main feature, number 5, of a logistics system.

Physical KPI	Lead time, Customer service, Process flexibility	Utilization, Productivity, Turnover rate
	Difficult, there are some methods such as Activity Based Costing	Budgets, costs for used resources, ROI
Financial KPI		
	Process performance	Function performance

Figure 12 Process and function performance (Aronsson and Andersson, 2002)

By the above discussion it can be argued that the next description aspect to consider to be able to evaluate whether the system under study measures to capture the whole system's logistics performance, is the description aspect of performance measurements. The measurements shall capture both the process's performance, along the flow and across functional borders, and the functional perspective by means of both physical and financial KPIs. The division of measurements also points to the fact that effective and efficient logistics systems require both efficient and effective processes (transformation) as well as functions (structure). Important question to answer in relation to this are *what physical and financial KPIs are used to monitor process and functional logistics performance?*

Description aspect VIII: Performance measurements

5.6 ADAPTIVE

Another main feature of an organisation (based in the systems theory) used in this thesis to be able to develop unique main features of logistics system and description aspects is that an organisation is *adaptive*.

As an open system, an organisation is constantly exposed to uncertainty from its surroundings, but also from factors within the system. Uncertainties can for example be

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

cyclical and seasonal variations in the demand for the organisation's products or services. Control thus includes responsible for continually adjusting the organisation's current and potential capacity to the current and potential demand from the environment (Emery, 1972). However, a logistics system can be seen as an adaptive system since it fulfils Ackoff's (1971) definition of an adaptive system, i.e. it has the ability to modify itself or its environment when either has changed to the system's disadvantage so as to regain at least some of its lost efficiency. The logistics system tries to manage disturbances with different forecasting tools, planning techniques and information sharing between different departments within the organisation but also by safety margins, e.g. stocking. An important adaption is to adjust the organisation's current and potential capacity to the current and potential demand from the environment. This is done by most organisations by forecasting customer demand to make a production plan for each function involved. One strategy is to produce before the "real" demand is known. This has to do with customers' unwillingness to wait for materials to be purchased and the product to be produced and finally distributed. The point in the logistics chain of activities where real demand meets the plan is called the demand penetration point. Upstream from this point everything is driven by forecasts and downstream the organisation can respond to customer demand (Christopher, 2005). This point is also known as the *decoupling point*. An example of this is shown in Figure 13 where the shift in strategy from lean to agile is the decoupling point. However, a decoupling point might occur at other points in the flow; it is basically just a point in the flow where there is a decoupling; a queue for example may cause such a point.

Figure 13 An example of a decoupling point; a shift from a lean to an agile strategy (Christopher, 2005)

Another strategy to meet demand is presented by Olhager and Johansson (2012), who address the timing and amount of capacity acquisitions relative to demand. The two extreme capacity strategies lead and lag demand (adapted from Hayes and Wheelwright (1984)) imply that capacity is acquired in advance of any demand increase or that capacity is never added if it cannot be fully utilised with new demand. In logistics the pull and a push approach is also a strategy for meeting customer demand. Pull relates to "pulling" products through the system and is sometimes called a "reactive" system or an agile strategy. The push strategy also uses inventory replenishment to handle anticipated future demand. A pull strategy applies more to independent demand and a push strategy to dependent demand (Langley et

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

al., 2008). If there is a shift between these two strategies within the same flow, this point can be, and is, often called a decoupling point.

The discussion above indicates that a logistics system is an adaptive system. Consequently, to be able to meet demand a logistics system has to have a strategy to meet it, whether the choice is a conscious one or not. Moreover, to be able to use the chosen strategy the logistics system needs to have adequate resources in place to prevent the disturbance having a negative impact on the system. This involves adapting and adjusting the organisation's current and potential capacity to the current and potential demand from the customers. It also includes the organisation needing to plan its capacity. The next main feature that makes a logistics system unique, linked to an organisation being adaptive, is therefore as follows:

Feature 6:

A logistics system has a strategy to meet demand

When an organisation is exposed by messes (Ackoff, 1974), internal or external, the organisation tries to parry by changing its own elements, the relation between the elements and/or its relation to its environment. An organisation is, as presented earlier, controlled by one or more purposeful elements which are responsible for choosing from different courses of action (Ackoff, 1971). The challenge is to maintain equilibrium to keep the system efficient, i.e. the basic principle, maintaining the system's character (Katz and Kahn, 1966a). This means that the element can be modified but the output remains the same, like a body that maintains its temperature despite it getting colder around it. Measurements are thus needed as management decision support on the basis that management requires support for both process and functional orientation.

One of the most critical tasks for organisations for decision-making and control is the availability of information about logistics KPI. Accurate cost data and accounting are therefore required to manage and control logistics operations as well as monitor logistics performance. Lambert et al. (1998) state that performance analysis is almost impossible without accurate cost data. The reason is that most decisions will lead to some costs increasing and others decreasing. In the same way, reducing the costs of individual activities can lead to increased costs of other components and total costs as well (Cavinato, 1992). It may also be case that an individual part of the system should not be operating at its lowest cost to contribute to the system's overall efficiency (if efficiency is measured in costs) (Langley et al., 2008). A choice between several alternatives makes it is therefore essential to capture the total cost of change that each option causes. However, without a measure of the total system performance against which costs can be compared, cost data means nothing whatsoever. Another aspect is that structural changes can be quantitatively measured by logistics performance but will also result in several non-quantitative effects (Abrahamsson and Aronsson, 1999).

It can be concluded that performance measurements are elementary to managing and controlling logistics operations as well as monitoring logistics performance, calculating the consequences of structural changes, foreseeing what is possible to achieve and setting

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

realistic goals. The logistics measurements should be used to regulate the logistics systems behaviour towards desired performance. Another main feature that makes a logistics system unique, linked to an organisation being adaptive, is therefore as follows

Feature 7:

A logistics system uses logistics measurements as feedback to regulate its behaviour to reduce differences between actual and desired performance.

5.7 THEORETICAL SUMMARY, DESCRIPTION AND ANALYSIS MODEL

The intention of this thesis is to present a method of evaluating a healthcare organisation by means of the main features of a logistics system. This is in order to provide a basis for management, control and controllability to such a system. The theoretical base in the development of the main features of a logistics system lies in systems theory linked to an organisation's main features. The fundamental basis is that a system is a network of related elements or activities that must be understood as a whole. The objective is to operate the whole system effectively, not just the individual parts.

The system approach is widely problematised in a philosophical manner, but few researchers applying the systems approach in a concrete and distinct way. This has however been done in this thesis. The selected main features of an organisation for the purposes of the study are that an organisation is *purposeful*, *opened and bounded*, consists of *interrelated elements*, has both *input and output*, and is *controlled* and *adaptive*. See Table 6 for a summary of these main features of an organisation and their content. These features are valid for many systems and by considering them from a logistics point of view both the main features of a logistics system and description aspects of such system can be designed.

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

Table 6 Organisation system's main features and their content

Organisation system's main features	Content
Purposeful	An organisation has meaning through having an aim
Opened and bounded	An organisation is open for exchange with environment by transforming something from it It has an environment which affects its state The bounded system can be controlled.
Interrelated elements	An organisation consists of a set of interrelated elements (functions of subsystems)
Input and output	An organisation transforms something from input to output with the assistance of resources Its behaviour and the output of the behaviour are both variable and chosen
Controlled	An organisation is controlled by purposeful elements which are responsible for choosing from different courses of action. These elements are also responsible for continually adjusting capacity to demand from the environment
Adaptive	An organisation has the ability to modify itself or its environment when disadvantages appear, by using feedback to reach equilibrium again

The seven main features of a logistics system that have been developed in this chapter is presented in Table 7 below. These features are additional features to the features of an organization and are thus unique to a logistics system. Consequently a logistics system possesses thus also these main features. However, the overall objective of a logistics system and the first main feature is to fulfil its purpose; *to meet customer requirements by cost-effective delivery service through flow orientation by prioritising total performance*. The other main features can then be categorised based on how they support the main purpose of a logistics system. It can be argued that the other main features can be divided into two parts. The first concerns the system's design to achieve the overall objective, i.e. how the system is meant to work to perform its duties. This is strongly connected to the flow-oriented structure of the system, which is a functional perspective of the design main feature 2. Likewise, the order and delivery driven transformation within the system is a process perspective, main feature 3. The second part concerns the management and control of the logistics system, i.e. how resources are applied and used in the system and how it is measured and regulated to perform its duties. This is strongly connected to the features of control of the transformation, measure of total performance, strategy to meet demand, and adaptation to desired performance (main features 4-7). The figure below shows the categorising of the main features, which is also the basis for the analysis of the case hospital in chapter 7.

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

Table 7 A logistics system's main features and their content

Logistics system's main features	
Overall objective	
Feature 1	A logistics system's purpose is to meet customer requirements by cost-effective delivery service through flow orientation by prioritising the total performance
Design	
Feature 2	A logistics system has a flow-oriented structure
Feature 3	A logistics system transforms orders into customer services in a flow-oriented process
Management and control	
Feature 4	A logistics system can control the transformation of input (demand) to output (customer service) and thus the cost of resources
Feature 5	A logistics system measures to capture the whole system's logistics performance, including total logistics costs, lead times and customer service
Feature 6	A logistics system has a strategy to meet demand
Feature 7	A logistics system uses logistics measurements as feedback to regulate its behaviour to reduce differences between actual and desired performance

The main features of a logistics system are to be used for analysing how well the two cases, represented by two different healthcare organisations, fulfil these features. Ultimately the analysis provides a picture of how flow-oriented these organisations are, which in the end, hopefully, give insights for potential flow efficient improvements. The analysis model is presented in Figure 14 below.

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

Figure 14 Analysis model, the purpose of a logistics system and the two main parts to achieve its objectives

However, to be able to analyse the case hospital and its features as a logistics system, the case hospital has to be described, although to be able to describe a system, simplifications of reality need to be made. Consequently, not all information can be described; the object differs depending on the viewer. The eight description aspects, defined in this chapter, are considered to cover the picture of a logistics system to be able to analyse it by means of the analysis model. The description aspects are one way to ensure a logistics focus when describing the “real” world. The description aspects are derived, as well as the main features of the logistics system, from the main features of an organisation. The logic is: if a system has this special main feature what has then to be describe to be able to evaluate whether the studied system has the presented logistics systems main features. This provides a description model, which is presented in Table 8. The eight aspects to consider when describing a system have no distinct frame and sometimes overlap.

MAIN FEATURES AND DESCRIPTION ASPECTS OF LOGISTICS SYSTEMS

Table 8 Description model, a logistics system's description aspects, the outcome of the description and questions to answer when describing the system

Description aspects	Outcome of description	Questions to answer
Purpose	The description of the purpose provides a picture of what the system wants to achieve	What is the purpose of the system?
Boundary and Surrounding	The boundaries define the factors that are important for the system to consider but are beyond its control, i.e. given factors. The description of the opened system's context gives an opportunity to explain and understand an individual component.	What is included in the studied logistics system? Where is the system boundary? What in the surroundings affects the system, i.e. what is excluded?
Structure	The structure describes the functional organization and gives a picture of how resources are organized, how responsibilities are divided between functions and how functions are related to each other. Hence, the functions are specialized and are to support the flow.	What are the elements of the system? What are their main task, activities and responsibilities? How are the elements related to each other?
Transformation	The description of the chain of activities in the transformation process, which has a specific start and end, is repetitive and cross functional. It focus on the core flow to where resources are primarily planned and managed to be integrated in that particular flow.	Which is the main flow's process? How are the transformations carried out? How does the system's customer order cycle operate?
Demand	The demand describes what enters the system as orders and that the system convert's into customer service.	What type of demand (input) enters the logistics system?
Customer service	The customer service gives a picture of what the logistics system is performing in providing time and space utility for a product or service.	What does the logistics system produce in terms of customer service (output)? Which different types of customer segment are to be satisfied?
Control	The control description presents how the control elements control and plans system operations, as well as senses the system environment. It also describes how the system analyzes and evaluates the logistics system's efficiency and progress over different time periods.	How are resources planned and managed to meet demand? How are the system managed?
Performance	The performance aspect gives a picture of which measurements the system use.	What physical and financial KPIs are used to monitor process and functional logistics performance?

6 DESCRIPTION OF THE CASE HOSPITAL

*In the previous chapter the analysis model of a logistics system's main features and the description model of it was developed and presented. In this chapter, two cases will be described by means of the eight description aspects, i.e. **purpose, boundary and surrounding, structure, transformation, demand, customer service, control, and performance** (see page 68). This is done in order to illustrate examples of how to view healthcare organisations to be able to analyse them as logistics systems. The information used is collected from interviews, observations, business system or the case hospital's homepage.*

DESCRIPTION OF THE CASE HOSPITAL

6.1 INTRODUCTION

The case hospital is part of an organisation along with three other divisions located in four different cities in southern Sweden. The case hospital is their main facility, where they have overall responsibility for all activities. They have approximately 500 employees and a turnover of just over SEK 600 million (Hässleholmssjukhusorganisation, 2013). The hospital is divided into two clinics: a community healthcare clinic and an orthopaedic clinic. The hospital provides scheduled and emergency primary healthcare, internal medicine, medical rehabilitation, and planned orthopaedic operations. Some general facts about the hospital from year 2011 are presented in Table 9. The case organisation is known for being a good care provider, particularly in orthopaedics where they perform the most knee and hip arthroplasty operations in Sweden.

Table 9 General facts about the case hospital

Production	4,000 operations 36,000 outpatient visits to physicians 26,000 outpatient visits to other professionals 6,000 hospitalisation 8,000 emergency patients
Beds	~110
Number of employees	~570 Approximately 17% work part-time
Professionals	Nurses 26% Assistant nurses 25% Physicians 17% Medical secretaries 8% Management/administrators 9% Physiotherapists/therapists 5% Other 8%

6.2 PURPOSES AT THE TWO CLINICS

The first aspect that describes a system is its purpose. The purpose of the logistics system is the overall objective that the system is intended to achieve. The description of the cases indicates how they prioritise logistics issues. An important question to answer in relation to this is what is the purpose of the system?

The two clinics' managers gave the following purpose formulation related to their logistics for the research project *Lean and Agile*.

Increase patient time and more flexible resource utilisation, especially of hospital beds (in the range of 90-130%) (Community healthcare clinic).

And...

Increase the number of surgeries, "mission doubling" (surgery doubled by the capacity of existing resources) (Orthopaedic clinic).

The operational development manager, who is also the hospital's head of the research project, stated in their organisational principles another goal for the organisation.

DESCRIPTION OF THE CASE HOSPITAL

“We will organize ourselves so that our patients receive the best possible care based on available financial resources.” (Independently translated, Organisational principles)

And...

