An investigation of how the Emergency Team within UNFPA could achieve a more effective balancing of supply and demand

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Preface

This study is the final part of our diploma in Master of Science in Industrial Engineering and Management at Lund University. We have been working with this case study during approximately six months and it has been a useful experience and a lot of hard work. It has been interesting learning about how a humanitarian organisation is working and meeting people that work with saving lives and help humans in need. We are grateful of have been given this opportunity and hope that this report can contribute to an increase interest in this research area in the future.

This master thesis would not have been possible without help and support from a lot of people. Thanks to everybody involved and the support that has been given, both in provided useful information but also in pushing us to perform better. We would like to give thanks to our supervisors, Marianne Jahre, Lund University, and Joakim Kembro, Lund University. Special thanks to Kristian Nielsen, UNFPA, who has been very engaging in this project and who has given us valuable insights in UNFPA and the Emergency Team.

Lastly, we would like to thank friends and family for supporting us through our five years of studying. It has been tough but most of all it has been a wonderful time in our lives and we will never forget many of the memories and friends from LTH and Lund.

Lund, June 2014

Emelie Krantz

Emma Sandin Hansson

Abstract

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Background: The Emergency Team within UNFPA operates when crisis strikes by distributing ERH-Kits to people in need. The Emergency Team has in the past been criticized of not responding rapidly enough to requests for ERH-Kits and the Executive Director of UNFPA has given new directives that UNFPA needs to become more responsive in its activities and create better prerequisites to deliver fast in emergency situations.

Purpose: To analyse and find improvements for a more effective balancing of supply and demand of ERH-Kits for the Emergency Team within UNFPA.

Research questions: 1: What is important to consider in order to strengthen the balancing of supply and demand regarding the ERH-Kits, while managing the uncertainty in demand and the risk of having expired goods in stock? 2: What factors are important in the development of a support tool and how could this be put together to help the Emergency Team to manage the ERH-Kits?

Methodology: For the purpose of this study, the single case study method is used to enable a comparison of the activities within the Emergency Team and existing theory. Interviews were conducted in order to understand the challenging areas within the team and get a deeper understanding of these. Historical data was also extracted to analyse the activities more thoroughly. When the literature study and the data were collected a gap analysis was done, followed by a workshop to integrate thoughts and ideas from the Emergency Team. The most important potential improvements from this comparison were thereafter used as inputs in the support tool.

Conclusions: The study result is that the two most important areas for balancing supply and demand are Responsiveness and Demand Management. For the Emergency Team the most crucial concepts identified were visibility, velocity, managing inventory and associated risk, performance metrics, understand demand and uncertainty, use various sources of data, establish appropriate forecasting techniques, processes, systems and training and using a cross functional approach. The support tool presents guidance for how the Emergency Team can improve its effectiveness in balancing supply and demand on the three decision levels, strategic, tactical and operational.

Keywords: Supply and Demand, Responsiveness, Demand Management, Humanitarian Logistics, Demand Planning, Forecasting, Inventory Management and Risk Management**.**

Sammanfattning

Titel: En undersökning av hur Emergency Teamet inom UNFPA ska kunna uppnå en effektivare balans mellan tillgång och efterfrågan.

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Handledare: Marianne Jahre, Department of Industrial Management and Logistics, Lund University and Department of Strategy Logistics, BI Norwegian School of Management and Joakim Kembro, Department of Industrial Management and Logistics and Kristian Nielsen, Inventory Management Associate and Global Forecast, UNFPA.

Bakgrund: Emergency Teamet skickar ut ERH-Kits då en efterfrågan från kunden uppstår, exempelvis efter en katastrofsituation. Emergency Teamet har blivit kritiserade för att inte ha svarat tillräckligt snabbt på efterfrågan och därför har Executive Director för UNFPA gett nya direktiv för att UNFPA ska svara snabbare och skapa bättre förutsättningar för att leverera snabbt i katastrofsituationer.

Syfte: Syftet med studien är att identifiera och föreslå förbättringar för en effektivare balansering av tillgång och efterfrågan av ERH-Kits för Emergency Teamet inom UNFPA.

Forskningsfrågor: 1: Vad är viktigt att ta hänsyn till för att stärka balansen mellan hanteringen av tillgång och efterfrågan för ERH-Kits och samtidigt hantera osäkerheten i efterfrågan samt risken av att hålla varor i lager som riskerar att bli för gamla? 2: Vilka faktorer är viktiga för utvecklingen av ett stödverktyg och hur kan detta sättas samman för att hjälpa Emergency Teamet i sin hantering av ERH-Kits?

Metod: Utifrån studiens syfte har en fallstudie genomförts för att jämföra Emergency Teamets aktiviteter med den tillgängliga teorin. Intervjuer utfördes för att förstå de utmaningar som finns för Emergency Teamet och för att få en djupare förståelse för dessa. Historisk data analyserades för en mer noggrann analys av studieobjektet. En jämförelse gjordes därefter mellan litteraturstudien och den empiriska studien för att identifiera potentiella förbättringsåtgärder. I samband med en workshop samlades åsikter och idéer från Emergency Teamet och därefter utvecklades ett beslutsverktyg med syfte att stödja Emergency Teamet i dess arbete för förbättringar.

Slutsatser: Fallstudien har identifierat reaktionsförmåga och efterfrågestyrning som de viktigaste områdena för att balansera tillgång och efterfrågan. De viktigaste faktorerna inom dessa områden för Emergency Teamet har identifierats som; synligheten och hastigheten i värdekedjan, lagerhantering, identifiering av framgångsfaktorer, förståelse för efterfrågan, varierande källor, lämpliga prognosmetoder samt ett krossfunktionellt arbetssätt. Det framtagna beslutsstödet ska ge vägledning för hur Emergency Teamet kan effektivisera balansen mellan tillgång och efterfrågan utifrån de tre beslutsnivåerna, strategisk, taktisk och operationell.

Nyckelord: Tillgång och efterfrågan, lättillgänglighet, efterfrågestyrning, humanitär logistik, efterfrågeplanering, prognostisering, lagerstyrning och riskhantering.

List of acronyms and abbreviations

CO	Country Office
CSB	Commodity Service Branch
EOQ	Economic Order Quantity
ERH-Kit	Emergency Reproductive Health Kit
ERM	Enterprise Risk Management
ERP	Enterprise Resource Planning
HRB	Humanitarian Response Branch
IAWG	Inter-Agency Working Group
ICPD	International Conference on Population Development
IMM	Atlas Inventory Management Module
KPI	Key Performance Indicator
LTA	Long Term Agreement
NGO	Non-Governmental Organisation
PM	Performance Measures
PO	Purchase Order
PSB	UNFPA Procurement Services Branch
RQ	Research Question
UN	United Nations
UNAIDS	The Joint United Nations Programme on HIV and AIDS
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
UNICEF	United Nations (International) Children's Fund
UN Woman Woman	United Nations Entity for Gender Equality and the Empowerment of
USAID	US Agency for International Development
WHO	World Health Organization

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1 Introduction

This initial chapter gives the reader an overview of the project. The background to the study is described and the problem discussion, research purpose and questions along with the focus and delimitations are presented. An introduction of humanitarian logistics and UNFPA are also presented and finally the disposition of the study is described.

1.1 Background

The growing trend in natural and man-made disasters throughout the recent years has resulted in an incremented interest in the area of emergency management (Zeimpekis, Ichoua and Minis 2013). Between 1975-2009 the number of natural disasters increased with a factor of five[1] (Majewski, Navangul and Heigh 2010). One of the most recent natural disasters struck the Philippines on the 8 of November 2013. The storm is the strongest ever registered and affected around 15 million lives, killed thousands and left millions of people homeless. (UNFPA, 2014a) An ongoing man-made disaster is the conflict in Syria, where 9.3 million people are in need of humanitarian aid and more than 2 million people have fled to other countries (USAID, 2014).

When a disaster strikes it is crucial to react fast and be able to deliver emergency supplies rapidly (Zeimpekis, Ichoua and Minis 2013). According to Van Wassenhove (2006) logistics is the most expensive part of a disaster relief and can be the difference between a successful and a failed operation. Humanitarian logistics includes the processes for helping people due to natural disasters and emergencies through the involvement of resources, knowledge and mobilisation of people. Activities covered are customs clearance, procurement, transportation, tracking and tracing and warehousing. (Thomas 2014) These activities may, according to Beamon and Kotleba (2006), be characterised by infrequent constraints and irregular demand patterns that can force every operation to be unique.

Despite the great importance of logistics and supply chain management in humanitarian logistics, the humanitarian organisations have only in the recent decade realised this (Van Wassenhove 2006). The tsunami catastrophe in South Asia in 2004 is one example of an event that has contributed to this interest in the area of logistics from both practitioners and academic researchers (Cozzolino 2012). The catastrophe increased the awareness and understanding of how to manage logistics and supply chain activities (Christopher and Tatham 2011).

Tomasini and Van Wassenhove (2009) mean that typical for humanitarian organisations is that they are governed by donors and funds. Further they cooperate with a large number of actors when managing operations. The lack of profit making motivation and many stakeholders may occasionally result in uncoordinated and spontaneous tasks. This

[1] The Emergency Events Database (EM-DAT). The database is maintained by the Centre of Research on the Epidemiology of Disasters (CRED) who records over six hundred disasters each year.

in combination with the need of fast response can lead to special circumstances like "reinvention of the wheel". This phenomenon can for example result in long lead times. Another issue in this matter is the impact of bureaucratic procedures, which is the case for several United Nations (UN) agencies. (Tomasini and Van Wassenhove 2009) Although logistics in a humanitarian context is much alike the one in private sector, best practice from the private sector is in many cases not applied in humanitarian organisations. Therefore there are great opportunities for improvement in this area and in the future. (Fritz Institute 2014)

A disaster is difficult to predict in terms of time, range and effect, which makes it hard to foresee the demand of emergency supplies that the effects of a disaster will induce (Beamon and Kotleba 2006). Chopra and Meindl (2013) argue that in order to manage demand uncertainty the supply chain needs to be responsive. In addition Lee (2004) argues that agility is crucial to be able to respond to short-term changes. In order to be responsive and having an agile supply chain, forecasting and planning of inventory is crucial. Depending on the lead times of items it might be necessary to keep inventory to be able to respond fast. (Simchi-Levi, Kaminsky and Simchi-Levi 2004) This is however also problematic due to the uncertainties in demand, since there is a risk that the inventory become unusable due to expiration, which may lead to loss of invested capital (Interview 1 2014).