“We must organize ourselves so that continuous changes in our operating environment will become, as far as possible, assets that can benefit us” (Independently translated, Organisational principles)

Expressed goal from unit managers and planners, are for example; to keep the health care guarantee and to manage their mission from the County Council. It is also mentioned that all Lex-Maria deviations (a Swedish healthcare law) should be reported and that they also should be reporting more in the deviation management system.

6.3 BOUNDARY AND SURROUNDING

The next description aspect to consider when describing the two cases is boundaries and surroundings. Logistics systems, like all organisations, are open systems which mean that they affect and are affected by their surroundings (the superior system). The surroundings’ effects on the logistics system must thus be seen as given factors. As a consequence, the system has to be bounded and defined. The boundaries define the factors that are important for the system to consider but are beyond its control, i.e. given factors. The description of the open system’s context gives an opportunity to explain and understand an individual component. Hence, important questions to answer in relation to this are what is included in the studied logistics system, where is the system boundary and what in the surroundings affects the system, i.e. what is excluded?

The two clinics at the case hospital represent the two systems that are going to be described and analysed based on the logistics system’s main features. Accordingly the organisational structure represents the two systems. These clinics provide care under the same roof at the same hospital but have fairly little contact in terms of patients. There are, however, two exceptions to the organisational division. At the orthopaedic clinic, the Sports Injuries practice is excluded. That function is relatively small and has almost no relation to the other elements at the clinic. At the community clinic, the Pain and Memory wards are excluded. These functions are fairly small and have almost no relation to the other elements at the clinic. They can both be seen as independent activities, because it is always a choice whether the system should be able to influence or not.

The constraints on the systems or subsystem provide the boundaries within which it must operate, which in these cases are, for instance, that the hospital is part of the Swedish public sector. They are thus funded by their County Council, which gives the hospital an assignment defining how much care they have to produce each year. The two systems are of course also affected by laws, political decisions, population structure in the catchment area, and requests for care.

6.4 STRUCTURE

The next description aspect is how the cases are organisationally structured. The structure refers to how the involved elements² are organised, i.e. their tasks, responsibilities, goals, relationships, and interaction with other functions. Important questions to answer in relation to this are: what are the elements of the system, what are their main tasks, activities and responsibilities, and how are the elements related to each other?

6.4.1 Structure of the community healthcare clinic

The community healthcare clinic consists of twelve units; an emergency department and several care units and practices. These units are also divided into out- and inpatient care. Patients who visit the primary care for a session are examined and then return home, therefore outpatient care. Inpatient care refers to patients who have been admitted to a ward and placed in a bed. At a session, a distinction is also made between patients who visit physicians or other professionals, such as nurses, physiotherapists, occupational therapists or social workers.

The two main fields of activity at this clinic are local emergency care and primary care. The latter's main task is to provide high quality basic internal medicine (treatment of diseases in internal organs by specialists without surgery) for the local citizens. They work mostly with the major diseases, e.g. heart attacks, heart failure, stroke, diabetes, and asthma and allergies. Primary care also has an emergency service, intended for patients with internal medical problems. Local emergency care serves patients with easier urgent problems. These patients generally return home afterwards. Patients from emergency primary care either go home, are scheduled for a session or are admitted to a department. Local emergency care and emergency primary care share space but the patient pathways are separated.

To illustrate the structure of the clinic all interrelated elements are shown in Figure 15. These are either functional (organisational division) or parts of functions based on their responsibilities. The elements are related to each other via patients, information, missions or control. Chronic patients are common at the clinic and consequently complexity increases because of the undefinable beginning and end of the care process for these patients.

² The term element is in this thesis used to underline the fact that the theoretical basis is system theory, i.e. a system is a set of interrelated elements. This is however close to the concept of functions, as in task division and not organizational units, within organisations.

DESCRIPTION OF THE CASE HOSPITAL

Figure 15 The Community Healthcare Clinic as a system. A description of relationships between elements

Interrelated elements at the community healthcare clinic

The elements presented in Figure 15 are further described by their responsibilities. The elements responsible for planning and managing at the clinic are described in greater detail in section 6.8.1 and 6.8.3. Consequently, only the element that have a direct connection to the patients are described below.

The emergency department, medical patients (ED)

ER is open between the hours of 8 am and 8 pm daily. There are care coordinators who coordinate patients from the ER to the wards if the patient must be treated at a ward and is not able to go home, or is sent to another care provider.

DESCRIPTION OF THE CASE HOSPITAL

The primary healthcare line

There is a local healthcare line, also an ED, which deals with minor acute surgical and orthopaedic conditions every weekday between 8 am and 5 pm. Most of these patients can go home after the visit. Patients who need major surgery or who have been admitted are referred to the Central Hospital in Kristianstad.

Outpatient department, children and young people

This is a specialised medical department for children and young people, including asthma and allergy issues, obesity, diabetes and bedwetting.

Outpatient department, medicine

This department is a general medical specialist department specialising in heart, brain and blood. Some activities, such as blood tests and ECGs, do not require appointments.

Outpatient department, geriatrics

This department is a department for elderly patients where the entire patient's sickness panorama is taken into consideration.

Ward 9

This ward primarily takes care of stroke patients but also neurological patients and patients in need of rehabilitation. The ward has 24 beds and the patients arrive from the hospital's ER or from other hospitals in the region.

Ward 38

This ward is an emergency ward and can admit patients who require specialist care around the clock. Patients with minor cardiac failure, COPD (chronic lung disease), or failing kidneys, are typical patient groups that are residential at this ward. The ward has 32 beds.

The Intensive Care Ward

This is medical ward with primarily cardiac patients but they also care for patients with intoxication and breathing difficulties. The ward has 14 beds, some of which have continuous monitoring of vital functions. It is located next to the ER.

Ward 38 C

This is a ward that can be opened if necessary.

Activities within an element

The elements consist of activities that have been suitably grouped for each responsibility. Consequently, many activities are performed within each element. This is exemplified by a ward at the community healthcare clinic, see Figure 16. These activities can of course be divided into smaller parts, which are then even more specific. This is thus the transformation within an element. Another refinement of the structure could be to describe different work teams. This is however not relevant for the analysis. The specified activity gives at least an idea of what is happening in the element and shows that it is possible to present a system at various levels of abstraction. All elements are described by their activities but not all are

DESCRIPTION OF THE CASE HOSPITAL

presented in this thesis. The activities described below are of cores of a general kind and from an individual patient perspective are not always true. The flow looks straight but there are many alternative paths through the ward depending on diagnosis, medical condition and so forth. Some of these steps may then be repeated, for example because other examinations are needed.

Figure 16 General activities in a ward

1. *Arrival* – The patient arrives at the ward and is given a bed.
2. *Registration* – The patient is registered at the ward.
3. *Care plan set up* – A care plan is set up that specifies the treatment or care procedures.
4. *Treatment or care* – The care plan is fulfilled.
5. *Evaluation* – The patient is evaluated during the doctor's rounds.
6. *Decision of aftercare* – When the patient's needs are lower than the ward's care level there is a decision on aftercare. Some patients are transferred to an external care provider, some go home with an appointment at the outpatient department and some just go home with a training schedule.
7. *Discharge* – The patient is discharged.
8. *Departure* – The patient leaves the ward.

6.4.2 Structure of the orthopaedic clinic

The orthopaedic clinic performs several types of orthopaedic procedures. The clinic specialises in plastic hip and knee joints, but also performs hand and foot day surgery. They also treat outpatients who come from home for an operation and then go home the same day without being admitted. The clinic also performs outpatient practice. The clinic has six fully equipped operating theatres and one for minor interventions. In total, five

DESCRIPTION OF THE CASE HOSPITAL

organisational units are connected to the care process at the orthopaedic clinic. The interrelated elements are shown in Figure 17. These elements are either function (organisational division) or parts of functions based on their responsibilities.

Figure 17 The orthopaedic clinic as a system. A description of relationships between elements.

The orthopaedic clinic's element

The elements presented in Figure 17 are further described by their responsibilities and tasks. The elements responsible for planning and managing the clinic are described in greater detail in section 6.8.2 and 6.8.3. Consequently, only the elements that have a direct connection to the patients are described below.

Pain outpatient department, first and revisit

This is a small department that treats pain conditions like chronic pain, neurogenic pain and pain caused by cancer. They also work consultatively with inpatients at the hospital which have intractable pain or pain after surgery.

General orthopaedic outpatient department, first visit

Patients visit the general orthopaedic practice for examination and evaluation before surgery or other treatments. The visit may also concern consulting or minor surgery. In cases where there is a decision for surgery, the patient can be fully prepared for the operation at this first visit. Otherwise, the patient returns for a pre-surgery visit. The visits are divided depending on how the patients visit; physicians or other staff. Other staff may be a nurse, an assistant nurse, a physiotherapist, an occupational therapist, a welfare officer or a gypsum technician.

DESCRIPTION OF THE CASE HOSPITAL

Pre-surgery in outpatient department

Examinations before surgery are conducted at the pre-surgery practice. The patients meet the orthopaedist, nurse, nurse anaesthetist, anaesthesiologist and assistant nurse with the aim to be prepared for the surgery. It may also be necessary to X-ray, perform ECG (electrocardiogram) or to make respiratory tests in order to minimise risks during the surgery. The patients are also given valuable information about the surgery.

General orthopaedic outpatient department (revisit)

Patients who return for further examination before surgery or other treatment are booked for a return visit.

Day surgery

Some operations are performed at the orthopaedic clinic. These are comparatively easy hand and foot operations. The patients come and leave the hospital on the same day.

Orthopaedic ward

Patients who will undergo planned orthopaedic surgery (for example replacement of the hip or part of the hip, knee, shoulder or elbow) are cared for at this ward before and after their operation. The ward has 38 beds but at weekends only 28. After surgery they return to the ward for care and also training as preparation to be able to return home. How long the patient remains depends upon the type of surgery performed.

Pre-operative ward

Some patients do not come from the orthopaedic ward, but come from home and are then prepared at the pre-operative ward before surgery.

Surgery department

The department specialises in hip and knee joint surgery. They have six operating theatres of which two are slightly smaller than the others. Activities at this department are further described below. After surgery, the patients either go to the postoperative ward or return home.

Post-operative ward

The patient wakes up in the postoperative ward immediately after surgery. How long the patient stays depends on what surgery the patient had, which type of anaesthesia the patient had, and how the patient feels after the surgery. When the patient is stable enough he or she is then moved back to the ward.

General orthopaedic outpatient department (follow-up visit)

After the patient has left the hospital, they are followed up by phone and after a specified time also one or two follow-up visits to check that the surgery went as expected.

Activities within a element

With the same motivation as for the community healthcare clinic, activities within an element are presented and exemplified by the surgery department, see Figure 18.

DESCRIPTION OF THE CASE HOSPITAL

Figure 18 Activities within the surgery department

1. *Locking* – The patient switches from bed to operating table.
2. *Preparations for anaesthesia* – Needles are inserted and the patient is informed about the anaesthesia that will act during the surgery.
3. *Preparations for surgery* – General or local anaesthesia is followed by cleaning of the area to undergo surgery.
4. *Setting surgical instruments* – the setting of the surgical instruments is prepared before the surgery in the operating theatre or in an adjacent room.
5. *Surgery* – The “knife time” begins when the scalpel enters the body and ends when the cutting is over.
6. *Bandaging and awakening* – Before the patient leaves the theatre the patient is bandaged and awoken.
7. *Locking* - The patient switch from operating table to bed.

6.5 TRANSFORMATION

Transformation is the next aspect to use when the two cases shall be described. In this thesis, transformation in a logistics system means to transform demand (internal or external) to customer service (internal or external) by means a chain of activities. The core flow then needs to be known to be able to describe the transformation from order to delivery along with the fulfilling activities. It is also of interest to know the implications of particular ways to organise these activities. Important questions to answer in relation to this are: which is the main flow's process, how are the transformations carried out, and how does the system's customer order cycle operate?

DESCRIPTION OF THE CASE HOSPITAL

6.5.1 Care processes at the community healthcare clinic

The community healthcare clinic has two general care processes: the emergency process and scheduled visits to the outpatient department.

Emergency

The hospital has two activities within the ED: local emergency care and emergency primary care. These share space but the patient pathways are separated. Local emergency care serves patients with minor urgent problems. These patients generally return home afterwards. The main task of primary emergency care is to conduct high basal internal medicine. Patients from the emergency departments are either admitted, transferred to an external care provider or return home (perhaps scheduled for a visit to one of the outpatient departments).

A general care process for patients entering the system via the ED is shown in Figure 19. The care process for an individual patient can be seen as a straight flow but for a large number of patients, as within an entire clinic, it is rather a network of alternative flow paths. Since it is general, there are exceptions, especially with regard to patients with a life-threatening condition.

Figure 19 Emergency department patient flow

1. Arrival – The patient arrives at the ED
2. Patient queue – The patient waits to be classified.
3. Classification of patients (triage) –All patients are classified on a scale depending on how serious their condition is. If the patient arrives by ambulance, the ambulance crew report to the ED staff who classify the patient. **Decision point**
4. Patient queue – The patient waits to be examined.
5. Examination – The patient is examined. **Decision point**
6. Patient queue – The patient waits for the result of the examination and perhaps also test results from the laboratory.
7. Supplementary examination - If necessary, a supplementary examination is made, e.g. X-ray.
8. Patient queue – The patient waits for the examination results.
9. Decision on further care or treatment – The patient is informed concerning treatment. **Decision point**
10. Patient queue – The patient waits for the treatment.
11. Treatment – The patient is treated

DESCRIPTION OF THE CASE HOSPITAL

12. Discharge – The patients leaves the ED or is transferred to an external care provider.

Decision point

13. Patient queue – The patient waits to be transferred to a ward or to an external care provider.

14. Transferred to a ward – The patient is transferred to a ward

15. Treatment or care in ward – See the figure for activities in a ward. **Decision point**

16. Discharge – The patient goes home or to an external care provider.

The flow looks straight when it is presented on this general level, but there are many alternative patient pathways. Other examinations may be needed, different types of diseases also make the path different, and sometimes certain steps have to be repeated and so on. Patients and referrals can also exit the system before all activities are completed. Some referrals are rejected and some patients do not need care at the level that the clinic offers or are sent to another type of specialist.

Scheduled visits at outpatient department

The general care process for individual patients scheduled to visit an outpatient department begins with a referral (an order) and ends with a discharge, as shown in Figure 20. Only orders between patients and the orthopaedic clinic are shown in the figure; there are also internal orders between activities.

The scheduled visits are preceded by a referral and the patients return home after the visit. (All visits are on weekdays.) The care process for scheduled outpatients is similar to the beginning of the care process at the orthopaedic clinic, which begins with scheduled visits before surgery or other treatments. The differences occur after the first visit since the treatments cannot be expressed with a common word (compare this to 'surgery'). The discharge can also be more undefinable due to the patient groups at the community healthcare clinic, e.g. chronic illness or health problems that have to be treated over a number of visits. Each activity can be described further since they are subsystems within the system. The care process can also be described by diagnosis to see a more unique process for each patient group. However, here it is the general care process that is shown in the figure.

Figure 20 General care process at the community healthcare clinic's outpatient department, scheduled visits

1. *Patient order* – Patients or external care providers (e.g. primary care) send a referral to the community healthcare clinic. This is the order which begins the care process within the system. From the patient's perspective it began when he or she decided to request care.
2. *Referral queue* – The referrals are placed in a queue waiting to be handled.

DESCRIPTION OF THE CASE HOSPITAL

3. *Referral handling* – The referrals are stamped upon arrival, reviewed and sorted. Some are rejected. **Decision point**
4. *Referral queue* – The referrals line up to be accepted or rejected (decision on treatment or not).
5. *Treatment decision*- Decision to treat or not treat. **Decision point**
6. *Patient queue* – Waiting to be scheduled for an appointment.
7. *Appointment* – The accepted referrals generate appointments for patients.
8. *Order acknowledgement* – An appointment is sent to the patient or the patient is informed by phone when no treatment will be given.
9. *Patient queue* – Outpatient waiting list. The patients wait for the scheduled first visit to the outpatient department.
10. *First visit* – The patients visit the outpatient department and meet specialists.
11. *Decision on treatment* – The first visit generates a decision on further treatment or discharge. **Decision point**
12. *Patient queue* – Outpatient waiting list. Patients wait for their next appointment.
13. *Revisit 1* – The treatment continues and generates a decision on further treatment or discharge. **Decision point**
14. *Patient queue* – Outpatient waiting list. Patients wait for their next appointment.
15. *Revisit N* – For some patient groups there is no clear discharge (e.g. chronic patients) and some patients need to be treated N number of times. **Decision point**

The flow looks straight when it is presented on this general level, but there are many alternative patient pathways. Other examinations may be needed, different types of diseases also make the path different, and sometimes certain steps have to be repeated and so on. Patients and referrals can also exit the system before all activities have been completed. Some referrals are rejected, and some patients do not need care at the level that the clinic offers or they are sent to another type of specialist. Chronic patients are also common at this clinic and consequently complexity increases because of the undefinable beginning and end of the care process for these patients.

6.5.2 Care processes at the orthopaedic clinic

Just like at the community healthcare clinic, the care process for an individual patient can be seen as a straight flow but for a large number of patients, as within an entire clinic, it is rather a network of alternative flow paths. The general care process for individual patients begins with a referral. The whole care process is shown in Figure 21. Only orders between patients and the orthopaedic clinic are shown in the figure; there are also internal orders between the activities. Moreover, these activities are slightly different depending on whether it is a matter of inpatient or outpatient surgery.

DESCRIPTION OF THE CASE HOSPITAL

Figure 21 General care process at the orthopaedic clinic

1. *Patient order* – The patient or an external care provider (e.g. primary care) sends a referral to the orthopaedic clinic. This is the order which begins the care process in this system. From the patient's perspective it began when he or she decided to request care.
2. *Referral handling* – The referrals are reviewed and sorted. Some are rejected.
3. *Referral queue* – Waiting for decision to treat or not.
4. *Treatment decision*– The decision on kind of treatment (surgery or training) or no treatment at all. **Decision point**
5. *Order acknowledgement* – An operation appointment is sent to the patient or the patient is informed by phone when no treatment will be given. The patient receives the appointment by post and is asked to fill in a health declaration.
6. *Patient queue* – Outpatient waiting list. The patient is scheduled for a first visit to the outpatient department or for a treatment visit (e.g. to a physiotherapist).
7. *Visit* – The patient visits the outpatient department once or twice to be prepared for their operation. This applies to the procedure itself and the anaesthetic issue. Some patients visit for training (e.g. by a physiotherapist) instead of surgery preparation. This is for some patients the first and only visit and they are discharged afterwards.

Decision point

8. *Patient queue* - Inpatient waiting list. The patient's operation is planned and scheduled.
9. *Surgery* – The surgery is performed, including preparation and aftercare before the patient leaves the hospital.
10. *Patient queue* – Outpatient waiting list. The patient is scheduled for follow-up visits or rehabilitation visits to the outpatient department.
11. *Follow-up* – One or more follow-ups and/or rehabilitation visits to the outpatient department. **Decision point**
12. *Patient queue* - Outpatient waiting list. The patient's visit is planned and scheduled between each new visit.
13. *Discharge* – The care process ends after a follow-up telephone call. Some patients have complications and are scheduled for a complication visit before the process can be ended. **Decision point**

6.6 DEMAND

The next description aspect is the aspect of demand. The demand describes what's entering the system as orders that the system converts into customer service. An important question to answer in relation to this is what type of demand (input) enters the logistics system.

DESCRIPTION OF THE CASE HOSPITAL

The demand can be divided into two different types of demand. The hospital is given a mission by the County Council each year on how much care they should provide. In Sweden we also have a healthcare guarantee. This means that the care providers have to offer care within a specified time. The real demands are thus the demands from patients and are in this case represented by referrals, emergency department or direct admission. Within the systems and between subsystems there may be other types of demand, e.g. requests for laboratory services, patient evaluations, accepted referrals, contact from a patient or request for support and so on.

6.6.1 Demand at both clinic departments

Demand from referral is the same for both clinics and can be described as follows. The community healthcare clinic also has patients entering the system from the emergency department and by direct admission. These are further described below.

Referrals

There are two different kind of external demand entering the orthopaedic clinic in terms of external patient referrals. The referrals come either from external care providers or from patients themselves. At the community healthcare clinic the referrals are made by other care providers or by the clinic itself. This is because they have patients entering the clinic via the ED and then the physicians can make a referral to their own outpatient department. This, however, is not the real demand; it is internal demand and the external demand is from the patient in the ED in the first place. Patients' demands are not always "pure" patient demands; they may of course be expressed by physicians via referrals. The patients' limited knowledge of their own care situation and their medical expertise make the physicians' decision the "real" demand.

The referrals are sent to the two clinics from district health care centres. In some cases, patients make referrals themselves and send them in by mail. After the referrals have been arrival-stamped they are reviewed by a physician. The referrals have different priority depending on the healthcare guarantee and are also prioritised over revisits. The reason for this is that such visits are not included in the healthcare guarantee.

Emergency department

Patients entering the emergency department (ED) have either an internal medical problem or a minor urgent problem. In this case, patients waiting in the ED are the demand.

Direct admission

Direct admission concerns patients who are often in need of hospitalisation and are most often elderly people. They have a special card that entitles them to be readmitted without passing through the emergency department or during the night, when there the emergency department is not open. Approximately 1.3 patients a night enter the system through direct admission. In this case, the call that the patient makes for permission to be readmitted is the demand.

DESCRIPTION OF THE CASE HOSPITAL

6.7 CUSTOMER SERVICE

Customer service is the next description aspect. It gives a picture of how well the logistics system is performing in providing time and space utility for a product or service. Important questions to answer in relation to this are what does the logistics system produce in terms of customer service (output) and which different types of customer segments are to be satisfied.

The output, and thus the customer service, is patients taken care of with treatment or care. The patients leave the system when there is a decision to discharge. Output to another subsystem can thus be referrals, accepted referrals, emergency patients, evaluated patients, contact from a patient, fulfilled support requests, etc. However, the customer service for the community healthcare clinic's system can be divided into scheduled and emergency care depending on the need for care. The orthopaedic clinic only has scheduled care and thus only one patient group to deliver customer service to. Both patients, medical guidelines and the County Council, through laws and recommendations, set the criteria for the customer service for the patient groups. The customer services for the two systems are described below.

6.7.1 The community healthcare clinic

Scheduled care

A special group within scheduled care is chronic patients. Basically, they do not leave the system at all. They need treatment and care over and over again for the rest of their lives. Consequently, the customer service cannot be when the patients "leave" the system by being discharged. One example of these groups of patients is dialysis patients. However, information about how customer service is evaluated or guidelines for it has not been found during data collection.

Emergency care

The two emergency lines, local emergency care and primary emergency care, take care of between 5,000 and 3,000 patients a year. For those patient groups that are registered and followed by the national quality register, the case hospital follows these performance parameters. Examples of these groups of patients are stroke and heart patients.

6.7.2 The orthopaedic clinic

Scheduled care

A working group of almost 40 people (care employees) has compiled a guideline rapport on the care process of knee and hip replacement surgery in the case organisation. The following can be deduced from the results of two care processes. For patients undergoing knee or hip replacement, the clinical documentation for the reduction of pain and improved function and quality of life is well documented internationally (Hässleholmssjukhusorganisation, 2007). Cost-effectiveness is another measure of the result of knee and hip replacement operations presented in the *Care program for hip and knee replacement surgery* (Hässleholmssjukhusorganisation, 2007). This is calculated as the number of years the

DESCRIPTION OF THE CASE HOSPITAL

patient will benefit from the surgery and the cost of the operation is related to the decrease in cost from the reduced need for disability support and medication. Both operations are considered to be very cost-effective in comparison with other procedures. The working group behind the report (Hässleholmssjukhusorganisation, 2007) summarise this in the following statement: *this means that with relatively small means we can achieve a great improvement in the patient's health.*

6.8 CONTROL

The next description aspect used to describe the two cases is that of control. The control functions in a logistics system control and plan the system's operation, as well as sense the system's surroundings. Feedback and response are two of the control functions to manage the system to attain the stated objectives. This aspect also includes planning and managing the system. Important questions to answer in relation to this are how are resources planned and managed to meet demand and how is the system managed.

In both systems, there are different planning and management elements. These elements all have different functions and are described further below for each clinic.

6.8.1 Planning at the community healthcare clinic

At this clinic there are three different planning elements; the planning group, scheduling of physicians (other professionals are scheduled by the respective ward or unit manager) and scheduling of scheduled visits. These elements all have different functions and are further described below.

The planning team

The planning team consists of employees who manage staffing and thus has a staffing responsibility. The assignment from the County Council is converted into an annual plan by the hospital's management team who then delegate the planning to the planning team. The team meets monthly to review and discuss any deviation from the annual plan, plan the next two to three months' work, present and discuss the members' resource needs and evaluate available resources (personnel, labs, physicians, departments, beds for inpatients, etc.). The planning done by the group is mainly based on forecasts.

Scheduling of physicians

The scheduling of physicians concerns staffing wards, units, scheduled visits and telephone times. Scheduling begins with the physicians' requests for leave, conferences and education and is then done based on these requests, competencies, continuity, visit rooms, hours of training and personal knowledge. The departments' staffing is prioritised and based on standard demand. The telephone times are then staffed and scheduled visits have the lowest priority. To be able to schedule physicians, it is stated that personal knowledge of individuals is the most important skill.

Scheduling of other professionals

Other professionals than physicians are scheduled by the respective ward or unit manager.

DESCRIPTION OF THE CASE HOSPITAL

Scheduling of scheduled visits

The visit schedule is drawn up based on how many visit hours are available from the physicians' schedules. Patients are then booked into the free appointment times and thereafter the order acknowledgements are sent to the patients.

6.8.2 Planning at the orthopaedic clinic

The orthopaedic clinic only performs planned care.

The planning team

Just like at the community healthcare clinic, the overall planning is managed by the planning team. Their stated planning priority is first the annual plan, then patients, number of operations a day, operating theatres, and at finally the physicians.

Scheduling of physicians

Based on how much the clinic has to produce over a year a rough production plan is made. The physicians' requests for leave and so on are continuously reported and registered. Together with forecasts of scheduled visits and surgery demand, a rough schedule is drawn up. The physicians are then positioned depending on how many patients they have on the waiting list but also depending on medical skills. The schedule is then transferred into the booking system and scheduled times will be available to book visits, operations and telephone hours. The stated priority for scheduling physicians is to staff operations or visits that have a very large patient stock first, then wards, operations and visit times last.

Scheduling of operations and scheduled visits

Reviewed referrals are converted into surgical notifications or visit orders. By means of the surgical notification the physicians register patients via the operation planning system Orbit. The patients are then sorted into the waiting list by hand. Based on the physician's schedule and type of surgery that can be performed within the slot, patients are identified from the waiting list and placed in the schedule for an operation. Operating theatres and visiting rooms are then booked for each patient. The patients are now sent an order acknowledgement by mail with information about their operation and or visit.

6.8.3 Management

The board of the hospital

The two clinics are managed by the hospital board. Each clinic and unit also has its own manager.

Operational management

In addition to its planning assignment, the planning team also has a management function. They strive to develop their activities by discussing and giving directions concerning operational work to address needs with the resources available.

DESCRIPTION OF THE CASE HOSPITAL

The community healthcare clinic uses co-ordinators to organise patients from the ED to the wards. They have contact with all wards and information about their bed status along with the number of patients in the ER waiting for a bed.

Management principles of the clinic's managers, planners and ward managers

The stated management principles regarding the organisation of the operational processes to organise good processes and flows, of the clinic's managers, planners and ward managers are described below. On a higher level, several mention that they adjust their activities based on the annual assignment from the County Council. Further, decisions are to be decentralised after the production goals for the year have been determined. The principles for detailed production planning at the Orthopaedic Clinic deals take in to account that the main production is performed within surgery and these activities are therefore prioritised before scheduled visits. It is also mentioned that they seek to have waiting times in the range of 6-8 weeks for joint plastic surgeries. One of the surgery planners also points this out, to hold six weeks waiting time to surgery makes the patients feel calm. This also means that the waiting list is updated and true because patients do not have to stand in line to be sure to get a surgery time. The goal of six weeks to surgery also aims to create the opportunity to plan and fill out surgical times and to give the patients the opportunity to be physically and mentally prepared.

Within the community healthcare clinic it is mentioned that the management principles are focused on patient quality and utilising resources, especially in inpatient care (the number of care hours of admitted patients). This is where the highest costs are.

Some unstated management principles can be understood from the interviews, for example that joint operations are the most important ones when planning, because they are more profitable. It is also stated that operations have higher priority than scheduled visits and that the physicians are the most expensive staff but there are also too few of them so planning has to be done with this employee group prioritised.

Adaption of activities

There is a consensus at both clinics that they must be flexible. The orthopaedic clinic is constantly scanning the market to try to take extra missions from other county councils, which will not pass the healthcare time guarantee. They also check markets in neighbouring countries for opportunities to expand their activities, i.e. opportunities to welcome so-called medical tourism. This is also mentioned in respect of the goal of doubling the number of operations, i.e. it shall be done by analysing the clinic's needs and match these to the expansion.