Balancing demand and supply is an essential focus when managing an efficient supply chain (Christopher 2011). Managing an efficient supply chain is a challenging task for many humanitarian organisations due to the fact that they are required to have the capacity to respond fast after a disaster has hit and deliver supply and aid relief (Jahre and Heigh 2008). United Nations Population Fund (UNFPA) PSB Emergency Team struggles with challenging operations and tasks on a daily basis when responding to emergency situations. The customer demand is uncertain, the goods are perishable and at the same time there are financial constraints regarding the amount of money available for holding inventory (Interview 2 2014). These special circumstances make UNFPA PSB Emergency Team's case interesting to investigate further and it is therefore chosen as the research object for this study.

United Nations Population Fund, UNFPA, is a humanitarian organisation working with governments, local organisations and other humanitarian partners to provide universal access to medical care and social support for sexual and reproductive health (UNFPA, 2014b). UNFPA Procurement Service Branch, PSB, is located in Copenhagen, Denmark. Hierarchical situated under the PSB is the Emergency Team, which operates when crisis strikes. (UNFPA, 2014c) The supplies and equipment that are sent in the early phase of a crisis situation are organised into what is called, Emergency Reproductive Health Kits (ERH-Kits) that are specially designed to be used in situations due to war or natural disasters. The ERH-Kits contains essential drugs, supplies and equipment to be used for a limited period of time and a specific number of people. (UNFPA, 2014d)

1.2 Problem definition

UNFPA PSB Emergency Team has in the past been criticised for not responding rapidly enough to requests for ERH-Kits due to stock-outs and long lead times of supply. One of the challenges is the result of the financial constraints that require low risk taking when investing in inventory, and at the same time fulfil incoming orders that are results of emergency situations. The higher inventory level, the higher the risk of losses due to goods expiring. (Interview 1 2014) The difficulties in predicting the future demand due to uncertainties add complexity to the handling of the ERH-Kits (Interview 2 2014). Further, due to limitations in access to reliable and accurate historical demand data, and as demand to a large extent is driven by emergencies (natural or man-made humanitarian disasters), forecasting demand has been limited and only sporadically performed. One of the main contributing factors is for example that the ERP system used by UNFPA does not capture actual demand, whether fulfilled or unfulfilled, but can only provide data for shipped goods. (Interview 1 2014)

The type of problem that UNFPA PSB Emergency Team is facing is not unique for its organisation; the complexity within the humanitarian context creates many challenges for humanitarian organisations to handle. There are previous case studies performed in the area of humanitarian logistics, and one example is a case study on United Nations International Children's Fund (UNICEF) in Uganda concerning how reducing supply-chain complexity may improve health in developing countries. The study were performed by Jahre et al. (2012) and the most important result can be summarised as *"… less supply-chain complexity can produce higher customer service in terms of less stock shortages, while keeping costs down"*. This study is closely connected to one of the problems for UNFPA PSB Emergency Team due to the customer service level and the criticism that has been received for not responding fast enough.

UNFPA PSB Emergency Team manages and keeps ERH-Kits in stock, but the activities are not pure emergency operations. Usually many other UN agencies respond to emergency situation directly and UNFPA comes in as the second tier when the aid operations have already started. New directives from the Executive Director of UNFPA concerns that UNFPA need to work towards becoming more responsive in their activities and create better prerequisites to enable to act and deliver faster in emergency situations. (Interview 3 2014) This is closely connected to the growing pressure on UNFPA regarding the donors' increased interest into knowing and being able to trace the allocation of their donations (Interview 1 2014). In addition, other stakeholders also put pressure on UNFPA for more transparency regarding the organisation's performance about e.g. number of stock outs, which currently is not possible (Interview 2 2014).

The mentioned challenges and difficulties that UNFPA PSB Emergency Team struggles with make the daily tasks challenging to handle. To summarise the problem definition, it is to investigate how UNFPA PSB Emergency Team could improve its balance of supply and demand by identifying the most important factors that contribute to a more efficient response in the context of managing demand uncertainty and financial constraints.

1.3 Research purpose and questions

In order to analyse and find improvements for matching supply and demand for UNFPA PSB Emergency Team's this study is twofold. Firstly the factors for UNFPA PSB Emergency Team's balancing of supply and demand are investigated and analysed and the most important factors are extracted. Due to the context UNFPA PSB Emergency Team is operating in important elements in this case are demand uncertainties and financial risk taking regarding tied up capital. The following research question is formulated with the aim to address the first part of the study.

- What is important to consider in order to strengthen the balance of supply and demand regarding the ERH-Kits, while managing uncertain demand and the risk of having expired goods in stock?

The approach to answer this question is to, through literature study, collection of information and data from UNFPA PSB Emergency Team identify the important factors. Therefore the second part of the study is to, develop a support tool that can help UNFPA PSB Emergency Team with an effective management of supply and demand. The following research question is formulated to address the second part of the study.

- What factors are important in the development of a support tool and how could this be put together to help the Emergency Team to manage the ERH-Kits?

The outcome of the first research question works as a foundation for the answer to the second research question. This in combination with applicable theory assists the authors to design the support tool for UNFPA PSB Emergency Team.

1.4 Research focus and delimitations

The focus is put on UNFPA PSB Emergency Team who from now on is denoted as the Emergency Team. The study is delimited to the Emergency Team's activities and also delimited to only include the inventory regarding the ERH-Kits. A significant part of the study focus on the uncertainty of demand and the ambiguous objectives between taking a financial risk by keeping inventory and the risk of not having the required capacity of supply to respond to inquiries that arises after an emergency situation. The units of analysis are the Emergency Team and the management of its 17 different ERH-Kits.

1.5 Disposition of the report

The study consists of seven chapters; introduction, methodology, theoretical framework, empirical study, analysis, support tool, conclusion, recommendations and future research.

The second chapter, methodology, includes reasoning around methodology and the motivation for the chosen type of research strategy, view and data collection. Chapter 3, theoretical framework, gives the reader an understanding of the existing theory within the chosen research area, and function as a reference for the data collection as well as the analysis. The empirical study in chapter 4 gives knowledge and understanding about the Emergency Team and its activities. Chapter 5 includes the analysis of the material collected and presented in chapter 4, by using the theory presented in chapter 3. In Chapter 6 the support tool is presented along with recommendations for the Emergency

Team. Finally the conclusion and suggestions for future research are presented in chapter 7. The disposition of the report is demonstrated below, Figure 1.1. The circles represent the scope and the focus of the individual sub-parts of the project.

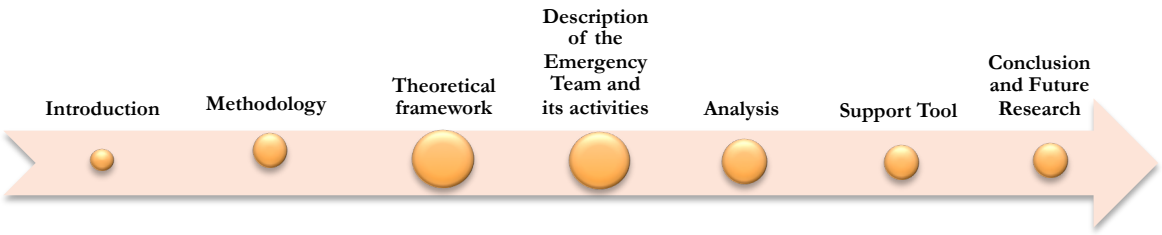

Figure 1.1. Illustration of the disposition of the report (Krantz and Sandin Hansson 2014)

2 Methodology

This second chapter include theory about various methodologies and tools that are applicable when conducting a research study. Every subchapter includes chosen theory and the motivation for this. Alternative theories that are not chosen for this study are also presented. Initially the structure of the chapter is presented and illustrated to make it easier for the reader to follow.

In order to thoroughly understand research results it is essential to understand the frameworks and methodologies chosen for the specific research. Presenting the methodology in every research study increases the understanding and credibility of previous research as well as how to continue in the future. (Gammelgaard 2004) According to Denscombe (1998) it is difficult to go back and start from the beginning as soon as the approach is decided for the research, which is why much emphasise is put into this chapter.

The structure for this chapter can be seen in Figure 2.1. Firstly, the Research Strategy is presented to get an overview of the chosen strategy and how this is connected to the purpose and the research questions. Secondly the Scientific View is explained followed by the Research Approach and the different Research Focus methods. Section 2.5 presents the Research Design for the study where the data collection is introduced. The next section describes the Data Collection process in detail followed by the Quality of the Study Result where various ways to enhance the credibility of the study is presented.

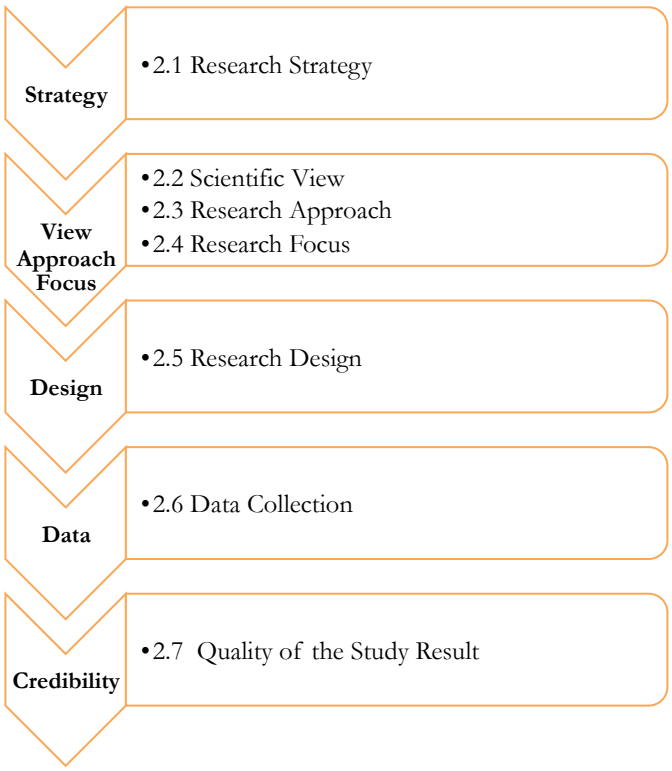

Figure 2.1. Structure of Methodology (Krantz and Sandin Hansson 2014)

2.1 Research Strategy

According to Yin (2003) the answers to the three following questions; 1. Form of research question?, 2. Requires control of behavioural events?, and 3. Focuses on contemporary events?, determines what research strategy that is best suitable for a specific study. A summary of Yin's (2003) suggestions regarding what strategy that best fit each answer is presented in Table 2.1.