"You have to be flexible in order to grab the available opportunities" and "Is there a need for 100 more joint operations, you have to think about it"

(Independently translated, Mats Molts)

The community healthcare clinic has the possibility to open an additional ward if necessary, depending on the number of patients who need to stay in hospital during their treatment

DESCRIPTION OF THE CASE HOSPITAL

and/or care. This will take four to five hours to arrange depending on the time it takes to find extra staff and the time it takes to supply the ward with medical equipment, medicine and food.

Both clinics agree that when daily work situations arise that they must adapt to it will work out well because the staff always makes a great effort to get it all together. The attitude of the staff is also mentioned as the most important factor to be flexible and have a flexible operational business.

6.9 PERFORMANCE

The final description aspect used in this thesis is that of the system's performance. The performance aspect gives a picture of which measurements the system uses. An important question to answer in relation to this is what physical and financial KPIs are used to monitor process and functional logistics performance.

Interviews and raw data from the case hospital's business system are used to describe how the systems monitor their logistics performance measurements. KPIs found in the business system are definitely measured but it is not clear whether these are in fact used. On the other hand, measurements mentioned in the interviews can be used for either follow-ups or decision-making. A classification has been made of these performance measurements and KPIs and is presented in Table 10. These measurements are mentioned by unit managers or administration staff. A total of 32 performance measurements and KPIs, not unique ones, were defined at the interviews and most were traditional functional KPIs.

DESCRIPTION OF THE CASE HOSPITAL

Table 10 Measurements at the case hospital

Classification	Examples from the interviews	Examples from the business system
Lead-time	Length of stay Lead-times	Lead-times
Production	Number of operations Number of visits	Number of visits, first and return, to physicians or other professionals Number of completed operations Other contacts
Productivity	Surgery time, percentage of total surgery time	Use of resources and occupancy
Demand	Number of patients waiting for a bed	Number of referrals Number of reviewed referrals Number of visits to emergency department
Occupancy	Overcrowded wards	Number of occupied beds
Costs	Economic outcomes compared to budget	Laboratory X-ray Employee Drug Medical
Waiting time	From request to surgery Number of waiting patients	Actual waiting time for new patients Number of waiting patients
Others	Quality Cancellations	Termination reasons Available beds Number of professionals (not physicians) per patient Reasons for rebooking/cancellation

At a higher level of the organisation it is mentioned that in daily operations the orthopaedic clinic traces the average length of stay and waiting time for new visits. These measurements are assumed to lead to action, if necessary, to reach a decent level and definitely stay within the healthcare guarantee.

At the community healthcare clinic they can follow the occupancy situation four times a day. They consider their monitoring system an easy system to monitor key performance indicators. “Press a few buttons and can you see what has been done” (Independently translated, Stefan Lamme). However, it is stated that the numbers are not presented automatically but that they can access them if they want to and can then also make calculations of whatever they want.

In addition, the financial accounting is monitored by the organisational functions, just as in the case of traditional accounting. Each functional unit naturally has a budget to follow. However, several people say that they want an easily understandable tool for economic monitoring customised for the ward staff.

7 ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

*In this chapter the following two questions will be discussed and answered: **Are the systems designed as logistics systems and are the systems controlled and managed as logistics systems?** This is done by means of an analysis of the case description in chapter 6, according to the analysis model presented in chapter 5. The main features of a logistics system are readily applied to the two case systems and evaluated. The chapter follows the logic in Figure 22 below. Accordingly, the design of the cases is analysed first, followed by an analysis of the management and control. At the end of the chapter a summary is presented together with an evaluation of how well the two cases fulfil the main features of a logistics system and the overall objective of such a system.*

Figure 22 The analysis model and the logic of this chapter

7.1 DESIGN

The purpose of this thesis is to develop a method of evaluating a healthcare organisation by means of the main features of a logistics system. The overall objective of a logistics system and the first main feature is *to meet customer requirements by cost-effective delivery service through flow orientation by prioritising the total performance* (main feature 1). To be able to evaluate the two cases' fulfilment of this main feature the analysis is divided into two parts. The first concerns the system's design, i.e. how the system is meant to work to perform its duties, which is presented below. This consists of two main features; *a logistics system has a flow-oriented structure* (main feature 2) *and a logistics system transforms orders into customer service in a flow-oriented process* (main feature 3).

7.1.1 Flow-oriented structure

The first feature that supports the design of a logistics system is that *the system must have a flow-oriented structure* (main feature 2). This means that the elements in the system interact and are arranged to support the flow and total performance of the system. This is analysed by the responsibility of the element and the functional division of resources within the two healthcare systems.

During a care treatment process, the patient passes through a number of units. There are also a number of other units that support these units through planning, managing and coordination or with diagnostic help, as shown in the *structure description* in chapter 6.

Within the two systems, there are various types of units which all have different characteristics and main tasks. All these units are part of the transformation of patient's demand into the fulfilment of that demand. These units can be classified as functions and presented according to which main tasks they have. The classification then makes it possible to analyse how the system's elements are related to each other and in the end evaluate whether the two systems have a flow-oriented structure.

Functions and their main tasks

Emergency department

The emergency department at the hospital is divided into two areas of activity; local emergency care and primary care emergencies. Both deal with unscheduled flows in which all patients will be graded according to how urgent their condition is.

Wards

The wards take care of patients who have to stay at the hospital for one or more nights to recover. These patients are called inpatients and are both cured and cared for in the wards, where some also have equipment to monitor vital functions. The wards at the hospital specialise in different diagnosis groups but the occupancy rate is also a factor in deciding where the patient can be hospitalised.

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

Outpatient departments

Patients visit outpatient departments to be examined by a specialist. In most cases, the patient has a referral from a general practitioner for an appointment time at one of the outpatient departments. The departments are organised by diagnosis and visits are divided into first visit and follow-up visits.

Surgery department

The surgery department performs operations, pre-op preparation and also monitors patients after their operations. The operating theatres are equipped with expensive equipment and the materials they use are also quite expensive.

Diagnostic departments

These departments provide diagnostic help for other units. At the hospital they have both an X-ray department and a laboratory, which support investigations of inpatients and outpatients.

Treatment departments

These departments consist of consultants, physiotherapists, occupational therapists, an almoner, and a nutritionist. They help patients recover after for example a stroke or an operation or better deal with their disease.

Medical secretaries

The secretaries take care of all incoming referrals, they write dictated medical records, archive records, monitor waiting times and carry out other administrative duties.

Determination units

These units plan, determine and allocate resources to the clinics' operations, e.g. outpatient visit planning, physicians' timetables, and have care coordinators who coordinate patients from the ER to the wards and planning teams.

Management

The hospital management board has the main responsibility for overall operations.

External care providers

Some patients, mainly patients from wards, are further cared for by another care provider such as the municipal housing department or public nursing homes

A system consists of two or more interrelated elements. As presented in the description in the previous section, the units have different characteristics. The care processes do not go from one unit to another; instead the units are divided into elements according to the activity sequence in the process. Some of the units have direct contact with patients, i.e. where the operational work with the core production is conducted. These units are called *Core elements*. Other elements exist to support the patient flow, i.e. the *Supporting elements* like X-ray and laboratory services but also medical secretary services that primarily support physicians.

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

These elements receive assignments from the core elements and can never be the trigger for generating production in other units. Another element group is the elements that plan, determine and control the operational work within the core elements and also decide how certain resources are allocated. The managerial board of the hospital is also included in the *Management and control elements*. These elements have no direct contact with patients or handle information that can be linked to an individual patient. The element groups are presented in Table 11 related to the units and the units' main tasks. It should also be mentioned that documentation is a task that is performed in almost every unit but is not a main task.

Table 11 The units of the case hospital, their main tasks and associated elements

Functions	Main tasks	
<i>Emergency room</i>	To take care of small injuries, first aid, and acute admissions	Core elements
<i>Surgery department</i>	Surgical procedures	
<i>Wards</i>	Cure and care, monitoring and to help patients to recover	
<i>Outpatient departments</i>	To perform first and follow-up visits, minor treatments	
<i>Diagnostic departments</i>	To serve other units with diagnostic tests	Supporting elements
<i>Treatment departments</i>	To serve other units with therapies expertise.	
<i>Medical secretaries</i>	To assist other units with administrative duties but also for most perform administrative work for physicians	
<i>Determination units</i>	Plan, determine and allocate resources to the clinic's activities	Management and Control elements
<i>Management</i>	Manages the overall running of the hospital	

The community healthcare clinic is organised into functions: outpatient department, emergency department and wards. These perform activities in different parts of the care process, which means that some of the functions perform activities that are not arranged in sequence. Hence, the core elements are created by combining these activities in a logical order along the care process.

The orthopaedic clinic is organised into three functions; orthopaedic outpatient department, surgery and orthopaedic ward. These perform activities in different parts of the care process, which means that some of the functions perform activities that are not arranged in sequence. Hence, the core elements are created by combining these activities in a logical order along the care process. The elements within each of these two systems are shown in Figure 23 and Figure 24.

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

Figure 23 The three element groups at the community healthcare clinic

Figure 24 The three element groups at the orthopaedic clinic

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

As the two figures show, there are complex networks of relationships between the elements in the systems. The relationships consist of patient flows, missions or resource allocation directives. The management and control and the supporting elements are almost the same in both systems. The differences can thus be seen in the core elements where the patients are taken care of. In the orthopaedic clinic's system (Figure 24) it can be concluded that the units are divided into smaller parts to form elements with a specific main activity responsibility. The elements' main activities are similar to the activities that patients experience in connection with an operation. By way of contrast, at the community healthcare clinic (Figure 23) it is much harder to see the patient flow with related activities. The elements are almost the same as the units, except for new visits and revisits to the outpatient department. The unit's concern should in any case be the total flow of patients or other units requiring a service from the unit (Visser and Beech, 2005).

The medical specialties drive the functional orientation (or perhaps a better word is medical specialist orientation) consisting of a number of relatively independent activities but in a common patient flow network. It is thus important to view the systems as an entity to be able to apply logistics principles, methods, and mindsets and so on at the case hospital.

To be able to redesign the structure into a more flow-oriented structure, the flow has to be defined. The two case systems have several ways to define the flow of patients. They can group the flows by entrance into the system (e.g. from the ER, outpatients and inpatients), diagnosis, diagnosis groups, diagnostically related groups (DRG), pathways, care processes and/or others. Regardless of how the flows are defined, the number of groups that are treated in the system is considerable.

7.1.2 Order and delivery driven transformation

The other main feature that supports the design of a logistics system is that *the system shall have an order and delivery driven transformation* (main feature 3). This is a process perspective, from patient order to fulfilment of that order. The two systems, represented by the two clinics at the case hospital, transform patient demand into patient service, e.g. treated or patient taken care of. To fulfil a logistics system's main feature the case systems has to produce patient service based on patient demand and production must be process-oriented. This means that the transformation can be predictable, has a distinct beginning and end, is intended, is repetitive and has defined steps and an expected outcome. In addition, the underlying aim of the design of the transformation is to produce required care according to the overall objectives of a logistics system.

Order process

For both case systems the customer order cycle can be used to describe the transformation on an aggregated level. First, the patient "order cycle", i.e. the order process, see Figure 25. (1) A referral or a visit to the ER represents placement of the order by the patient. (2) The care provider receives it, either as a referral to one of the clinics or a patient at the triage in the ER. (3) The order is then handled by the care provider and (4) the patient is then given information about how the order will be handled, i.e. order acknowledgement.

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

It is realised, already here in the first part of the patient's order cycle, that there is a difference between emergency and scheduled care. The order process for scheduled care is handled in of weeks and for the emergency department in hours, and in very urgent situations minutes or seconds.

Figure 25 The order process, the first part of the patient's order cycle

Fulfilment process

Within scheduled care at the case hospital, the patient and the care provider now meet for the first time and the fulfilment process begins, see Figure 26. For patients in the ER the first meeting has already taken place. (5) The treatment decision is made after the patient's examination in the diagnostic phase. (6) The patient then receives treatment or care, also with both patient and care provider present. (7) The last part of the fulfilment process is discharge. It is not always easy to determine when this process ends, e.g. for chronic patients or patients with multiple diseases.

Figure 26 The second part of the patient's order cycle, the fulfilment process

Patient order "cycle"

The order and fulfilment processes complete the patient order cycle. See the Figure 27 below. (See customer order cycle, chapter 5.4, for more details). It is this cycle that needs to be optimised and not the functions that perform the activities in the process of treating or taking care of all patient orders that enter the systems.

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

Figure 27 The patient's order cycle

Based on the patient order cycle, the transformation from patient order to discharge cannot always be seen as a process. This is because the activities cannot always be predicted when the patient order is placed, i.e. the steps involved are not defined when the transformation begins. For some patient groups, decisions on the following steps have to be taken step by step. For example, laboratory results or some other important information about the state of the patient have to be evaluated before the next step can be decided. The activities of diagnostic phase (5) and treatment (6) are therefore repeated one or several times in both systems. There is thus a chain of decisions where there is a dependency on decisions from earlier in the chain. The process cannot be predicted when the patient order is placed, and as a result nor can the action that needs to be taken further down the chain or its outcome. The decisions are made in sequence, step by step, checking the patient's reaction or laboratory or radiological results and deciding on the next step from there. Consequently, there is no pre-defined lay-out that the patient will follow. This has of course relevance for how to manage and control these patient flows. It is then important to try and make the clinic's operations more predictable and strive to define the patient flows as processes. However, there are patient flows that are designated processes, such as the hip and knee operations at the orthopaedic clinic but also urgent stroke and heart patients at the community healthcare clinic. These are well-defined complaints with high certainty about the process and the outcome and which De Vries et al. (1999) call routine processes. It is possible to define a treatment path based on medical guidelines that defines the chain of activities in the process.

To summarise, instead of one predictable customer cycle, from order to fulfilment of that order, there are several small customer order cycles that structure the chain at the case hospital, see Figure 28 below. Consequently, it is not possible to outline the total patient order cycle. It is a case of one decision, then another decision, and then another decision, i.e. order and fulfilment cycles between each of the decisions, which in themselves can be seen as processes. The lack of control of the overall customer order cycle thus remains. It should be noted that uncertainty as regards outcome is often higher before the treatment is set (in the diagnostic phase) than is involved in the treatment phase. Consequently, variability is then higher upstream and not downstream as is common in manufacturing settings (De Vries et al., 1999). Accordingly, it requires a higher degree of flexibility and agility to be built into the system's design.

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

Figure 28 Instead of one extensive patient order cycle there is several small ones within it

A clear difference from the industrial context where the customer order cycle is derived from is that services are co-produced. It is not possible to produce care or treatment without a patient. The transformation of patient demand is depending on a specific patient, which makes it driven by order and delivery. However, incorrect transformation may occur, i.e. activities not needed by the patient that do not give him or her any benefits. It may be that the patient has to wait meaninglessly, which Peltokorpi and Kujala (2006) call negative waiting time. Another risk is overcapacity, which will not lead to transformation of customer demand due to the service production logic. The main focus should be on the core flow, i.e. transform orders into treatment and care of patients.

When an order arrives in the system it is not clear what the exact output, customer service, is to be produced. It is obvious that the patient must be taken care of but not how or when or how long time it will take or what it will cost. Consequently, the outcome cannot be defined or predicted. The input, which is the demand from the patient, leads to a new kind of demand, some kind of decision on action. Consequently, there are two types of demand; one when the referral or the patient arrives at the ER (the problem) and the other when it is decided how the “problem” should be addressed. Health professional also always make a judgment as a basis for decisions on further treatment. This means that the demand as an order cannot always be met even if the patient wants it to be. The converse may also be true: the patient may not want the treatment that is offered.

The transformation is driven by demand but the demand is divided into small pieces. Constant checks are made in order to evaluate decision support and inform the patient and the other stakeholders about the “new” demand. Furthermore, the two clinics have special circumstances, with different types of demand, planned care and emergencies. Accordingly, there is variation both between specialties and within a specialty. The variation in routine and predictability is much lower in the orthopaedic clinic’s surgical path way than for the community healthcare clinic’s internal medicine. There is also variation within single patients’ flows (for example a diagnosis) at the level of a unit; homogeneity is low due to variation within patient groups, practices within units and practices within groups of specialists. The design of the patient flow from demand to outcome and the design principles when designing the order and delivery process for a healthcare system are most certainly affected by these conditions.

The analysis of the transformation at the two clinics shows that before the diagnostic phase ((5) in Figure 27) the process cannot be predicted. The process cannot be predicted when the patient order is placed and therefore neither can the action that must be taken further down the chain nor its outcome. The decisions are made in sequence, step by step, checking

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

the patient's reaction or laboratory or radiological results and deciding on the next step from there. Consequently, there is no pre-determined layout that the patient will follow. The transformation has thus a distinct beginning and end when the patient order is placed. At an aggregated level, the transformation is intended and repetitive and the steps are defined. However, on a lower level it is hard to classify the healthcare systems by means of these characteristics. Instead of one predictable customer cycle, from order to fulfilment of that order, there are several small customer order cycles that structure the chain at the case hospital, see Figure 28. Consequently, it is not possible to outline the total patient order cycle. First there is one decision, followed by another and then another, i.e. order and fulfilment cycles between each of the decisions which in themselves can be regarded as processes. The transformation is driven by demand but the demand is divided into small pieces. Constant checks are made in order to evaluate decision support and inform the patient and the other stakeholders about the “new” demand. The lack of control of the overall customer order cycle therefore remains. It should be noted that uncertainty regarding outcome is often higher before the treatment is set (in the diagnostic phase) than is involved in the actual treatment phase. Consequently, variability is then higher upstream than downstream, as is common in manufacturing settings. Another difference against the industrial context is that services are co-produced.

To summarise, the two healthcare systems have some intentions to have an order and delivery driven transformation. The question is thus whether they can have a “fully” process-oriented transformation due to the fact that they are highly advanced service organisations.

7.1.3 Conclusions about the systems' design

There are parts that in a way remain about how a logistics system is designed. However, the systems are not wholly designed as logistics systems; they are rather functionally organised and medically oriented organisations.

Healthcare organisations are very knowledge and high-tech intensive with quite low patient volumes. Consequently, resources are shared between different functions. Healthcare organisations have long been classified by function and one of the major reasons for this is that the medical profession has a strong orientation towards different sub-disciplines, such as ear nose and throat clinic, dermatology clinic and cardiovascular clinic (Berlin and Kastberg, 2011). Naturally there is the risk of sub-optimisation as functions focus too much on their own part and not enough on overall patient flow, which should be observed by the management and control.

7.2 MANAGEMENT AND CONTROL

The next part in the analysis of the two cases is how the systems are managed and controlled. By reviewing the systems' characteristics and how well they fulfil the main features *measure of total performance*, *strategy to meet demand*, and *adaption to desired performance* (main features 4-7) the cases can be evaluated from a logistics system point of view.

7.2.1 Control of transformation - from patient demand to fulfilment

The first management and control part to evaluate in the two systems is the main feature *a logistics system can control the transformation of input (demand) to output (customer service) and thus the cost of resources*. This means that a logistics system has the ability to choose behaviour and output

Due to the facts that demand changes and are also determined retrospectively for both systems but especially for the community healthcare clinic by the outpatient department, the transformation cannot be fully controlled. Each patient order cycle can be controlled and defined as a process, but not the whole transformation. For the processes that are defined (knee and hip arthroplasties, stroke and the treatment of heart patients) there is a possibility to control the transformation. However, full control of the transformation presupposes complete and explicit specifications of the end-products' requirements and delivery requirements.

Due to the fact that services are considered to be different from products (see for example Zeithaml et al. (1985) and Grönroos (2007)) the customer order cycle will seem different within a healthcare setting. The reason for this has mostly to do with the inseparability characteristic of services. That the inseparability involves simultaneous production and consumption, which most services are characterised by (Zeithaml et al., 1985). Since the patient must be present during the production of many health services and the provider and the patient then are the same entity, this causes the fulfilment phase to involve both the patient and the provider. However, there are three perspectives integrated when patient orders are transformed to fulfilment of orders: the patient perspective, the care provider perspective, and fulfilment. Consequently, neither of the two systems can fully control the transformation because of the uncertainty that co-creation brings, see Figure 29. This co-creation cannot be an excuse for controlling the transformation from patient demand to fulfilment of request. However, full control of the transformation presupposes complete and explicit specifications of the end-products requirements and delivery requirements. The uncertainty is thus on a low level in the transformation, in the meeting with a patient. On a higher level, a more holistic view, these uncertainties should not appear. In fact, it should be an option to use the patient's own ability in the transformation. This is in line with Grönroos and Ravald's (2011) joint value creation with the customer, which is then possible.

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

Figure 29 Patient perspective (1), Care provider perspective (2) and Fulfilment of care perspective (3)

Information technology to provide and support communication that links customer and supplier together is a very important part of logistics and computer technology has had a major impact on logistics and has contributed to the development of logistics management. Support to fulfil the demand is scarce in the two case care systems. Generally, in the healthcare sector, documentation is very comprehensive but information for decision support about transformation control is rarer. In both the two case systems, pen, paper and knowledge are used more in the control of the transformation than support from information technology. The operational planning staffs have extensive knowledge and understanding of both healthcare and the professionals, which makes it work. There are many dependencies when it comes to use of resources; both professionals and physical resources are shared between units as well as consecutively.

The management of the two systems has limited possibilities to control the transformation of demand into outcome as the order and delivery cycle is driven by medical specialists who do not manage the process of transformation. Ownership of patient flows is less defined than clearly defined medical responsibilities within each specialty. The interwoven resource dependency is another argument for aggregated transformation and resource control in the total system at hospital level. All resources are added to the system in order to transform

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

demand (input) into customer service (output). Control is thus in both systems insufficient for the costs connected with the flow. The total logistics costs and costs along the flow are not monitored. For these reasons a need for professions with logistics expertise to complement the medical specialists is indicated.

Further indication that the community healthcare clinic's system does not have full control of the transformation is that they use coordinators. This shows that there is a need to coordinate and make decisions part-way into the flow to allocate critical resources.

7.2.2 Measure of the total logistics performance

The next main feature to use in this analysis of the two cases is that *A logistics system measures to capture the whole system's logistics performance, including total logistics costs, lead times and customer service*. This means that a logistics system chooses measurements to give information about the state of the whole system's performance.

The division of measurements, physical KPI or financial KPI and process or function, is made by the purpose of measuring. The division assumes that there is a need for both functional and process performance information to support managers in their decisions (Aronsson and Andersson, 2002). The classification used is thus divided into these four groups, see Figure 30 below. This is to illustrate not only what is measured and the measurements used but also to see what is missing in terms of ratios to obtain a complete picture of the complex underlying logistics system within the two systems. A total of 32 performance measurements and KPIs, but not unique ones, were defined at the interviews. Most were traditional functional KPIs, such as waiting time, demand, and occupancy.

It can be concluded that the two systems measure a great deal but there is significant uncertainty as to how much the information is used. There is a lack of definition of the measurements, knowledge and understanding regarding what the measurements include. This contributes to the difficulties to use the measurements to evaluate the systems' performance and steer towards specific goals. Moreover, there was no indication of the use of the customer service concept in the pre-transaction element, i.e. the organisation's ability to give the patient a clear picture of what service to expect, neither for the transaction element that refers to the actual delivery of the service nor the post-transaction, which relates to the system's ability to handle complaints or re-admissions. It is also realised that there were no KPIs that could be grouped as financial process indicators. This was thus mentioned by the respondents as a needed instrument.

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

Physical KPI	Lead time	Production, Productivity Demand, Occupancy Waiting time
Financial KPI		Costs
	Process performance	Function performance

Figure 30 Division of found measurements

Generally, all care providers in Sweden have strong requirements and standards for medical documentation. At the case hospital, the documentation around each single patient is also very extensive but there is a lack of information aggregated from operational level about patient processes that is made available for strategic decision-making. Neither of the two cases measures on the basis of improving patient flow efficiency.

7.2.3 Strategy to meet demand

The next main feature to evaluate the two systems by is that *a logistics system has a strategy to meet demand* (main feature 6). This means adapting and adjusting the organisation’s current and potential capacity to the current and potential demand from the customers. It also includes having adequate resources in place to prevent the demand having a negative impact on the system.

The strategy at the orthopaedic clinic is to first set up an annual plan to fit the county council’s mission. Closer to the real demand, the physicians’ schedules are set up and hence the point when staff are tied up. This is followed by tying patients from the surgical waiting list to a unique physician. (Other professions are scheduled within each unit). Operating theatres are then booked, which means that the space resource space is tied up (both patient and physician are linked to an operating theatre). Thereafter, and finally, the patient is given an order acknowledgement regarding his or her operation. Accordingly, the system’s strategy is to plan the resources (physicians, other professions and rooms/theatres) before the real demand is known. The resource base is then fixed. When the demand is higher than the plan they have forecast, the staff must either increase capacity by doing more or a queue builds up. Capacity in a service context is the counterpart of inventory in that it allows the organisation to increase its level of production to respond to customer demand. This has a similar effect to increasing safety stocks of goods: both have a buffering effect, allowing the supplier to be more responsive and flexible to meet increased customer demand (Ellram et al., 2004). This is thus also expensive if the customer demand is lower than planned.

The strategy to meet demand at the community healthcare clinic is similar to the strategy at the orthopaedic clinic, where resources are planned before the real demand is known. Activities within this system consist largely of outpatient visits. Visit activities serve to

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

smooth the system, which is a chosen strategy to meet the demand. The fact that these activities have lower priority when planning and scheduling, which makes it act as a rubber band, makes it easier to plan and schedule the clinic's activities. However, this strategy is likely to bring fluctuations in arrivals of new patients and thus also visit demand as the number of referrals depends on the number of new patient visits. Likewise, it is likely that it also creates fluctuation in the number of patients waiting for revisits, dependent demand, when the activity is given lower priority. It is not until the queue is "too" long that the visits are scheduled and the queue diminishes. The dependent demand is not that easy to forecast; it has to be calculated because of the interaction both upstream and downstream.

Resources are used both within units and along the chains of patient flows, which means that the requirements and incentives in terms of the planning and control of these resources differ according to whether a unit or chain perspective is adopted (Visser and Beech, 2005). The chosen strategy in both systems indicates that a more unit perspective is used than viewing clinic's activities as a system.

Stocks are kept with the intention to protect companies against fluctuations in demand or to smooth out demand by production for stock. In the manufacturing industry stocks are thus linked to strategy, a variable that can be changed, whereas this is difficult to do in the healthcare sector since storage of healthcare services is not possible, e.g. patients cannot have an appendectomy before they have appendicitis just because there is capacity to do so. In times of low demand, unused capacity is lost forever. "Contrary to this, during periods of excess demand the excess business is usually lost." However, a patient queue can make it possible to handle small, short fluctuations. Consequently, the stock concept is a little complicated to express in terms of care. The concept of work in process is a variant of stock but without the connection to business strategy and is therefore perhaps more suitable for a healthcare context. The number of queuing patients also binds capital while the staff put effort into monitoring the queues for production planning purposes and to keep the waiting time guarantee.

To summarise, the two systems' strategy is to plan the resources (physicians, other professions and rooms/theatres) before the real demand is known. The resource base is then fixed. Both clinics meet fluctuations with effort and sacrifice rather than face it systematically, e.g. with a lead or lag strategy, see (Olhager and Johansson, 2012). There is no evidence for a pull strategy; instead patients are pushed through both the systems. Another conclusion that can be drawn is that both systems try to convert dependent demand into independent demand by applying decoupling points along the patient flow. Between each activity in the patient flow there is a queue of referrals or patients. Furthermore, the penetration point occurs when a unique patient is linked to unique resources, like a physician and a room. Consequently, the two systems both have strategies to meet demand but they are not in line with traditional logistics strategies. There is a lack of demand strategies that support the total logistics performance of the systems.

7.2.4 Adaption to desired performance

The last main feature of a logistics system is that of *it uses logistics measurements as feedback to adjust its behaviour to reduce differences between actual and desired performance*. The feature consists of two parts; first, the system has to use logistics measurements and second it has to have logistics objectives for the clinic's activities.

There are few intentions pointing to the use of logistics measurements within each system. The interviews gave a picture of that both clinics measure a great deal but there were no examples or evidence that the measurements are used. It is also unclear whether they actually measure the quality measures listed in the hip and knee surgery care process program. Nobody mentions it in the interviews. The report on care processes also mentions some customer service measurements; these are thus also more quality measures than measures of logistics. It is essential to measure the processes to achieve good customer service – the result and output of a system.

The objectives that are mentioned can be classified as production goals rather than logistics goals. An objective for the clinics is their organisational principles:

“We will organize ourselves so that our patients receive the best possible care based on the financial available resources.” (Independently translated, Organisational principles)

This indicates that the economy sets the framework and the service will be thereafter. This is contrary to the core of logistics; to perform customer service at a certain level at the lowest possible cost. This is probably a consequence of how Swedish healthcare is governed, as economic governance is not the same as patient flow focus.

Since the objectives are non-logistical and measurements to support an adaptation are scarce, it is difficult to talk about adaptation to desired performance. Hence, there are no stated objectives or support to adapt the clinic's activities to attain the undeclared logistics goals. However, if the view of adaptation is broadened a little the orthopaedic clinic's business plan to increase production may be a sign of adaptation to meet the budget objective. They thus take the opportunity to increase production by performing more operations than the assignment says. They take patients from those county councils who do not manage to keep the healthcare guarantee. They also sense what happen in neighbouring countries in order to scout for opportunities to expand the clinic's activities.