Table 2.1. Summary of Research Methods (Yin 2003)

Method	Form of research question	Requires control of behavioural events?	Focuses on contemporary events?
Experiment	How, why?	yes	yes
Survey	Who, what, where, how many, how much?	no	yes
Archival Analysis	Who, what, where, how many, how much?	no	yes/no
History	How, why?	no	no
Case study	How, why?	no	yes

After briefly viewing the questions formulated by Yin (2003) and comparing them with the formulated purpose of the study in Chapter 1 the authors found that, a survey, a case study or archival analysis could be suitable strategies. This since the study did not require control of behavioural events but rather focused on contemporary events. However, when studying the different research strategies more thoroughly the case study strategy was considered to be the best choice. For example focus was not put on archival records from a database and therefore this strategy was excluded. Neither was all the data collected at a certain moment nor the analysis in the study focused on a snapshot. According to Denscombe (1998) these are characteristics of a survey strategy and therefore this strategy as well was rejected. The research questions formulated for this study are open and concerns what factors that are important for a specific situation or tool, and are therefore considered suitable for a case study by the authors.

Another motive for the choice of case study is that this research strategy allows the researchers to understand characteristics of a real life event (Yin 2003). Further various methods for collecting data were used which according to (Yin 2003) is one of the strengths with case study. This strategy was also considered to be suitable since a case study according to Denscombe (1998) not only focuses on the result of the outcome but rather on why the results occur, which is an effect of that case studies often focus on processes and relations which makes it possible to dig deeper in the complexity for understanding a problem. Another advantage with the case study is that it is suitable for a small-scale research. However, it is important to be aware of the disadvantages that a case study can have, which are the challenges for the reliability of the generalisations, criticism of not fulfilling the requirements on research and difficulties in defining the scope and the limits of the study. (Denscombe 1998)

Depending on the mission that the researchers seek to achieve the number of case studies is chosen. When considering a multiple case study the result is a comparison between the studies, demonstrated in similarities and differences. A single case study is

further developed and analysed regarding a comparison with the theory. (Ellram 1996) This study is focusing on the comparison between theory and reality and therefore a single case study is most suitable.

2.2 Scientific View

Arbnor and Bjerke (2009) mean that depending on the choice of scientific view, various interpretations about the reality can be made and different models and theories can be developed. Arbnor and Bjerke (2009) have formulated a framework containing three methodological views to consider when deciding on the scientific view of a study.

The purpose of this study is to evaluate potential improvements for how to balance the supply and demand of emergency supplies in an Emergency Team within a humanitarian organisation. It is also to, with the result from the evaluation, develop a support tool for the organisation. To fulfil this purpose the authors needed to understand different aspects affecting this area, the relationship between them, and therefore a holistic view was preferred. Arbnor and Bjerke (2009) state that when aiming for a holistic view and when the objective is to view all components in the reality as in a system, the system approach is the most suitable approach. To achieve this, the relation between each component in the system needs to be identified in order to suggest improvements and recommendations.

To meet the purpose and answer the research questions both qualitative and quantitative studies were necessary, also interaction with the study object as well as observations was needed. This correlates with the characteristics that Arbnor and Bjerke (2009) mention when using the systems approach. They mean that it is not enough to only explain the reality, thus the reality also needs to be understood, which implies that both qualitative and quantitative studies are suitable. When using this approach the investigator generally observes the research object from the outside when gathering information. Nevertheless the pragmatism implies the opposite meaning that the researcher should interact with the research object. With these aspects in mind the authors' choice for this study was to adopt the systems approach. The system of this case study consists of the Emergency Team and all the actors around the team. The Emergency Team operates in a complex system and therefore it is important to map the connections to understand the context it acts in and the constraints of the managing of ERH-Kits for an improved quality of the overall result.

The two other approaches presented by Arbnor and Bjerke (2009) are the analytical approach and the actors approach. The first of these two is characterised by that it explains the objective reality, the presumption is that the reality can be separated down to the smallest components and each component can be tested and presented alone. In the second of these approaches the aim is to understand the reality, which is done by viewing different actors through qualitative studies. (Arbnor and Bjerke 2009) A short presentation of the three approaches can be seen in Table 2.2

Table 2.2. The Arbnor and Bjerke Framework (2009)

	Analytical approach	Systems approach	Actors approach
Theory type	Determining cause-effect relations. Explanations, predictions. Universal time and value free laws	Models, Recommendations, normative aspects. Knowledge about concrete systems	Interpretations, understanding. Contextual knowledge
Preferred method	Quantitative (qualitative research only for validation)	Case studies (qualitative and quantitative)	Qualitative
Unit of analysis	Concepts and their relations	Systems: links, feedback mechanisms and boundaries	People - and their interaction
Data Analysis	Description, hypothesis testing	Mapping, modelling	Interpretation
Position of the researcher	Outside	Preferably outside	Inside - as part of the process

2.3 Research Approach

The authors' focus is on understanding and building theory from the case study and compares this to the already existing theory. The reason for this is that the existing theory about Responsiveness and Demand Management in a humanitarian context is unsufficient. In addition these activities within the Emergency Team are today not very comprehensive. The approach for this study is therefore abductive since the authors move in between observations and theory and manage a lot of information towards the aim of developing a support tool. An abductive approach is a form of logical inference according to Queiroz and Merrell (2005) and it is described by Pierce, Charles S. as "*the process of forming explanatory hypotheses*".

The abductive approach has emerged from the fact that most of the scientific growth does not come from neither an inductive nor a deductive approach (Taylor, Fischer and Dufresne 2002). A deductive approach is the most common in the relation between theory and practice when it comes to Social Sciences. (Bryman 2008) The deductive reasoning is the use of a general law that is applied on a certain case. (Taylor, Fischer and Dufresne 2002) On the contrary, in an inductive approach the theory is the result that leads from observations (Bryman 2008). Characteristics of the deductive learning are rule-based, applies a theory, proceeds from the general to the specifics, conclusions are certain and teaching is more structured (Whetten and Clark 1996). Typical for the inductive approach is that it is example or experience based, conclusions are probable and not certain, the theory is built and not applied and that teaching is less structured. (Whetten and Clark 1996)

2.4 Research Focus

Björklund and Paulsson (2012) argue that when conducting a research study the current knowledge about the research area often determines what focus the study will have. To

understand how the Emergency Team can improve its balancing of supply and demand the overall focus of this study was to use an explanatory focus. The study consisted of different sub parts and therefore it was considered that various focuses were suitable for different parts.

Initially an exploratory focus was applied to get an understanding of the problem background and find what data that was available for the analysis. Björklund and Paulsson (2012) state that in addition to the above mentioned situation an exploratory focus can also be used during a study, when more understanding and knowledge about an area is necessary, to be able to proceed with the study. Secondly an explanatory focus was used, which according to Lekvall and Wahlbin (2001) give deeper understanding and clarify the relations of events thoroughly, since it both describes and explains a situation. The aim with this choice of focus was therefore to get a deep understanding of the Emergency Team's activities.

Further, when the authors had the required information needed for the analysis the focus changed to a normative focus. This since the second purpose for the study was to give recommendations by developing a support tool that can guide the Emergency Team towards a more effective balancing of supply and demand. The normative focus aims to suggest improvements and give guidance when certain knowledge within the area already exists (Björklund and Paulsson 2012).

2.5 Research Design

The research design for this study shows all the activities performed in the study. It was developed by the authors with the aim to meet the research purpose and answer the formulated research questions. The research design is presented in Figure 2.2. Initially a literature review was performed in order to build up an understanding of previous research in the area of humanitarian logistics and to start understand the challenges within the context. The databases used were EBSCO and Google Scholar, the keywords used were humanitarian logistics, emergency and disaster management. Research articles, e-books, printed books and web sites were used for the collection of information. At the same time the authors performed exploratory interviews with selected representatives from UNFPA in order to understand the background of the problems and challenges for the Emergency Team with its managing of ERH-Kits. The result of the initial review served together with the exploratory interviews as the foundation for the background and problem formulation of the study.

Further a more thorough literature review was performed with the aim to identify definitions and theories to create the theoretical framework in order to build a suitable framework for the analysis. The start point of the review was to understand and find theories regarding management of demand and supply involving demand planning, uncertainties in demand, risk taking, inventory management and responsiveness. The same databases were used for this part as for the first, EBSCO and Google Scholar. Keywords mostly used for this part were supply and demand, responsiveness, demand management, humanitarian logistics, demand planning, forecasting, risk management and inventory management. These keywords were often combined with humanitarian

logistics in order to find the most suitable theory within the area. However, this combination resulted often in an inadequate outcome. The theories and knowledge extracted for this part of the study also came from research articles and books. This was done in order to build a trustworthy base of theories for the analysis in chapter 5, to ensure the quality of the study.

The collection of empirical data was then performed using different methods that are explained and discussed in section 2.7. The gathered data was thereafter analysed by using the Theoretical Framework for Analysis. The result and outcome of the analysis was thereafter used to develop a support tool. In the development of the support tool a workshop was held to integrate the ideas and thoughts from the Supply Chain Coordinator, the Inventory Management Associate and Global Forecast and the Demand Planner and Inventory Associate into the support tool. The workshop developed into a group discussion. A group discussion is when a group of people together develops opinions under mutual interference (Holme and Solvang 1991). The authors wanted to create a situation where the individuals could be open about their opinions and discuss these with each other, to potentially raise ideas for improvements. The workshop had the Theoretical Framework for Analysis as its basis and starting point.