7.2.5 Conclusions about the system's management and control

The two clinics are not entirely managed and controlled according to logistics principles. The analysis of how they fulfil the main features of a logistics system's ability to manage and control demonstrates the lack of a flow-oriented focus. It can be concluded that overall control of the transformation from patient demand to fulfilment of that demand is less than optimal, which is likely a consequence of the embedded uncertainty in co-creation with the patients. Signs of scant control are also found in the analysis of which measurements are used in the two cases. Neither of the two cases measures or uses the measurements to improve patient flow efficiency. When it comes to the strategy of meeting patient demand, it

is indicated that the management of resources uses a unit perspective rather than a holistic view of the clinic as a system.

7.3 FULFILMENT OF LOGISTICS' PURPOSE AND PRIORITIES

The two healthcare cases have been analysed by means of several main features of a logistics system. The first part concerns the design of the system where it can be assumed that some parts remain about how a logistics system is designed but not the whole system. The design is rather a functionally organised and medically oriented business. The second part is that of management and control. The overall picture is that management and control are non-flow-focused; the overall notion of flow efficiency is missing.

A summation of the analysed features provides a picture of how well the case hospital lives up to the overall objective of a logistics system; *meet customer requirements by cost-effective delivery service through flow orientation by prioritising the total performance*. It can be concluded that the two case systems do not prioritise logistics thinking or flow efficiency to any great extent. This is thus probably involuntary. Though, the orthopaedic clinic demonstrates a slightly higher degree of fulfilment because they have larger volumes of patient groups, more homogeneous patient mix and they have no emergency care. However, a representation of fulfilment, based on the analysis in this chapter, is made to provide a picture of the cases' logistics features, see Figure 31. It can be noted that the fulfilment of the first main feature, the overall objective of a logistics system, is a summation of the remaining features. Additionally, the fulfilment rate of 100% represents a theoretical optimal and it is therefore neither attainable nor desirable. A further discussion about the fulfilment of these main features, the potential in comparing a healthcare clinic with a "perfectly working" logistics system and the generality of the model can be found in the next chapter.

ANALYSIS – THE CASE HOSPITAL AS A LOGISTICS SYSTEM

Figure 31 The evaluation model, fulfilment rate of the two healthcare cases' ability to live up to a logistics system's main features. (C = community healthcare clinic, O = orthopaedic clinic)

8 CONCLUSIONS AND CONTRIBUTION

This chapter concludes the findings and presents an overall discussion of these findings along with the connection to the purpose. By this means, the purpose of the thesis will be answered; to develop a method intended for evaluating a healthcare organisation by means of the main features of a logistics system. The thesis's contribution, managerial implications and further research are also presented. As was stated in the introduction, the intention of the thesis is not to propose definitive solutions to problems but promote a new mindset whereby they can more easily be solved (just as a reminder).

CONCLUSIONS AND CONTRIBUTION

8.1 CONCLUDING DISCUSSION

Based on the analysis it is realistic to suggest that a healthcare organisation can be evaluated by means of a logistics system's main features. This is done by means of frame of references by both systems approach and basic logistics literature. The features and description aspects of a logistics system were then used to describe and evaluate two different healthcare clinics' fulfilment of these features. The main features of a logistics system as used in that analysis are shown in Figure 32, the evaluation model. Increased logistics focus can be achieved by using the model and objectives towards increased flow efficiency by ambitions for each feature. The ideal objective is probably not a rate of 100% on all features, but the ideal result on the evaluation model is not studied in this thesis. The model is here used for evaluation of healthcare organisations but it also has potential for use in other contexts.

Figure 32 General model of fulfilment of a logistics system's main features, the evaluation model

8.1.1 A logistics system's main features viable in a healthcare context

It can be concluded that a healthcare organisation can be represented as a system. The case hospital's two systems have represented illustrations of how to describe a healthcare organisation with the aim of evaluating it by means of a logistics system's main features. The description is presented in chapter 6. However, the observer always chooses the perspective

CONCLUSIONS AND CONTRIBUTION

and the objective depends on the issue or what ought to be analysed in the system. Consequently, in order to make a more operational analysis, for example identify bottlenecks or enhance variations, it is likely that other, more tailored description aspects are needed. Nevertheless, the analysis presented in chapter 7 demonstrates the possibility to use the presented description aspects to evaluate healthcare organisations using logistics flow efficiency terms.

The first main feature, *to meet customer requirements by cost-effective delivery service through flow orientation by prioritising the total performance*, in this thesis represents the purpose of a logistics system. The other features create the capacity to achieve this. They are either features connected to the design of a logistics system or to how the system is managed and controlled.

The second main feature concerns the design of a logistics system, *an order and delivery driven transformation*, and can be considered applicable to a healthcare context based on the following discussion. The analysis shows that the transformation is driven by demand but the overall transformation design is divided into several small customer order cycles. The customer order cycle is derived from an industrial context and the differences occur in fulfilment, in the diagnostic phase, where co-creation begins. Despite these differences, the analysis shows that it is fruitful to apply the customer order cycle concept to locate flow efficiency potential. The analysis shows that it is not possible to outline the total patient order cycle but there are some aspects that probably make it hard to fulfil this main feature completely. This can be derived from the fact that the patient's requirements always need to be assessed; the patient may not want to undergo the treatment offered transparency may be limited transparency since the procedure may be interactive and exploratory. This means that the order and deliver cycle is sometimes well-defined, which shows similarities with the processes found in industry although they may also be exploratory when it is necessary to take one step at a time because of the patient's illness. Both well-defined and explorative order and delivery cycles can be found in both cases. This suggests that some flexibility must be built into the system design to transform patent demand efficiently.

The analysis of the third main feature, *a flow-oriented structure*, confirms the picture of an organisational design driven by medical specialties. This implies a possibility to change perspective to a more holistic view with the patient flow in focus. Furthermore, the perspective change has to come with awareness that there are many different types of patient flows that may be central to the design. Consequently, there must also be an awareness of the consequences of the choice for the overall system's performance.

A critical look at the fourth main feature, *control of the transformation of demand into customer service and thus the customer service and the cost of resources*, shows that a very useful analysis can be made when evaluating healthcare organisations. This is due to the fact that there are very few possibilities to control the transformation. This has partly to do with the fact that ownership of patient flows is less well-defined than clearly defined medical responsibilities within each specialty. It also has to do with the inability to distinguish between the uncertainty regarding unique patients on a low level of aggregation and at the higher level where there should be

CONCLUSIONS AND CONTRIBUTION

complete and explicit specifications of the end-product requirements and delivery requirements.

By studying the measurements used at the two clinics it is possible to evaluate the intention to measure flow efficiency. This represents the logistics system's main feature number five, *to measure total logistics costs and customer service to capture the whole system's logistics performance*. There is nothing in the empirical data that indicates intentions to measure the total systems' performance, especially not the total patient flow costs or the total logistics costs. It is apparent that the medical documentation needs to be complemented with available information on both functional and patient process performance. This is to make it possible to make proper strategic decisions to increase the possibility to meet patients' requirements through cost-effective delivery service, which is the aim of a logistics system. The generics in this feature should allow it to be 100% fulfilled by a healthcare organisation.

The sixth feature, *strategy to meet demand*, gives valuable information concerning what strategy a healthcare organisation chooses when meeting patient demand. This thesis shows that established strategies can be used to evaluate the potential in managing planning to meet demand. The analysis shows that the strategy at the case hospital is to create a fixed resource base before the real demand is known. The lack of demand strategies that support the total logistics performance ultimately leads to both clinics having to use a sacrificing work effort rather than working systematically to be able to meet the demand. This, however, is a conscious strategy but it is not in line with either traditional logistics demand strategy or a pull strategy since their demand strategy does not support the total logistics performance of the systems.

The last main feature, *to use logistics measurements as feedback to adjust the behaviour to reduce differences between actual and desired performance*, is also probably the hardest feature to fulfil. Fulfilment of this feature probably indicates the level of logistics "maturity". It requires both a clear purpose of the organisation and that the organisation use logistics measures in the improvement process for better flow efficiency. However, the study shows that this feature is nevertheless useful to evaluate a healthcare organisation's ability to adopt a more flow-oriented way of working since the analysis indicates that the clinic's economy sets the framework and service will be thereafter. This is contrary to the core of logistics; to performing customer service at a certain level at the lowest possible cost.

From the discussion above it can be concluded that a logistics system's main features are usable to analyse a healthcare organisation's potential to be more flow-efficient. Even if the evaluation concerns a special kind of service and the fundamentals of the features are from a different context the main features of a logistics system complete their aim. However, given that the theoretical basis is derived from systems theory, it should be mentioned that the system boundaries used are not fixed. A shift in the boundaries divides the systems into sub-systems or enlarges them, probably giving new opportunities and insights to improve logistics efficiency. The fundamentals of systems theory should thus be considered; viz that every sub-system is a part of a larger system and that they are not separable from the larger system as a whole, i.e. they are interactive. The healthcare organisations have been viewed as

CONCLUSIONS AND CONTRIBUTION

two separate systems. Other potential for flow efficiency might appear if they were merged to form a single system or in a wider sense also include upstream and downstream healthcare providers.

The main features that are now included are in a way more focused on operational excellence, i.e. focus on internal efficiency (doing things right). To evaluate dynamic efficiency and sense the surrounding market in order to be able to do the right things, additional main features are probably needed. It might require a feature, or several, that exploit the system's ability to maintain a sustainable strategy to meet long-term demand and changes in the surrounding market.

However, the six present features together provide a possibility to complement a healthcare organisation's ability to meet patient requirements through cost-effective delivery service through flow orientation by prioritising the total performance, i.e. to be flow efficient and demonstrate logistics operational excellence.

8.1.2 Great potential for healthcare organisations

As a direct consequence of the above discussion, and the indications in Figure 31, it is interesting to look further at the potential for the organisation to fulfil the main features of a logistics system better. It is concluded in section 7.1.3 that the case systems demonstrate some parts that in a way remain about how a logistics system is designed. Thus, the systems are not designed as logistics systems; they are rather functionally organised and medically oriented operations. The potential that lies in a possible redesign of the healthcare organisations is found in both the creation of efficient processes based on patient flow and supporting this with a suitable sharing of responsibilities by the functions. To strive for a design where the transformation is predictable, has a distinct beginning and end, is intended, is repetitive, and has defined steps and an expected outcome. Additionally, potential for improved management and control can be found in providing sufficient support for particular process owners. In order to be able to assess any progress when making improvements in either or both design and management and control, an adequate baseline is thus needed. The baseline should address both a process and a functional perspective, e.g. by costs, lead times, and ability to meet promises and for the last perspective resource utilisation, throughput time and productivity. These measures, however, are only suggestions and a proper study to define useful operative key performance indicators is therefore needed.

However, the greatest potential may lie in establishing views about healthcare organisations in patient flows and establishing flow-oriented objectives including total performance of patient service and costs.

8.1.3 The importance of objective

Aimlessness makes it hard to create improvements for better total performance. The mindset of flow thinking can in that case not be present. The case study shows that the objectives are rather formulated as narrowly defined productivity concepts than an effectiveness-oriented holistic view. To change such an approach, healthcare has to have

CONCLUSIONS AND CONTRIBUTION

greater focus and create target images for the results as a whole than on productivity in single care units or isolated patient groups. Moreover, large patient processes lack targets, with the consequence that useful metrics and standards are absent. The consequences are the same; improvements in business development are inhibited. The reason for this is that the overall purpose of logistics and flow efficiency is to accomplish a change. That is why a more distinct objective and vision is required in terms of more effective flows, i.e. improved patient service, decreased costs and shorter lead times for patients.

8.1.4 The economic governance has consequences

The Swedish healthcare system is decentralised, where the main part is managed and financed from public funds. Consequently, the obvious relationship in other industries between customer and producer are replaced by a third part where the behaviour of the producers and patients are affected but that a third party accounts for most of the funding. There is also much less price-performance interaction than in most production environments. The economic governance limits the creative incentives to develop healthcare as a flow-controlled system since the measurement only focuses on costs. One way to institute the new productivity approach is to view healthcare as a value-creating industry rather than just a community cost.

A key aspect in logistics is that management (control element) must consider the total of all logistics costs (e.g. costs connected to the flow of products or services) (Stock and Lambert, 2001, Lambert et al., 1998) because the impact of reducing specific costs within logistics functions may be less than optimal for the system as a whole, leading to higher total costs, when using a non-integrative approach to logistics cost analysis (Lambert et al., 1998, Grant et al., 2006). Likewise, the case hospital in this thesis is controlled by functional budgets, which probably leads to sub-optimisation of costs.

Hence, it takes strength and clear objectives to be able to have a means whereby costs and performance of the patient flows can be assessed. The healthcare organisation itself must thus provide its own flow-oriented objectives since this is not encouraged from a higher level, i.e. the county council. This is because the healthcare organisation is not measured or privileged by the objectives of logistics. Without incentives from governing institutions, this requires possibilities for a flow efficient perspective and opportunities to measure, manage and follow up changes to be created.

8.1.5 The measurements indicate the focus

Change management tends to focus on what can be measured and the measurements used often govern development. In logistics, delivery service is more justified than product quality although the analysis of the case hospital shows that clinical measurements and diagnosis measure or treatment outcome are more common in terms of measurements used. These organisations' specific quality measurements are not to be used as support in decision-making or follow-ups or to control the organisation at a management level. The focus in the healthcare sector then shifts to a strategic level with quality indexes for the end results, but scarcely to facilitate or support the work methods to get there. Additionally, these measurements provide a poor picture of the patient flows due to their end result orientation.

CONCLUSIONS AND CONTRIBUTION

Measurements of both processes and functions are important to manage and control a healthcare organisation and develop it towards greater patient flow orientation. Measuring, monitoring, and using physical KPIs for process and functional performance within the studied systems thus has great potential. Customer service (delivery precision, delivery reliability, service level and perfect order), lead time, throughput time and queuing time can be used to measure process performance. Functional performance can be monitored as demand, work in progress, average stock level, productivity, and utilisation.

8.2 CONTRIBUTIONS

This licentiate thesis stresses the importance of the “new” research field of logistics management and encourages transfer of knowledge of efficient flow management to a new sector. One of its fundamental intentions is to more clearly define the field of healthcare logistics research and provide both a conceptual foundation and empirical observations.

The research is a practical interpretation of general theories where the systems approach and general logistics literature are elaborated in a healthcare context. The system approach is in a philosophical manner widely problematised. Within logistics research the systems approach is fundamental but few researchers have applied the systems approach concretely and distinctly in their research. This thesis has presented the main features of a logistics system by considering a system’s main features along with the theoretical foundations of logistics. This part, along with the description aspects of a logistics system, also presented in this thesis, contributes theoretically to the field of logistics in new contexts. These theoretical models, answers to RQ 1 and RQ 2, represent a generality to other contexts than healthcare. They are very likely generic to other service industries, e.g. banking and insurance, but also to other contexts.

A first step towards analysing healthcare organisations’ potential to develop towards more flow efficiency is also proposed in this thesis. The research presents an analysis of two different healthcare organisations’ fulfilment of a logistics systems main features, see chapter 7. This has contributed to a methodology which makes it possible to transfer already developed knowledge to a new context, i.e. the healthcare sector. More about managerial implications is presented in the next section. The structurally conducted literature review of logistics research in a healthcare context also contributes to the body of literature on healthcare logistics.

8.3 MANAGERIAL IMPLICATIONS

The conclusions of the “shortcomings” illustrated by the fulfilment rate in Figure 31 are not that revolutionary. Several researchers have looked at the same implications. The major managerial contribution is thus the analysis based on the logistics system’s main features, which gives a more purposive understanding of what can be done to improve flow efficiency within a healthcare organisation to make healthcare organisations progress in their ability to be more flow-oriented. It will hopefully lead to increased learning and knowledge about flow efficiency to develop a more flow-oriented healthcare.

CONCLUSIONS AND CONTRIBUTION

8.4 FUTURE RESEARCH

This thesis states that the increased efficiency and effectiveness of a unique patient or production flow is one thing, but it is the means for the system's performance as a whole that matters. Likewise, the question is how will the entire system be influenced when optimising utilisation of resources such as physicians or operating theatres? The patient flow of a particular care group is rarely isolated but is rather included in a network with other patient flows and prioritising one patient group over other groups' health needs is not always accepted. Healthcare systems are often very complex. The complexity is partly due to the fact that healthcare organisations are very knowledge and high-tech intensive together with relatively low patient volumes. As a consequence, resources have to be shared between different functions. There is a constant risk of sub-optimisation of functions, resources or specific flows when the studied system's boundaries are too narrow. A key question is exactly how to design, manage and control a healthcare organisation to handle several of these unique patient flows in a structured and standardised manner. This is a straight extension of the findings in this thesis.

Another interesting research perspective is the question of how to measure costs along the patient flow. Budget pressure will probably not change and the two case organisations need support for decisions and to manage activities in all patient flows on a cost basis. The empirical findings show that there were no KPIs that could be grouped as financial process indicators. This was also mentioned by the respondents as a needed instrument. Consequently, methods need to be developed for cost control (use of resources) and customer service (value perceived by the customer) in the healthcare sector.

The section above shows that it is not that easy to monitor the total cost of a logistics system. It is therefore of interest to know what an appropriate flow-oriented costing system should provide. It should have the ability to focus on the output of the system, in essence the provision of customer service, and to identify the unique costs associated with that output (Christopher, 2005). It should also be capable of enabling separate cost and revenue analyses to be made by customer type and by market segment or distribution channel. This requires an 'output' orientation to costing. The cost connected to the flow depends on the business area, the order structure and the working methods of the company, etc (Manunen, 2000).

It is thus essential that the performance measurement outcome can make the transition from measurements to management in order to make an organisation efficient. The logic behind the logistics system itself should therefore be fully understood. Otherwise, designing the measurement systems will continue to be a problem. The empirical data collection in this thesis is a good start in that sense. There are good examples of methods used within logistics to capture costs along flows, see for example (Abrahamsson and Aronsson, 1999) who present a conceptual model for measuring logistics structures based on a total cost analysis in combination with a methodology similar to activity-based costing (ABC). Their model has been used in several distribution redesign projects, both as a simulation tool to define a new structure as well as a reference mark in the change process itself, i.e. a baseline. This model might be a good starting point to develop something similar for the healthcare sector. It is

CONCLUSIONS AND CONTRIBUTION

indicated that ABC is also relevant to healthcare organisations since almost all costs are fixed once resources have been committed (Kelemen et al., 2007). Another argument is that ABC is claimed to be beneficial in complex organisations where activities consume various levels of overhead (Naranjo-Gil et al., 2009). For a healthcare organisation there has to be a logical and quantifiable relationship between the utilisation of resources, the performance of activities, and services that the care provider provides, all connected to the patient flow. The total cost analysis, which derives from the logistics field for calculation of the total logistics cost tied to a particular decision in a given situation, seems to be, in combination with ABC, useful for the healthcare sector.

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APPENDIX I

LITERATURE REVIEW – LOGISTICS RESEARCH IN A HEALTHCARE CONTEXT

Number of articles with a healthcare context (first search phase), structured by topic and journal; and Reviewed patient flow articles and categorization

Journal	Volume, issue, year		Number of articles on	
	From	To	Patient flow	Physical products flow
<i>International Journal of Logistics Management</i>	17,1,2006	22,3,2011	1	0
<i>International Journal of Logistics: Research & Applications</i>	9,1,2006	14,6,2011	0	0
<i>Journal of Business Logistics</i>	27,1,2006	32,4,2011	0	1
<i>Journal of Purchasing and Supply Management</i>	12,1,2006	17,4,2011	0	3
<i>Journal of Supply Chain Management</i>	42,1,2006	48,1,2012	0	0
<i>Supply Chain management: An International Journal</i>	11,1,2006	17,1,2012	5	4
<i>International Journal of Physical Distribution & Logistics Management</i>	36,1,2006	42,1,2012	0	3

Reviewed patient flow articles (a total number of 26 articles)

Patient flow articles (The bold ones is the patient flow related articles from the first search phase, followed by their references from search phase two)	Number of healthcare related references (Total number of references)
<i>Engineering cellular organization and operation for effective healthcare delivery supply chains</i> . J. Parnaby and D.R Towill (2009)	27 (51)
<i>Performance improvement capability: keys to accelerating performance improvement in hospitals</i> . Adler, P. S., Riley, P., Kwon, S. W., Signer, J., Lee, B. & Satrasala, R. (2003)	
<i>An example of a good but partially successful OR engagement: Improving outpatient clinic operations</i> . Bennett, J. C. & Worthington, D. (1998)	
<i>Managing the Care of Health and the Cure of Disease--Part I: Differentiation</i> . Glouberman, S. & Mintzberg, H. (2001)	
<i>Viewing Kaiser Permanente via the logistician lens</i> . Towill, D. R. (2006)	
<i>Seamless healthcare delivery systems</i> . Parnaby, J. & Towill, D. R. (2008)	
<i>The introduction of patient process re-engineering in the Peterborough Hospitals NHS Trust</i> . Probert, D., Stevenson, B., Tang, N. K. H. & Scarborough, H. (1999)	
<i>Supply chain leagility in professional services: how to apply decoupling point concept in healthcare delivery system</i> . Rahimnia, F. & Moghadasian, M. (2010)	3 (49)
<i>Measuring lean initiatives in health care services: issues and findings</i> . Kollberg, B., Dahlggaard, J. J. & Brehmer, P. O. (2006)	
<i>An evolutionary approach to the architecture of effective healthcare delivery systems</i> . Towill, D. & Christopher, M. (2005)	
<i>Supply chain management in health services: an overview</i> . Jan de Vries, Robbert Huijsman (2011)	12 (32)
<i>Health care reform in Portugal: an evaluation of the NHS experience</i> . Oliveira, M. D. & Pinto, C. G. (2005)	
<i>A stakeholder-integrated approach to health care management</i> . Zinkhan, G. M. & Balazs, A. L. (2004)	
<i>Developing lean and agile health care supply chains</i> . Håkan Aronsson, Mats Abrahamsson and Karen Spens (2011)	17 (27)

Number of
healthcare
related
references
(Total
number of
references)

Patient flow articles (continued from previous page)

Quality improvement in the healthcare industry: some evidence from Singapore. Chow-Chua, C. & Goh, M. (2000)

Why we are wasting time in the operating theatre? Saha, P., Pinjani, A., Al-Shabibi, N., Madari, S., Ruston, J. & Magos, A. (2009)

Explaining Anomalous High Performance in a Health Care Supply Chain * Shah, R. & Goldstein, S. (2008)

Supply chain management practices for improving patient-oriented care. Meijboom, B., Schmidt-Bakx, S. & Westert, (2011)

Medicine's service challenge: blending custom and standard care. Bohmer, R. M. J. (2005)

Barriers to Swift, Even Flow in the Internal Supply Chain of Perioperative Surgical Services Department: A Case Study *.

Fredendall, L. D., Craig, J. B., Fowler, P. J. & Damali, U. (2009)

Bringing Robustness to Patient Flow Management Through Optimized Patient Transports in Hospitals. Hanne, T., Melo, T. & Nickel, S. (2009)

Networks for integrated care provision: an economic approach based on opportunism and trust. Meijboom, B., Haan, J. d. & Verheyen, P. (2004)

ABC: The Pathway to Comparison of the Costs of Integrated Care. Paulus, A., Van Raak, A. & Keijzer, F. (2002)

Processes, episodes and events in health service supply chains. Lillrank, P., Groop, J. & Venesmaa, J. (2011)

Time-based management of patient processes. Kujala, J., Lillrank, P., Kronström, V. & Peltokorpi, A. (2006)

Time-based analysis of total cost of patient episodes: A case study of hip replacement, Peltokorpi, A. & Kujala, J. (2006)

49(78)

10(44)

APPENDIX II:

LITERATURE REVIEW – SYSTEMS APPROACH

Reviewed researchers within the field of systems approach

Ackoff

Towards a system of systems concepts (1971)
Science in the system age: beyond IE, OR, and MS (1972)
The system revolution (1974)

Beer

The brain of the firm (1972)
Diagnosing the system for organizations (1985)

Bertalanffy

The history and status of general systems theory (1972)
An outline of general systems theory (1950)

Boulding

General systems theory – the skeleton of science (1956)

Checkland

Systems thinking, systems practice (1981)

Churchman

The systems approach (1968)
The systems approach and its enemies (1979)

Flood

Rethinking fifth discipline (1999)

Forrester

Industrial dynamics (1961)

Gharajedaghi

Systems thinking- managing chaos and complexity, a platform for designing business architecture (2011)

Jackson

The origins and nature of critical systems thinking (1991)
Towards a system of systems methodologies (1984)
Beyond a system of systems methodologies (1990)
Beyond problem structuring methods: reinventing the future of OR/MS (2006)
Fifty years of systems thinking for management (2009)

Quade

The methodology of systems analysis (1985)
Analytic strategies and their components (1988)

Senge

The fifth discipline the art & practice of the learning organization (1990)

Sterman

Business dynamics: systems thinking and modeling for complex world (2000)

Ulrich

Critical heuristics of social planning: A new approach to practical philosophy (1983)

Van Gogh

System design modeling and metamodeling (1991)

APPENDIX III

LITERATURE REVIEW – LOGISTICS SYSTEMS

Reviewed articles regarding systems approach in logistics research

Author	Systems approach in logistics
Sanders, N. R. (2007) The benefits of using e-business technology: the supplier perspective. <i>Journal of Business Logistics</i> , Vol. 28 No. 2, pp. 177-207.	Claims that SCM has a systems view because all activities and functions that are needed to bring a product or service to market are considered.
Gammelgaard, B. (2004) Schools in logistics research?: A methodological framework for analysis of the discipline. <i>International Journal of Physical Distribution & Logistics Management</i> , Vol. 34 No. 6, pp. 479-491.	Logistics research can be divided in to two schools based on the underlying methodological approach: the analytical school (positivism) and the systems school (systems theory).
Arlbjørn, J. S. & Halldorsson, A. (2002) Logistics knowledge creation: reflections on content, context and processes. <i>International Journal of Physical Distribution & Logistics Management</i> , Vol. 32 No. 1, pp. 22-40.	Uses the term <i>hard core</i> to explain what is unchangeable and to illustrate what the knowledge within logistics is all about. They formulate it as “directed towards the flow of materials, information and services; along the vertical and horizontal value chain (or supply chain) that seeks to; coordinate the flows and is based on system thinking (a holistic view) where; the unit of analysis essential is the flow”.
Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D. & Zacharia, Z. G. (2001) Defining supply chain management. <i>Journal of Business Logistics</i> , Vol. 22 No. 2, pp. 1-25.	See SCM as a management philosophy and state that SCM has a systems approach to view the supply chain as a whole to managing the total flow.
Ellram, L. M. & Cooper, M. C. (1990) Supply chain management, partnership, and the shipper-third party relationship. <i>International Journal of Logistics Management, The</i> , Vol. 1 No. 2, pp. 1-10.	“supply chain management is a systems approach to viewing the channel as a whole rather than a set of fragmented parts”.
Bechtel, C. & Jayaram, J. (1997) Supply chain management: a strategic perspective. <i>International Journal of Logistics Management, The</i> , Vol. 8 No. 1, pp. 15-34.	Underline that that systems thinking is the most mentioned underpinning philosophy in the SCM literature.
Novack, R. A., Rinehart, L. M. & Wells, M. V. (1992) Rethinking concept foundations in logistics management <i>Journal of Business Logistics</i> , Vol. 13 No. 2, pp. 233-267.	Present a guide to develop the logistics discipline and the systems approach is the underlying premise in the conceptual framework of logistics management.
Gregson, R. (1976) The Development of a Decision Making Framework for Logistics Management: I. The Systems Approach. <i>International Journal of Physical Distribution & Logistics Management</i> , Vol. 7 No. 3, pp. 150-158	Logistics within a company could be represented as a system because it portrays a total pattern of phenomena whose components are interrelated
Heskett et al (1973) in Gomes, R. & Mentzer, J. T. (1988) A systems approach to the investigation of just-in-time. <i>Journal of Business Logistics</i> , Vol. 9 No. 2.	Listing observations concerning logistics systems
Geisler, M. A. & Steger, W. A. (1963) The Combination of Alternative Research Techniques in Logistics Systems Analysis. <i>Management Technology</i> , Vol. No., pp. 68-77.	Listing a number of characteristics to the basic components of a logistics system.

APPENDIX IV

INTERVIEW GUIDE – SESSION 1

Frågor till sjukhusledningen inför intervju den 22 oktober, 2009

Intervjun med dig är en del i att beskriva en baseline av hur HSO och din enhet arbetar med förändring, och med de operativa processerna. Det är en del i ett gemensamt forsknings projekt mellan HSO, Linköpings Tekniska Högskola och Karolinska Institutet.

Frågor (förändring, 20 min)

- 1 Vilka bärande principer är viktiga för dig i förändringsarbete?
- 2 I vilka strukturer bedrivs förändringsarbetet?
- 3 Vilka rutiner eller standardiserade arbetssätt använder ni er av för att bedriva förändringsarbete?
- 4 Vilka verktyg och metoder använder ni?
- 5 Hur fördelas ansvar och roller i utvecklingsarbetet?