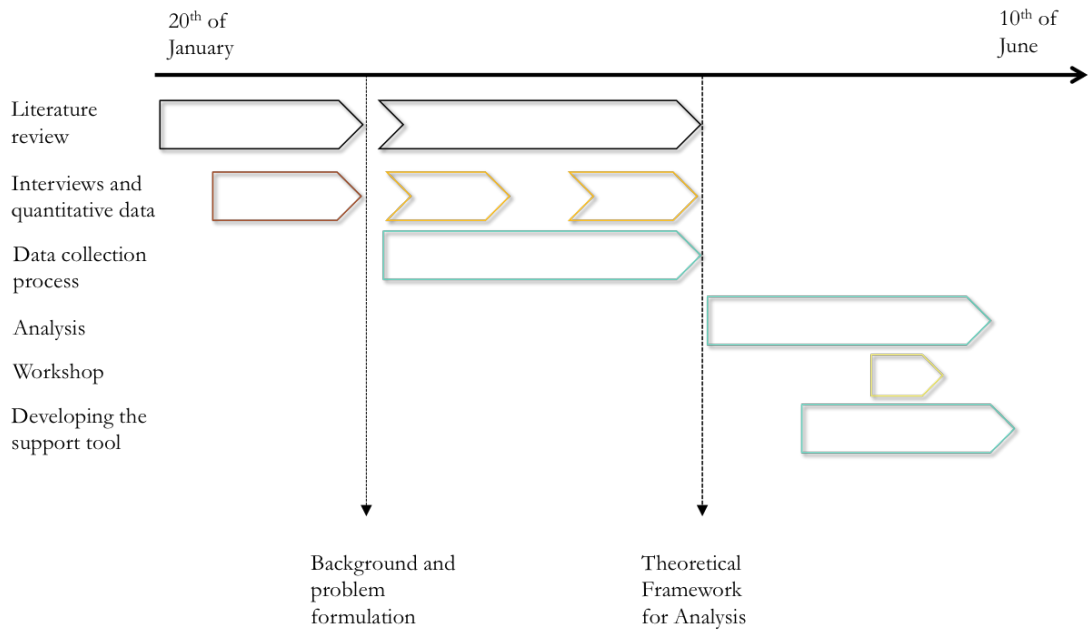

Figure 2.2. Research Design (Krantz and Sandin Hansson 2014)

2.6 Data Collection

When performing a research study the data collection process is of great importance since it very much affects the result and conclusions of the study. Collection of data can be done in several ways. In order to answer the research questions formulated to fulfill the purpose of the study, various types of data collection methods were used for this study. The data collection process with its events is presented in Figure 2.3.

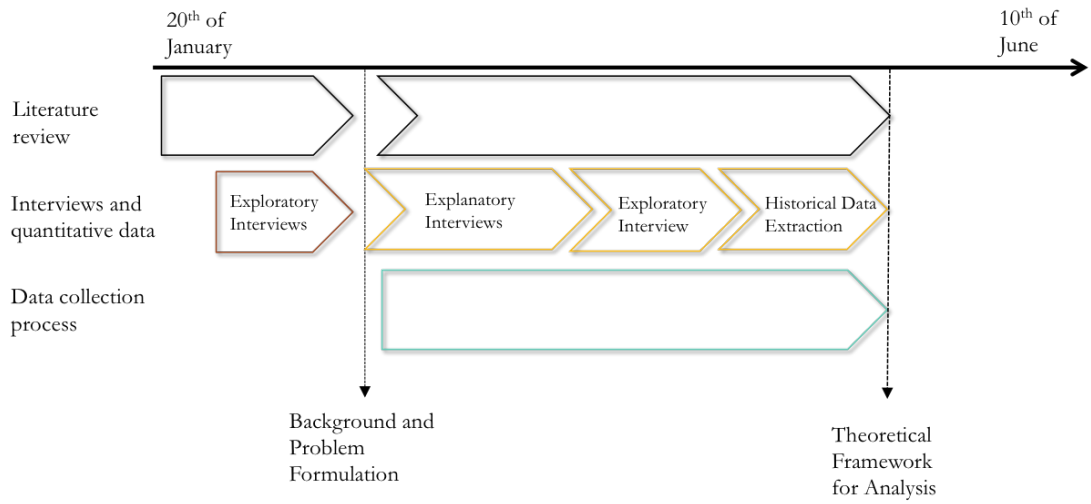

Figure 2.3. Data Collection Process (Krantz and Sandin Hansson 2014)

To increase the trustworthiness for a case study there are, according to Yin (2003), three principles to follow when performing the data collection; Use Multiple Sources of Evidence, Create a Case Study Database and Maintain a Chain of Evidence. The first principle is about using several points of reference to strengthen the data collection result. This principle is described more thoroughly in section 2.6.4. The second principle concerns the organisation of documentation and data. The last principle stresses that the reliability of a study arises when it is possible from an external observer's perspective to follow and trace all steps in a case study in both directions hence from start to conclusion and vice versa. (Yin, 2003)

In order to answer the research questions formulated in this study both a quantitative and a qualitative approach was adopted. According to Eisenhardt (1989) quantitative and qualitative data can in combination create synergies. The quantitative analysis emphasise quants in the data collection, while the qualitative research emphasises the importance of the spoken word. (Bryman 2008) However, according to Denscombe (1998) it is difficult to distinct the research into these divisions. This since both of them often are applied in practice and the theoretical distinction between them are too simplified. Björklund and Paulsson (2012) argue that a quantitative analysis is limited in terms of that not everything can be measured and that a qualitative analysis can create a deeper knowledge. In this case study the qualitative studies were performed to obtain an understanding and gain a deeper knowledge of the problem area. Further, in order to investigate the operations more thoroughly a quantitative study was applied throughout the analysis of the historical data.

2.6.1 Literature Analysis

The study used a wide amount of theory from different sources to compare with the empirical data and evaluate similarities and differences. Björklund and Paulsson (2012) define literature as all written material and the extracted information is considered as secondary data. Literature is often extracted from databases and the choice of database and search word affects the result of the literature analysis.

The literature used for the study was gathered, as mentioned in the research design, in section 2.5 from research articles, e-books, printed books and web sites. The literature analysis according to Höst et al. (2006) is considered to be a very important part of the study because it often determines the basis for the study. Therefore the authors have studied literature in two rounds as described in section 2.5 research design. The scope extends over many different fields of research, which results in a lot of literature studying that is reflected in the number of references used. Due to the unsufficient existing literature in many affected areas of this study and the specific situation the research object is operating in, it was chosen to explore Humanitarian Logistics separately from Responsiveness and Demand Management. The most important features from Humanitarian Logistics were thereafter integrated in the analysis and in the development of the support tool. This method is strengthening by literature that argues for the importance of learning from companies in humanitarian organisations (Cozzolino 2012).

2.6.2 Interviews

In this case study interviews have been used as a data collection method. An interview can be performed either individually or in groups and is carried out through that the interviewer asks the respondent questions. (Lekvall and Wahlbin 2001) Further interviews are performed since conducting interviews gives, according to Björklund and Paulsson (2012), the possibility to understand the research area more thoroughly because it is possible to adjust the questions for each respondent as well observing the respondent's body language and reactions. Höst et al. (2006) mean that there are three various ways that interviews can be organised in; structured, semi-structured and unstructured, their characteristics are summarised in Table 2.3.

Table 2.3. Three various ways that interviews can be organised in (Höst et al. 2006)

	Structured interview	**Semi-structured interview**	**Unstructured interview**
Purpose	Descriptive or/and explanatory	Descriptive or/and explanatory	Exploratory
Type of questions	Pre-decided	Pre-decided and open	Constructed during the interview

This case study used semi-structured interviews to get an understanding of UNFPA, the Emergency Team and activities regarding Responsiveness and Demand Management of ERH-Kits. Also a structured interview and an unstructured interview were held with the purpose to extract certain information and for a more exploratory approach. All interviews held were performed at the UN-City office in Copenhagen, except from the interview held with the Contracting Assistant that was executed through a video call. During the interviews one of the authors was the interviewer while the other one documented the interview by taking notes and recording. These tasks have shifted among the authors between the different interviews. The recorded material was transcribed after the interview and a summary of the transcribed material was sent to each interviewee for validation. An overview of the interviews held can be seen in Table 2.4, and the interview guides can be found in Appendix 2.

Table 2.4. Summary of held interviews (Krantz and Sandin Hansson 2014)

Interviewee Position	Interview date	Duration time	Type of interview	Information gathered about
Inventory Management Associate and Global Forecast	2014-02-05	50 min	Semi-structured	The processes and challenges within demand planning
Demand Planner and Inventory Associate (Former Procurement assistant within the Emergency Team)	2014-02-05	45 min	Semi-structured	The operational work and the daily challenges
Supply Chain Coordinator	2014-03-17	25 min	Unstructured	Understand the Emergency Team and its problem areas
Inventory Management Associate and Global Forecast, and Demand Planner and Inventory Associate	2014-03-17	100 min	Structured	The ERP-system and additional information regarding the Emergency Team's processes
Supply Chain Coordinator	2014-04-03	20 min	Semi-structured	Understanding the strategy and goals for the Emergency Team
Finance Specialist for PSB	2014-04-03	60 min	Semi-structured	Understanding the financial regulation of the ERH-Kits
Contracting Assistant	2014-04-16	50 min	Semi-structured	Understanding the contracting of suppliers and the challenges

In the first round of interviews three interviews in total were held, in order to understand the background of the study and problem as well as to narrow down the purpose and set the scope. The first two interviews were held with Inventory Management Associate and Global Forecast and Demand Planner and Inventory Associate. To identify the challenging areas and understand all problems these interviews started with a few pre-decided questions. The respondents were asked to elaborate and explain further in areas where they felt it could provide additional value in the process of understanding. The third interview was held with the Supply Chain Coordinator. The aim was to get an understanding for the problems and the organisation and therefore the interviewee was asked to discuss around the Emergency Team, their tasks and issues.

Thereafter the chosen interview objects for the second round of interviews were based on the purpose of the study. The interest in Responsiveness, Demand Management and Inventory Management, as well as in the daily operations resulted in that interviews were held with the Inventory Management Associate and Global Forecast and the Demand planner and Inventory Associate within the Emergency Team. The authors wanted to get a better understanding of the Emergency Team's strategy and goals and therefore the

Supply Chain Coordinator was interviewed once again. For further insights into the Emergency Team's financial set-up the Finance Specialist for PSB was interviewed. The last interview was held with a contracting assistant involved in the contracting of ERH-Kits to understand the contracting and relationship to the suppliers.

Further complementary conversations were performed with the Inventory Management Associate and Global Forecast and Demand Planner and Inventory Associate to sort out queries arisen after the interviews.

2.6.3 Historical data from UNFPA PSB Emergency Team's ERP-system

Data regarding the ERH-Kits were extracted from the ERP-system by the Emergency Team and given to the authors in order to analyse the ERH-Kits. This secondary data was analysed by using Microsoft Excel. A summary of the type of extracted data, when and why the data was chosen can be seen in Table 2.5.