Frågor (logistik, flöden, 20 min)

- 1 Vilka styrande principer används vid för hur de operativa processerna organiseras?
- 2 Hur sker planeringen av verksamheten?
- 3 Hur sker samordningen med andra enheter som är inblandade i patientens väg genom sjukhuset?
- 4 Vilka verktyg och metoder använder ni?
- 5 Hur fördelas ansvar och roller för planering och styrning av verksamheten?

Frågor (resultat, 20 min)

- 1 Vilka nyckeltal som ni följer upp är viktigast för dig?
- 2 Är flexibilitet viktigt för din organisation, och vilken typ av flexibilitet anser du att ni är i behov av?
- 3 Vilka behov av uppföljning och planering har du idag som du skulle vilja ha stöd för? (t ex ekonomi, resursplanering osv.)

APPENDIX V

INTERVIEW GUIDE – SESSION 2

Frågor inför intervju den 12 och 17 november 2009

Intervjun med dig är en del i att beskriva en baseline, nulägesbeskrivning, av hur HSO och din enhet arbetar med de operativa processerna. Det är en del i ett gemensamt forsknings projekt mellan HSO, Linköpings Tekniska Högskola och Karolinska Institutet.

Frågor (logistik, flöden)

- 1 Vilka styrande principer används vid för hur de operativa processerna organiseras?
- 2 Hur sker planeringen av verksamheten?
- 3 Hur sker samordningen med andra enheter som är inblandade i patientens väg genom sjukhuset?
- 4 Vilka verktyg och metoder använder ni?
- 5 Hur fördelas ansvar och roller för planering och styrning av verksamheten?

Frågor (resultat)

- 1 Vilka nyckeltal som ni följer upp är viktigast för dig?
- 2 Är flexibilitet viktigt för din organisation, och vilken typ av flexibilitet anser du att ni är i behov av?
- 3 Vilka behov av uppföljning och planering har du idag som du skulle vilja ha stöd för? (t ex ekonomi, resursplanering osv.)

Frågor (operativt, enheterna)

Detta är en övergripande struktur av frågor som kommer behandlas under intervjun. Vi kommer att anpassa frågorna efter respondent och då fokusera mer på vissa frågor genom underfrågor.

Respondenter

Datum	Respondent	Befattning	Längd
12 oktober 2009	Respondent 5	Chefsläkare ortoped, läkare	1h
12 oktober 2009	Respondent 6 och 7	Chef operationsavdelningen, ssk Chef anestesienheten, läkare	1,5h
12 oktober 2009	Respondent 8	Chefsläkare närsjukvården, läkare	1h
12 oktober 2009	Respondent 9 och 10	Enhetschef avd 9 Enhetschef Dialys	1,5h
17 oktober 2009	Respondent 11 och 12	Koordinator utvecklingsdelen (forskning) Koordinator ortoped	1,5h
17 oktober 2009	Respondent 13 och 14	Sekreterare närsjukvården Verksamhetschefens sekreterare ortoped	1,5h
17 oktober 2009	Respondent 15 och 16	Koordinator ort ssk Schemaläggare för läkarschemat ortoped	1,5h
17 oktober 2009	Respondent 17 och 18	Vårdkoordinator närsjukvården, ssk Vårdkoordinator närsjukvården, ssk	1,5h

Mer information om respondenterna

Respondent 5 – Började på sjukhuset 1992, har varit enhetschef och är nu överläkare.

Respondent 11 – Tar hand om allt runt logistiken med patienter som ingår i studier, ssk. Respondent

12 – ssk i botten, jobbar som mottagningsplanerare och operationsplanerare.

Respondent 13 – Sekreterare i botten, ansvarar nu för schemaläggning på NS och särskilda boenden + en primärvårds mottagning. Systemadministratör för avvikelser i systemet. Lokalansvarig vid lokalbyten osv och är med i miljögruppen kliniken. Kallar sig diversearbetare.

Respondent 14 – Medicinsksekreterare men nu chefssekreterare. Jobbar mot klinikchefen. Fixar telefoner.

Respondent 15 – Ansvarar för väntelistan, operationsprogrammen för läkarna är fyllda, att rätt dr är på plats och även patientfrågor och kontakt med dessa.

Respondent 16 - Jobbar på ortoped mottagningen i Kristianstad, enhetschef för läkarsekreterarna, schemaläggare för alla läkare (Hässleholm, Kristianstad, Ystad, Lund och Ängelholm)

Respondent 17 – Jobbar på akuten och är vårdplatskoordinator men har även andra uppgifter.

Respondent 18 – Jobbar på akuten, ssk, och är vårdplatskoordinator men har även andra uppgifter.

Största uppgiften är att ha hand om vårdplatserna, det övergripande ansvaret och ha kontroll över hur många vi har. Jobbar 1-2 pass/v som koordinator.

APPENDIX VI

INTERVIEW GUIDE – SESSION 3

Respondenter och Intervjuunderlag 10 och 11 mars 2010

Datum	Namn	Befattning	Längd
10 mars 2010	Respondent 19	Ortopeden, ssk	30 min
10 mars 2010	Respondent 20	Ortopedi mottagningen och närsjukvården minnesmottagning	45 min
10 mars 2010	Respondent 21	Ortopedavdelningen	30 min
10 mars 2010	Respondent 22	Närsjukvården, akutmottagningen	45 min
10 mars 2010	Respondent 6	Operationsavdelningen, ssk	20 min
11 mars 2010	Respondent 15	Operationsplanerare, ansvarig för väntelistan operationsschemat	45 min
11 mars 2010	Respondent 13	Närsjukvården, lägger läkarschemat	45 min
11 mars 2010	Respondent 14	Chefssekreterare ortoped	45 min
11 mars 2010	Respondent 23	Medicinnmottagning, IVÖ, ssk	45 min

Respondent 19

Onsdag kl 10.30 (Skalpellen) Ortopeden, postoperativa avdelningen

- Hur många anställda, heltid?
 - Yrkeskategorier? Ssk, usk och övriga, även administrativ personal.
- Fördelning av usk och ssk:s tid på olika aktiviteter? Uppskattning ur det ser ut hos er.
 - På närsjukvården har de gjort en undersökning där de delat upp de olika aktiviteterna enligt följande:
 - **Direkt vård:** Alla aktiviteter där medarbetare och patient är närvarande samtidigt t ex tvättning, behandling, information osv.
 - **Indirekt vård:** Avser en viss speciell patient, men patienten är inte närvarande när aktiviteten utförs t ex dokumentation, kommunikation med anhöriga per telefon osv.
 - **Systemrelaterad aktivitet:** Gemensamt för alla patienter ex städning, förrådsarbete osv. Avser även pauser, väntetider osv.
 - Skiljer sig vården åt före och efter operation enligt ovanstående definition?
- Hur stor andel av patienterna passerar er för och efter operation?
 - Finns det patienter som varken passerar er eller avd 1 före och efter operation som sker på operationsavdelningen?

Respondent 20

Onsdag kl 11.15 (Skalpellen)

Ortopedi mottagningen och närsjukvården minnesmottagning

- Lite allmänt om hur flödet på mottagningarna ser ut.
- Hur många anställda, heltid?
 - Yrkeskategorier? Ssk, usk och övriga
- Fördelning av usk och ssk:s tid på olika aktiviteter? Uppskattning hur det ser ut hos er.
 - På närsjukvården har de gjort en undersökning där de delat upp de olika aktiviteterna enligt följande:
 - Direkt vård:** Alla aktiviteter där medarbetare och patient är närvarande samtidigt t ex tvättning, behandling, information osv.
 - Indirekt vård:** Avser en viss speciell patient, men patienten är inte närvarande när aktiviteten utförs t ex dokumentation, kommunikation med anhöriga per telefon osv.
 - Systemrelaterad aktivitet:** Gemensamt för alla patienter ex städning, förrådsarbete osv. Avser även pauser, väntetider osv.
- Antalet besök?
 - Nybesök respektive återbesök för de olika mottagningarna?
 - Kan man även se om det är återbesök före eller efter operation?
- Hur många patienter operera på mottagningen?
- Finns det patienter som vårdas på avd 1 innan eller efter operation på mottagning?

Respondent 21

Onsdag kl 13 (Skalpellen)
Ortopedi, avdelning

- Hur många anställda, heltid?
 - Yrkeskategorier? Ssk, usk och övriga (även administrativ personal)
- Fördelning av usk och ssk:s tid på olika aktiviteter? Uppskattning hur det ser ut hos er.
 - På närsjukvården har de gjort en undersökning där de delat upp de olika aktiviteterna enligt följande:
 - Direkt vård:** Alla aktiviteter där medarbetare och patient är närvarande samtidigt t ex tvättning, behandling, information osv.
 - Indirekt vård:** Avser en viss speciell patient, men patienten är inte närvarande när aktiviteten utförs t ex dokumentation, kommunikation med anhöriga per telefon osv.
 - Systemrelaterad aktivitet:** Gemensamt för alla patienter ex städning, förrådsarbete osv. Avser även pauser, väntetider osv.
- Medelvårdtid i dagar?
 - Före och efter operation?

Respondent 22

Onsdag kl 13.30(Skalpellen)
Närsjukvården, akutmottagningen

- Lite allmänt om flödet på akuten.
- Hur många anställda, heltid?
 - Yrkeskategorier? Ssk, usk och övriga (även administrativ personal)
 - Uppdelning mellan medicin och NS linjen?
- Fördelning av usk och ssk:s tid på olika aktiviteter? Uppskattning hur det ser ut hos er.
 - På närsjukvården har de gjort en undersökning där de delat upp de olika aktiviteterna enligt följande:
 - Direkt vård:** Alla aktiviteter där medarbetare och patient är närvarande samtidigt t ex tvättning, behandling, information osv.
 - Indirekt vård:** Avser en viss speciell patient, men patienten är inte närvarande när aktiviteten utförs t ex dokumentation, kommunikation med anhöriga per telefon osv.
 - Systemrelaterad aktivitet:** Gemensamt för alla patienter ex städning, förrådsarbete osv. Avser även pauser, väntetider osv.

Respondent 6

Onsdag 14.15 (Skalpell)
Ortopedi, operationsavdelning

- Hur många anställda, heltid?
 - Yrkeskategorier? Ssk, usk och övriga (även administrativ personal)
- Fördelning av usk och ssk:s tid på olika aktiviteter? Uppskattning hur det ser ut hos er.
 - På närsjukvården har de gjort en undersökning där de delat upp de olika aktiviteterna enligt följande:
 - Direkt vård:** Alla aktiviteter där medarbetare och patient är närvarande samtidigt t ex tvättning, behandling, information osv.
 - Indirekt vård:** Avser en viss speciell patient, men patienten är inte närvarande när aktiviteten utförs t ex dokumentation, kommunikation med anhöriga per telefon osv.
 - Systemrelaterad aktivitet:** Gemensamt för alla patienter ex städning, förrådsarbete osv. Avser även pauser, väntetider osv.

Respondent 15

Torsdag 10.15

Operationsplanerare, ansvarig för väntelistan operationsschemat. Även för att dr är på plats och för operationsfrågor och patientfrågor

- Antalet på operationsavdelningen som arbetar med administration eller andra uppgifter som inte har direkt patientkontakt?
 - Vilka uppgifter har dessa personer?
- Volymer/produktion
 - Hur många opererades under 2009?
 - Hur stor andel av olika typer av operationer?
 - Kan man se hur många patienter som har ett besök innan operation eller flera?
 - Kan man se hur många patienter som besöker annan yrkeskategori än läkare innan och efter operation? Och hur många besök innan och efter?
 - Kan man se hur många telefonmöten som ske i samband med operationsprocessen med patient?
- På närsjukvården gjorde de en undersökning om hur usk och ssk fördelar sin tid. Har du någon uppfattning om hur läkarna på operationsavdelningen fördelar sin tid de dagar de jobbar hos er? På närsjukvården använde de följande uppdelning:
 - Direkt vård:** Alla aktiviteter där medarbetare och patient är närvarande samtidigt t ex tvättning, behandling, information osv.
 - Indirekt vård:** Avser en viss speciell patient, men patienten är inte närvarande när aktiviteten utförs t ex dokumentation, kommunikation med anhöriga per telefon osv.
 - Systemrelaterad aktivitet:** Gemensamt för alla patienter ex städning, förrådsarbete osv. Avser även pauser, väntetider osv.

Respondent 13

Torsdag kl 11
Närsjukvården, läkarschemat

- Antal anställd administrativ personal på närsjukvården?
 - Hur många omräknat till heltid?
- Arbetsuppgifter hos administrativ personal?
 - Mest intresserad av de som jobbar med flödet av patienter, även indirekt så som schemaläggning och planering av patienter, journalskrivning, remisshantering mm
- Läkarna och deras fördelning av tiden på olika aktiviteter? (utgår ifrån hur de schemaläggs)
 - Frågor kring läkarschemat. Jag har med mig schemat som jag fick av dig, så utgår vi från det.
 - På närsjukvården gjorde de ju undersökningen av hur ssk och usk fördelar sin tid, där de delat upp de olika aktiviteterna enligt följande:
 - **Direkt vård:** Alla aktiviteter där medarbetare och patient är närvarande samtidigt t ex tvättning, behandling, information osv.
 - **Indirekt vård:** Avser en viss speciell patient, men patienten är inte närvarande när aktiviteten utförs t ex dokumentation, kommunikation med anhöriga per telefon osv.
 - **Systemrelaterad aktivitet:** Gemensamt för alla patienter ex städning, förrådsarbete osv. Avser även pauser, väntetider osv.
 - Kan man göra någon form av uppskattning på hur läkarna fördelar sin tid enligt ovan?

Respondent 14

Torsdag kl 13.45

Chefssekreterare ortopedern

Berätta lite mer om de olika uppgifterna som läkarsekreterarna utför

Finns det fler administrativa som jobbar med flödet? Hur många och vad gör de?

Respondent 23

Torsdag kl 13.00
Medicinnmottagning, IVÖ

- Lite kort allmän information om flödet på mottagningen.
- Hur många anställda, heltid?
 - Yrkeskategorier? Ssk, usk och övriga (även administrativ personal)
- Fördelning av usk och ssk:s tid på olika aktiviteter? Uppskattning hur det ser ut hos er. Jag har ej tagit del av resultatet på er undersökning men skulle behöva veta på ett ungefär hur ni fördelar tiden?
 - Direkt vård:** Alla aktiviteter där medarbetare och patient är närvarande samtidigt t ex tvättning, behandling, information osv.
 - Indirekt vård:** Avser en viss speciell patient, men patienten är inte närvarande när aktiviteten utförs t ex dokumentation, kommunikation med anhöriga per telefon osv.
 - Systemrelaterad aktivitet:** Gemensamt för alla patienter ex städning, förrådsarbete osv. Avser även pauser, väntetider osv.
- Medelvårdtid i dagar?
- Antalet besök?
 - Nybesök respektive återbesök på er mottagning?