Table 2.5. Summary of extracted historical data (Krantz and Sandin Hansson 2014)

Type of Data	Date of reception	Purpose of data
Item transaction detail ERH-Kits	2014-02-06	To analyse the approximate historical demand pattern and to calculate the changes in inventory levels for the ERH-Kits
ERH-Kits monthly balance	2014-05-26	To calculate the monthly inventory levels per type of ERH-Kit
Supplier metrics- replenishment orders	2014-05-26	To calculate the Lead Time for every ERH-Kits, and every PO. This data in combination with the ERH-Kits monthly balance was used to calculate the historical balance in the revolving fund

Other data collection methods that could have been used in this case study are Questionnaires and Observations. Questionnaires were not applied because of the fact that the study is not interested in extract information from large group of respondents. An observation is very time consuming and when performing an observation the observer can either observe the object or event from the outside or participate in the event. The performance of the observation can either be announced or be carried out unannounced. (Björklund and Paulsson 2012) Even though this case study did not use observations as a method, the study was influenced by this methodology during one of the interviews were the interviewee demonstrated how the ERP system works.

2.6.4 Triangulation

In this case study triangulation has been used to strengthen the data of the result. Denzin (2009) defines triangulation as *"the combination of methodologies in the study of the same phenomenon"*. Yin (2003) argues that the possibility of using several reference points in a case study is positive for the result since it gives a wider perspective. Yin (2003) also stresses that using several reference points probably increases the accuracy of a case study. Denzin (2009) presented four different types of triangulation; Data triangulation, Investigator triangulation, Theoretical triangulation and Methodological triangulation. The first mentioned entails the collection of data from different times and from a variety of people. The second type deals with the use of more than one researcher to interpret

data. The third refers to the use of more than one type of theory for the interpretation meanwhile the last one regards the use of more than one method for collecting data. (Denzin 2009)

The method of using several reference points in this study is illustrated in Figure 2.4. This case study is practicing triangulation on collecting data from several different actors both within the Emergency Team as well as from the outside of the team, e.g. Demand Planner and Inventory Associate, Supply Chain Coordinator, Historical Data. It also involves both a quantitative and a qualitative analysis, which contribute to the use of different methods to collect data. Further two people have performed this study and contributed to the collection of data. Additionally for the collection of information for the theoretical approach many different sources are used. An example of what result that is likely to occur if triangulation is not used according to Yin (2013) is that the conclusions are made based on just a single reference point and the result might therefore not be completely accurate.

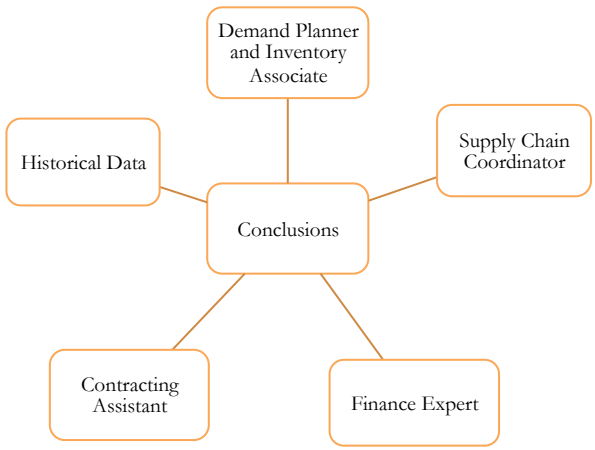

Figure 2.4. Triangulation Illustration (Krantz and Sandin Hansson 2014, inspired by Yin 2003)

2.7 Quality of the Study

Different authors suggest various aspects that are important when evaluating the credibility of a research study. The credibility of this study is well supported, firstly since triangulation has been used in various ways during the study. The information and data used in the study is gathered from interviews, the organisations web page, research articles and books from Lund University Library. According to Björklund and Paulsson (2012) there are three important aspects to consider regarding the credibility; Validity and Reliability and Objectivity.

Validity measures if and how well the domain focus of the research is investigated. There are a number of different types of validity, e.g. face validity, concurrent validity, construct validity, predictive validity, and convergent validity. (Bryman 2008) In order to validate the information used in the study that was gathered from interviews, the report and interview transcripts were sent to the respondents to approve the written information.

To achieve a holistic view, objectivity, and accurate information for the study the interviewees were carefully selected.

Reliability is the measurement that evaluates how consistent the results are and how accurate the study is if it is performed again. This is often interesting when dealing with a quantitative approach. (Bryman 2008) Bryman argues that reliability can be measured through; stability, internal reliability and the conformity of different observatories. (Bryman 2008) Reliability in this study is achieved by a well-structured data collection. In addition the case study protocol that was conducted from the authors strengthen the reliability of the study.

According to Björklund and Paulsson (2012) objectivity means into what extent the result of a research study is affected by the researchers own values. Also the selections and delimitations during the theoretical study and data collection affect the objectivity of the result (Höst et al. 2011). Objectivity in the study was reached through interviewing different people in the organisation regarding the same research area and by asking similar questions.

Yin (2003) argues that in order to assess the quality of a scientific study there are four tests that generally are performed; Construct Validity, Internal Validity, External Validity, and Reliability. A summary of the tests conducted in this study is viewed in Table 2.6.

Table 2.6. Quality Tests of this Case Study (Krantz and Sandin Hansson 2014, inspired by Yin 2003)

Tests		Case Study Tactic	Phase of research in which tactic occurs
Construct Validity	1	Use multiple sources of evidence	Data collection
	2	Establish chain of evidence	Data collection
	3	Have key informants review draft case study report	Composition
Internal Validity	4	Do explanation-building	Data analysis
External Validity	5	Use theory in single-case studies	Research design
Reliability	6	Use case study protocol	Data collection
	7	Develop case study database	Data collection

Tactics used for the first test, Construct Validity, in this case study were multiple sources of evidence, establishing chain of evidence and have key informants to review draft of the report. Multiple sources of evidence were accomplished by the diversification of interviewees and the usage of quantitative data. Establish chain of evidence was done through the creation of the research design, which gives the possibility for the reader to follow the research process. Lastly, to meet the third tactic representatives from UNFPA as well as academic supervisors reviewed drafts of the case study report. For the test regarding internal validity the tactic used was to explain the situation regarding the balancing of demand and supply.

For the external validity test, theory was used for the study, further the unit of analysis in this case study is not considered to be generalizable within UNFPA since the other procurement teams are working with other prerequisites. However it might be generalizable to other organisations that work with procurement and selling transactions of emergency supplies. To make sure that the study is reliable a protocol was written for all activities performed during the research. Reliability was also achieved by gathering all the collected data at the same place.

3 Theoretical framework

This chapter presents the theoretical framework that this study is built upon. The chapter starts with an introduction to supply and demand to identify the most essential features regarding this. In the end of the chapter the Theoretical Framework for Analysis is presented.

The simplest supply chain often consists of an organisation or company and its closest supplier and customer (Mentzer et al. 2001). Further Chopra and Meindl (2013) mean that a supply chain actually often is constructed as a network rather than as a chain that the name implies, because of the many actors that can be involved, a manufacturer can for example have several suppliers. Within a supply chain there are various stages and activities and when managing a supply chain balancing supply and demand is the essential target (Chopra and Meindl 2013; Christopher 2011).

Christopher (2011) likens this match of demand and supply with a fulcrum and means that it is the point where it is decided on the volume and mix to source and ship. The aim is to take decisions as late as possible. The supply chain fulcrum is illustrated as seen in Figure 3.1 below. On one side the demand is represented and on the other the supply including inventory and supplier capacity is represented. If the fulcrum is moved in any direction the level of demand or/and supply needs to be adjusted in order to keep the balance.

Figure 3.1. The Supply Chain Fulcrum (Christopher 2011)

Figure 3.2. The Supply Chain Fulcrum moved towards the demand (Christopher 2011)

In Figure 3.2 the fulcrum is moved closer to the demand, this results in that the same amount of demand can be balanced with less inventory and/or less capacity. Often companies face the opposite situation where the fulcrum is moved towards capacity and inventory and there is a need for balancing against the demand by increasing inventory and capacity. (Christopher 2011) To enable a movement of the fulcrum towards the demand, it is necessary with a more effective Demand Management and an increase in Responsiveness. Demand Management is described as a set of tools and procedures that facilitate a more effective balancing of demand and supply that is achieved by the understanding of the causes of demand volatility (Christopher 2011). To enable the ability of Responsiveness Fisher (1997) means that inventory could be managed and

according to Simchi-Levi, Kaminsky and Simchi-Levi (2004) inventory is crucial for Responsiveness. When considering inventory and stock it is also important to understand the risk connected, such as overstocking and stock outs (lost sales). (Borghesi and Gaudenzi 2013) This argumentation led to that Inventory Management and risk taking are presented as parts of Responsiveness in section 3.2.

To summarise the most important factors for an effective balancing of demand and supply the authors have identified Responsiveness and Demand Management as the most important concepts. Figure 3.3 illustrates the main areas presented in this chapter. The theory begins with an introduction to Humanitarian Logistics in section 3.1 to give the reader an understanding of the context. Thereafter the chapter continues with presenting Responsiveness, section 3.2 and as described above this section includes Inventory Management and risk taking regarding inventory. The next subchapter is section 3.3 that describes Demand Management. Lastly, a summary of the most important factors from this chapter is presented and these factors are later used as a basis for the data collection, analysis, and answer to RQ1 and RQ2.

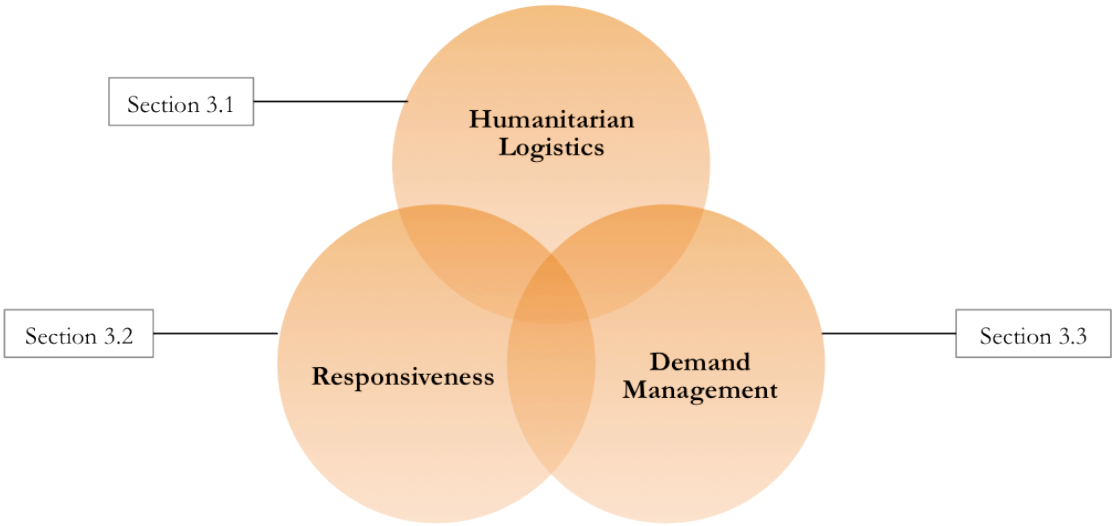

Figure 3.3. Illustration of the main areas of the chapter (Krantz and Sandin Hansson 2014)

3.1 Humanitarian Logistics

Humanitarian logistics is defined by Van Wassenhove (2006) as,*"…the processes and systems involved in mobilizing people, resources, skills and knowledge to help vulnerable people affected by disaster"*. Cozzolino (2012) argues that managing logistics and the supply chain is crucial for setting the disaster response. To achieve this Cozzolino (2012) means that the integration of actors and good coordination enables maximising the efficiency along the supply chain. After closely observing the aid operations after the Haiti earthquake in 2010 Beiser (2010), say that humanitarian logistics is a discipline that lives somewhere between the ultrahigh-speed, money-is-no-object requirements of a military campaign and the customer-focused, margin-cutting focus of a commercial supply chain. There are several challenges connected to humanitarian logistics, Jahre and Heigh (2008) mention the requirement of answering to a disaster within hours after is has struck and being able to do so by delivering relief goods and provide resources regardless of where in the world the disaster has struck. Other comments about humanitarian logistics are that it is

highly dynamic, innovative and characterised by high levels of uncertainty in demand and supplies. Further the operational conditions are complex and the climate is often politically volatile. (Kumar, Latif and Daver 2012)

Thomas and Kopczak (2005) discuss the issue concerning funding and say that it is not seldom the donated money is linked to a certain disaster which obstruct the long term work regarding strategies and preparedness. Therefore investments in systems and processes are difficult to do (Thomas and Kopczak 2005). Jahre and Heigh (2008), also stresses the issue with inappropriate and undesirable donations of items. Another factor is that most of the donations are made when a disaster struck which obstruct the preparedness work since the aid operations cannot begin until funding become available (Balcik et al. 2010). Further the problem with coordination is a factor that is discussed as a big challenge for the humanitarian logistics work. There are many actors involved and the environment is unregulated in terms of the controlling of the aid operations. Various motives, constraints along with communication challenges are factors that obstruct the coordination in between actors. (Balcik et al. 2010) Six elements that are considered to summarise the characteristics of humanitarian logistics are; Ambiguous objectives, Limited resources, High uncertainty, Urgency, Politicized Environment and Speed (Tomasini and Van Wassenhove 2009).

The procurement of goods often consists of 65% of the total disaster relief budget. Procurement in humanitarian organisations is the activities that involves that the humanitarian organisation acquire relief supply and pay the suppliers for the supply. Table 3.1 presents various differences between commercial logistics and humanitarian logistics that contribute to the complexity of humanitarian procurement, such as the funding mechanism, donor expectations, unpredictability of disasters and the diversity of stakeholders. (Zeimpekis, Ichoua and Minis 2013) While the overall logistics has moved to a more interest in reducing cost through lean processes humanitarian logistics has focused on Responsiveness and agile supply chains (Jahre and Jensen 2009). More attention among the humanitarian aid organisations is also devoted to measure the performance of the aid operations. However deficient existence of information about performance and the lack of literature about the topic are reasons for the slow evolvement. (Galasso et al. 2013)

Table 3.1. Comparison of commercial and humanitarian logistics (inspired by Zeimpekis, Ichoua and Minis 2013)

Topic	Commercial logistics	Humanitarian logistics
Main objective	Maximise profit	Save lives and help beneficiaries
Demand pattern	Fairly stable and can be predicted with forecasting techniques	Irregular with respect to quantity, time, and place. Demand is estimated within the first hours of response
Supply pattern	Mostly predictable	Cash is donated for procurement.
Flow type	Commercial products	Resources like people, shelter, food, hygiene kits, etc.
Lead time	Mostly predetermined	Approximately zero lead time, demand is needed immediately
Inventory control	Safety stocks for certain service levels can be found easily when demand and supply pattern is given	Unpredictable demand pattern makes inventory control challenging. Pre-positioned inventories are usually insufficient
Technology and information systems	Highly developed technology is used with commercial software packages	Less technology is used, few software packages that can record and track logistics data. Data network is non-existent
Performance measurement method	Based on standard supply chain metrics	Time to respond to the disaster, fill rate, percentage of demand supplied fully, meeting donor expectation
Stakeholders	Shareholders, customers, suppliers	Donors, governments, military, NGOs, beneficiaries, United Nations etc.

Good preparations are essential to enable a successful and effective response in urgent situations (Van Wassenhove 2006). Emergencies and disasters are linked to each other by the capabilities of the established emergency services. For instance, when the response requirements of an emergency event exceed the capabilities of the already established emergency services the event is classified as a disaster. (Haddow, Bullock and Coppola 2011) There are various kinds of disasters and they can be separated into natural disasters and man-made disasters. The two types of disasters can be both slow onset and sudden onset. As an example a sudden onset natural disaster can be a tsunami and a slow onset man-made disaster can be a political crisis. (Van Wassenhove 2006)

According to Ammann (2008) the tasks of managing emergency situations and disasters should be a permanent process with clear resource allocation, responsibilities and delegation of tasks. The process is in need for a clear strategy, involve all stakeholders and risk scenarios. Kovács and Spens (2007) argue that disaster management consists of three parts; preparation phase, response phase and the reconstruction phase, see Figure 3.4. (Zeimpekis, Ichoua and Minis 2013) Cozzolino (2012) name the three steps preparation, response and reconstruction the humanitarian logistics stream, see illustration in Figure 3.4. Seydin, Ryan and Keshtgar (2011) argue that planning and training are crucial in the preparation for aid operations in response to disasters. The purpose of disaster management planning is to enable management to make qualitative decisions under time pressure while avoiding or minimising injury. (Seydin, Ryan and Keshtgar 2011)

Figure 3.4. The Humanitarian Logistics Stream (Cozzolino 2012)

There are generally three types of disaster planning methods; comprehensive disaster management planning, business continuity planning, and contingency planning. The comprehensive disaster management planning concerns how an organisation helps its clients to manage disasters, while business continuity planning concerns the way the organisation itself manages the outcome of a disaster. (Seydin, Ryan and Keshtgar 2011) Contingency planning can be explained as the process of creating strategies and methods to use for devised potential situations, in order to provide aid to the victims of a crisis. Mainly there are three types of methods for contingency planning, scenario planning, preparedness planning and all-hazards emergency planning. The most common type of planning is the scenario planning which is the process of building scenarios to create a response plan. (Choularton 2007) Seydin, Ryan and Keshtgar (2011) write that scenario planning must be reflected in contingency planning. Scenarios are often used as a base for the preparedness planning. The goal with the preparedness plan is to make the emergency response more effective. This is to be achieved through the analysis of gaps and challenges in the emergency response with the aim to decrease the gaps. All-hazards emergency plans often consist of standard procedures to direct emergency response. This type of planning is common in governmental emergency management organisations and clarifies the responsibility and the division of roles. (Choularton 2007)

One part of the preparation concerns forecasting and Kumar, Latif and Daver (2012) mean that forecasting cannot be managed without mathematical models and tools. It has been shown that a relatively small number of statistical distributions satisfy most needs in emergency logistics planning, one of these is the exponential distribution. It has become apparent that the number of disasters reported between 1900-2011 is exponential increasing with respect to time. (Kumar, Latif and Daver 2012) Further Ausloos and Lambiotte (2005) mean that time lags between commercial airline disasters are described by Poisson random events. The waiting time between two successive Poisson events is distributed as a negative exponential function. (Ausloos and Lambiotte 2005) Kumar, Latif and Daver (2012) argue that in 2012 no available forecasting tool existed that could be applied by the humanitarian organisations in their operations. Therefore, more research is needed to develop models that are suitable for disaster management. Important for the tool is that it is dynamic and thereby compliant with disasters and that

it is suitable for every disasters and can anticipate future needs. (Kumar, Latif and Daver 2012)

Whybark (2007) means that even though it is difficult to forecast disaster events it is obvious that the number of disasters is increasing. A relatively new approach to enable quick response within disaster relief, is global pre-positioning of inventory. Currently there are only a few NGOs that can support the large expense of operating a warehouse. (Beamon and Kotleba 2006) Das and Hanaoka (2014) stresses that Inventory Management within humanitarian organisations is neither well researched nor completely understood. This is further strengthened by Whybark (2007) and Beamon and Kotleba (2006) that say when searching within literature on disaster relief Inventory Management there is little to be found. Two quantitative inventory models found for humanitarian logistics are composed by Das and Hanaoka (2014) and Beamon and Kotleba (2006). Due to the complexity in these inventory models that were found the authors chose not to further look into these due to the limitation in time for this study.

There are many factors affecting the operations in the context of humanitarian logistics. The most important factors are summarised in Table 3.2. These factors are important to have in mind while performing research within this area.

Table 3.2. Important factors from Humanitarian Logistics (Krantz and Sandin Hansson 2014)

Factors affecting	Authors (year)
Main objective is to save lives and help beneficiaries	Zeimpekis, Ichoua and Minis (2013)
Funding	Thomas and Kopczak (2005); Jahre and Heigh (2008); Balcik et al. (2010)
Coordination	Balcik et al. (2010)
Unpredictable demand patterns	Kumar, Latif and Daver (2012) Zeimpekis, Ichoua and Minis (2013)
Many stakeholders	Zeimpekis, Ichoua and Minis (2013)
Fast response	Beiser (2010); Jahre and Heigh (2008)

3.2 Responsiveness

Responsiveness is considered to be the key that pushes the competitive performance forward (Van Wassenhove 2006; Eisenhower 2005; Barclay, Poolton and Dann 1996). Fisher (1997) mean that the primary objective with a market-responsive process is to answer fast to uncertain demand, keep down stock outs, forced markdowns and expired stock. There are different opinions on, if inventory results in positive or negative effects on Responsiveness, this is further presented in section 3.2.1 Inventory Management. According to Fisher (1997) the inventory strategy needs to be to build stock and the lead time focus should be to find possibilities to decrease the lead time. In the selection of suppliers there ought to be a focus on lead time in terms of speed, as well as flexibility and quality. (Fisher 1997) Accurate response is essential for products with short shelf-life. (Fisher et al. 1994) Responsiveness as a term is mentioned in a number of areas within literature such as; agile manufacturing, flexible manufacturing and time-based competition. The definition that is used for this study is formulated by Barclay, Poolton

and Dann (1996) and expressed as *"Responsiveness is the ability to react purposefully and within an appropriate timescale to significant events*".

Christopher (2011) argues that in order to increase the performance in an organisation the focus must be put on Responsiveness throughout the whole supply chain. Additionally he stresses that there are many factors contributing to achieve Responsiveness. Christopher (2011) also presents a framework that he calls the "Routemap to the responsive business". This framework is founded on lean and agile theories. The framework suggests that the lean supply chain is suitable when demand is predictable and volumes are high. The agile approach is however more suitable when the demand varies and is uncertain and the volumes is hard to predict. (Christopher 2011) Performance measurements serve as one of the starting points for an agile business and shapes behaviour. Depending on the type of organisation the performance metrics can be created differently. For example, in organisations where activities take place within functions the performance measurements are often based on departments such as the budget and productivity improvement. These types of performance metrics are not suitable for agile practices because they often lead to less flexibility and additional inventory. An example for a more agile performance metrics is the one that are connected to the customer, like the "perfect order achievement". This is an order where the customers receive exactly what they want at the right time. (Christopher 2011)

Christopher (2011) means that the main drivers for a responsive supply chain are visibility of demand and velocity of the supply chain. These drivers are also considered to be the key ingredients of an agile supply chain (Christopher and Peck 2004) and according to Holweg (2005) Responsiveness could be rephrased to system flexibility. The drivers, visibility and velocity have in turn several key factors affecting them (Christopher 2011). The relation of different factors and drivers can be seen in Figure 3.5.

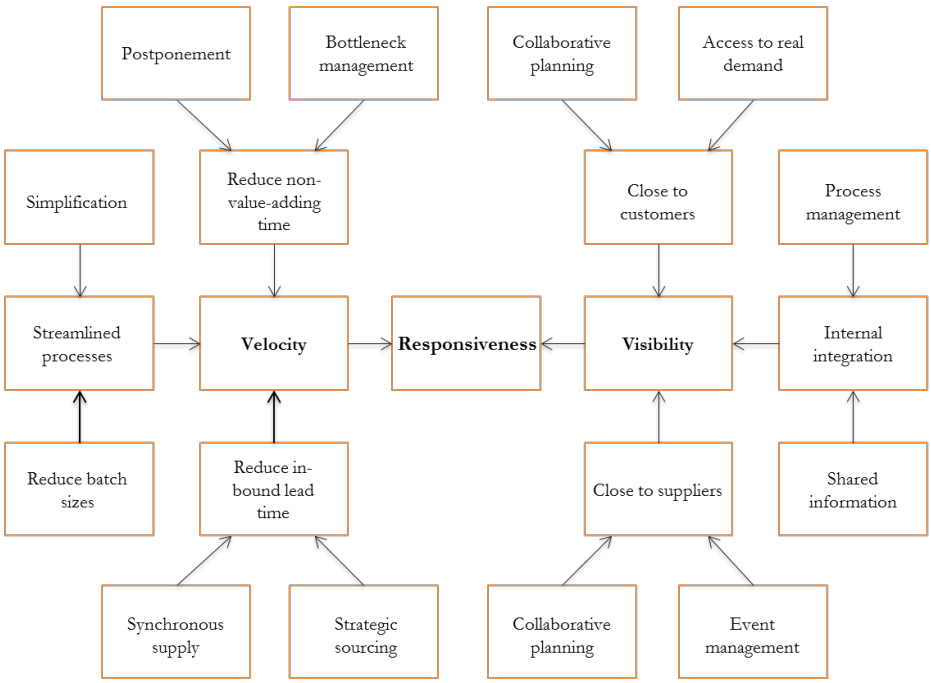

Figure 3.5. Key drivers for responsiveness (Christopher 2011)

Visibility refers to the ability to see from one point of the supply chain to the other, meaning having a clear view of the upstream and downstream inventory, demand and supply conditions, production and purchasing schedules. Further it implies an internal visibility with clear communication and agreements. The central key to achieve visibility in the supply chain is to have a close collaboration with customers and suppliers as well as internal integration within the business. (Christopher and Peck 2004; Christopher 2011) Downwards collaborative planning is important to enable visibility in order to get as correct information as possible early regarding customer demand and to share information. Collaborative planning with suppliers is also significant and can facilitate the event management, which in turn enable alerts for potential supply disturbances. According to the "Routemap to the responsive business" the involved suppliers also needs to be agile and close in the supply chain to achieve good coordination. Further to have internal agility is important, as well as working in process teams and avoiding working in functional silos. (Christopher 2011)

Another important driver for Responsiveness is velocity in the supply chain. A factor that can improve the velocity is to partner with the supplier to reduce in-bound lead times. In the past, suppliers have often been chosen on the basis of price rather than the ability to be responsive. Often the processes have been designed in a vacuum, meaning the processes seldom are aligned with the processes of other actors in the supply chain. (Christopher 2011) It is shown that closer partnerships and information sharing across the supply chain can lead to a reduction in in-bound lead time. (Christopher 2011; Christopher and Peck 2004) Further synchronised scheduling enables the suppliers to become agile without holding inventory and strategic sourcing sets the prerequisites that the supplier must be able to respond rapidly and cope with short term changes. (Christopher and Peck 2004) Another ingredient for improving velocity is streamlined processes, amounting that processes are simplified and designed to reduce the number of stages or activities involved (Christopher and Peck 2004; Fisher et al. 1994). Additionally small batch sizes are desired since the focus is put on flexibility and not economies of scale. (Christopher and Peck 2004) The third foundation for velocity is, to reduce non-value-adding time. Postponement can be used to lower the non-value-adding time, which concerns delaying the commitment of a product to its final form for as long as possible. Managing the decelerating activities is called bottleneck management and contributes to minimise the non-value-adding time. (Christopher 2011) Moreover Christopher and Peck (2004) mean that there are many activities performed in an organisation that are not valuable for the customers, where one of these is managing inventory. Conversely Fisher (1997) has another opinion and means that inventory could be the difference between an efficient and a responsive organisation.

Eisenhower (2005) has another view of Responsiveness, he suggests that Responsiveness can be multidimensional and discusses different dimensions of Supply Chain Responsiveness and the impact of inventory. The findings are in contrast to other authors' findings, not entirely the same. He means that inventory may have both a negative and positive impact on Responsiveness depending on the affecting situation e.g. upward demand shift or technological change. (Eisenhower 2005) Inventory's impact on

Responsiveness is a highly interesting thing to discuss since cost of holding inventory is a great part of the cost within a Supply Chain (Chopra and Meindl 2013).

3.2.1 Inventory Management

According to Simchi-Levi, Kaminsky and Simchi-Levi (2004) it is obvious that the coordination and positioning of inventory have a high impact on the service level of the supply chain and the ability to assist its clients. Further it is shown that inventory planning can contribute to successful emergency logistics (Kumar, Latif and Daver 2012). Some mentioned reasons for keeping inventory are the uncertainty of customer demand in terms of quantity and quality and supplier costs. Further are long lead times and economies of scale other reasons that are mentioned. Because of the complexity of forecasting and planning, managing inventory is often difficult. (Simchi-Levi, Kaminsky and Simchi-Levi 2004)

Chopra and Meindl (2013) define lead time as the gap between the placement and the reception of an order. Axsäter (2006) argues that the lead-time can be both constant and stochastic. Due to forecast errors that often occur because of demand volatility it can be advantageous to reduce lead time. If it is not possible to reduce lead time a safety stock can be held. (Christopher 2011) Further an often asked question regarding Inventory Management regards the amount of kept inventory to assure supply, yet at the same time avoid unnecessary costs and investments connected to inventory. This in addition with the frequency of restocking affects the inventory. (Glock and Ries 2011) Glock and Ries (2011) argue that inventory and sourcing strategies can be potentially risk reducers. A simple tool for managing inventory is the Economic Order Quantity (EOQ) (Chopra and Meindl 2013).

When calculating the optimal quantity the well-known optimising EOQ-model, seen in Figure 3.6, can be used. The Figure 3.6 shows the inventory level over time, Q stands for the quantity in a lot or batch size and d is the demand per unit time. (Chopra and Meindl 2013) The EOQ-model is based on a few assumptions; the demand is continuous and constant, ordering and holding costs are constant over time, the batch quantity does not need to be an integer, the whole batch quantity is delivered at the same time and no shortages are allowed (Axsäter 2006).

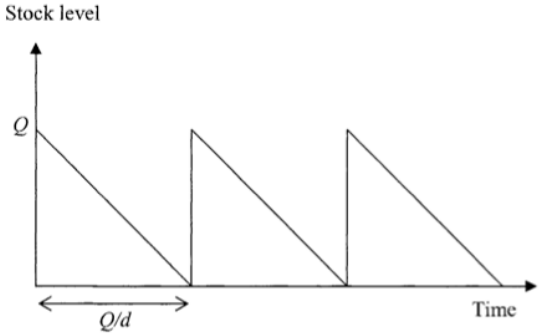

Figure 3.6. Inventory Level over Time (Axsäter 2006)

Large batches allows the use of economies of scale and therefore also the possibility of lowering the costs. (Chopra and Meindl 2013) The inventory level cost is presented in the equation below and is based on the inventory model in Figure 3.6.

$$C = \frac{Q}{2} * h + \frac{d}{Q} * A$$

$C = Cost\ per\ time\ unit$

$Q = Batch\ quantity$

$h = Holding\ cost\ per\ unit\ and\ time\ unit$

$d = Demand\ per\ time\ unit$

$A = Ordering\ or\ setup\ cost$

There are various unforeseen events that can occur when managing stock. However, it is important that the service level is maintained despite unexpected situations. Examples of unexpected events are that the demand differs from the forecasts made, the deliveries from the supplier are delayed or that something within the own internal processes goes wrong. (Aronsson, Ekdahl and Oskarsson 2013) Lumsden (2006) also mention the uncertainty of demand during the lead time and the inventory level as factors that affects the service level. To secure the performance despite the mentioned events a safety stock can be held (Beutel and Minner 2012), though the safety stock does not have to be used if everything runs as planned. The level of uncertainty and the wanted service level determine the safety stock level. (Aronsson, Ekdahl and Oskarsson 2013) The principle for safety stock is illustrated in Figure 3.7.

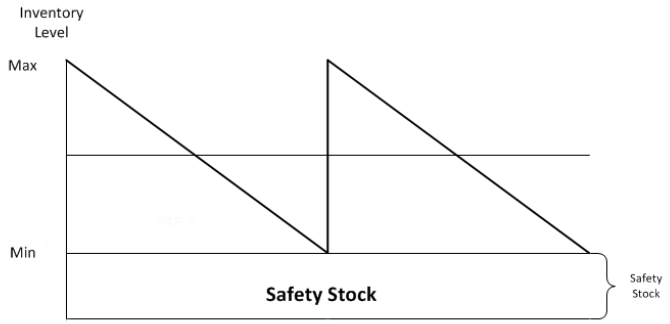

Figure 3.7. Safety Stock (Krantz and Sandin Hansson 2014, inspired by Axsäter 2006)

Various kinds of goods can be kept in stock but some goods are more complex to handle than others, e.g. perishable goods. Chopra and Meindl (2013) define perishable goods as any asset that over time lose value. According to Amorim, Alem and Almada-Lobo (2013) the supply chains for perishable goods have become more complex and global than ever before. Chopra and Meindl (2013) present two tactics that can be used for perishable goods in order to increase the revenue; Dynamic Pricing and Overbook Sales. The first principle implies to varying the price of goods over time and the second implies to overbook sales in order to be prepared for cancellations (Chopra and Meindl 2013). The biggest risks for perishable goods is listed as spoilage, contamination, stock out and tied up capital (Amorim, Alem and Almada Lobo 2013).

Risk have an increasingly impact on the decision and control management within organisations today. According to Simangunsong, Hendry and Stevenson (2012) risk is solely connected to negative results and Norrman and Jansson (2004) means that it is possible to calculate on risk. Jüttner, Peck and Christopher (2003) suggest that the term risk should be divided into two categories, risk source and risk consequences. The risk sources include factors related to the environment, organisation and the supply chain that is difficult to forecast. Risk consequences are the outcome if the risk realises and includes e.g. factors concerning cost and quality. (Jüttner, Peck and Christopher 2003) Manuj and Mentzer (2008) mean that within research there are several definitions of risk and even more different perceptions of risk. The definitions vary a lot depending on what field of literature that is reviewed. Risk within the finance field can for example concern the unevenness of investment returns or the risk of bankruptcy. (Manuj and Mentzer 2008) For the purpose of this study the risk concerns the risk of tied up capital for perishable goods without knowing the future demand, and the risk of not having the possibility to respond due to an insufficient level of inventory when the demand arises.

Manuj and Mentzer (2008) mean that there are factors that can be identified in most of the formulated concepts and definitions of risk; what are the potential losses, i.e., if the risk is realised, what losses will result? How likely are those losses, i.e., the probability of the occurrence of an event that leads to realisation of the risk? and What is the significance of the consequences of the losses?

To address the challenges with risk further and to be able to take efficient decisions regarding the reduction of risk, it is critical to follow a risk management approach. (Ammann 2008) Risk governance concerns decisions related to risk with a wide number of stakeholders involved. Good risk governance needs to balance risk with chance and be able to cope with the expectations from the stakeholders. (Ammann 2008) Risks cannot be eliminated but it should be minimised as much as possible, e.g. to reduce costs. (Borghesi 2013)

An integrated risk management approach has a variety of different names; Enterprise Risk Management, Business Risk Management and Strategic Risk Management. It is further denoted as Enterprise Risk Management, (ERM). ERM is used to integrate and coordinate the management of risks that characterise business processes while meeting the expectations from the stakeholders. The advantages with the ERM is for example the optimisation of cost of capital and of cost of risk, the assessment of risks that can threaten the company, the support of decision-making processes and the protection of corporate image. The ERM approach requires a holistic approach, so if the organisation functions in silos a shift towards becoming more cross-functional is necessary. Risk assessment is an important part of the ERM and accordingly to the ISO 31.000 standard, the risk assessment process consists of three parts; Risk identification, Risk analysis and Risk evaluation. (Borghesi, 2013)

Figure 3.8. Steps in Risk Assessment (inspired by Borghesi 2013)

1. Risk Identification

Five methods to use for identifying risks are organisational charts, flow charts, vulnerability analysis, matrix of interdependencies, checklists, and event chain diagrams (Borghesi 2013).

2. Risk Analysis

Risk analysis, *"…involves developing an understanding of risk and impacts both positive and negative. Risk analysis provides input for risk evaluation and decisions on the most appropriate risk treatment strategies and methods. Risk analysis can also provide input for making decisions where the options involve different types and levels of risk assumption, mitigation, reduction, and avoidance."* Risk is characterized by two features; the severity of the possible consequence and the probability of occurrence of each consequence. In order to analyse these two factors both qualitative and quantitative data may be used. (Borghesi 2013)

3. Risk Evaluation

Different organisations accept different levels of risk and two factors that found the decision of risk level is the risk appetite and risk tolerance. Risk appetite is considered as; *"the risks that an organization is in business to take, based on its corporate goals and its strategic imperatives."* While risk tolerance is, *"the threshold of risk that that organization considers acceptable, based on its capabilities to manage the identified risks"*. (Borghesi 2013)

Factors that various researchers believe are important for Responsiveness are summarised in Table 3.3. These concepts serve as one part of the base for the data gathering for the material presented in chapter 4 and the analysis in chapter 5.

Table 3.3. Concepts for Responsiveness (Krantz and Sandin Hansson 2014)

Concept	Christopher (2011)	Christopher & Peck (2004)	Eisenhower (2005)	Fischer (1997)	Fischer et al. (1994)
Performance metrics	X				
Visibility	X	X			X
Velocity	X	X			X
Managing Inventory			X	X	

3.3 Demand Management

Demand Management in terms of balancing supply and demand is according to Christopher (2011) the essential target when managing a supply chain. The main challenge with Demand Management activities in a supply chain is to manage the uncertainty of demand. (Christopher 2011) According to Norrman and Jansson (2004)

uncertainty is somewhat unpredictable. Manuj and Mentzer (2008) develop this discussion and say that the incapability to forecast or identify all possible results linked to an event or decision is a key feature of uncertainty. Further uncertainty is related to both positive and negative outcomes. (Simangunsong, Hendry and Stevenson 2012) According to Manuj and Mentzer (2008) there are many different activities and tasks that are to be performed with uncertainty involved. One of the challenges addressed in the problem definition for this study regards the inability to predict the customer demand due to its volatile characteristic. When considering Responsiveness in relation to uncertainty in demand, it is necessary to manage great planning and executions to handle the different situations that can occur. (Eisenhower 2005)

Lambert and Cooper (2000) say that in the process of demand management, the customers' demand and requirements needs to be synchronised with the supply ability. According to Christopher (2011) the term demand management involves the operations and tools that increase the effectiveness in the demand and supply balancing tasks. He argues that the conventional way to cope with this is through keeping inventory that comply the forecast. To manage forecasts that are minor than the actual demand a certain amount of extra inventory can be held. The main challenge with the demand management activities in a supply chain is to manage the uncertainty of demand. In the task of balancing demand and supply in demand management one of the main parts is according to Christopher (2001) demand planning.

3.3.1 Demand Planning

Demand planning is an important tool to manage a business. Although the definition of demand planning among researchers differs, the overall idea is that demand planning and demand forecasts are parts of the planning process. This outcome should ensure the ability to supply products in time at a proper cost to customers, but at the same time take inventory turns, lead time and important measures into account so that no unnecessary inventory is stored. (Vlckova and Patak 2011) According to Chen, Hsu and Blue (2006) and Szozda and Werbińska-Wojciechowska (2013) demand planning is the first activity in a company's business planning. It serves as a foundation for the following activities such as purchasing, production, capacity, distribution and cash flow planning (Szozda and Werbińska-Wojciechowska 2013). Chen, Hsu and Blue (2006) stress that the results of an organisation's operations highly depends on the performance of the demand planning and that misleading demand planning will pass on and amplify through the processes. In literature various authors have different views of demand planning, some authors have broad views and some more concentrated (Vlckova and Patak 2011). Christopher (2001) defines demand planning as *"…the translation of our understanding of what the real requirement of the market is into a fulfilment programme, i.e. making sure that products can be made available at the right time and place"*, this is also the definition used for this study.

There are many factors that influence the result of demand planning such as, the level of uncertainty, lead-time, what type of business, products that the planning concerns as well as the size of the organisation and strategy of production (Szozda and Werbińska-Wojciechowska, 2013; Woon and Piplani 2003). Chen and Wolfe (2011) mention the gathering of information from different sources as an important part of the demand

planning process. Further Vlckova and Patak (2011) mean that the structure of an organisation and the choice of data for the forecasting are important factors in order to receive a good outcome of the demand planning. Vlckova and Patak (2011) and Gattorna (1998) discuss various elements that are important to bear in mind for a successful demand planning. A summary of these elements can be seen in Table 3.4.

Table 3.4. Factors for Demand Planning (Krantz and Sandin Hansson 2014)

Author (year)	Factors to consider in demand planning
Vlckova and Patak (2011) Gattorna (1998)	▪ Integrate systems for forecasting and planning ▪ Identify factors influencing demand level ▪ Identify and understand customer segments ▪ Appropriate forecasting techniques for example statistical ▪ Create suitable performance measures to monitor and track performance
Vlckova and Patak (2011)	▪ Understand essential forecast principles
Gattorna (1998)	▪ Cross-functional forecasting process

3.3.2 Forecasting

Vlckova and Patak (2011) mean that when discussing efficient demand planning the most important requirements are effective demand forecasting and integration of forecasting and functional planning. Axsäter (2006) write that forecast is an estimated average over a future period of time. A common opinion among researchers regarding forecasting is that it is extremely difficult to perform a correct forecast (Simchi-Levi, Kaminsky and Simchi-Levi 2004; Axsäter 2006; Chopra and Meindl 2013) and therefore it is one of the most challenging tasks within the organisation (Szozda and Werbińska-Wojciechowska 2013). However, it is also one of the most important tools for managing uncertainties. Other important tools are inventory and material management (Chopra and Meindl 2013).

Simchi-Levi, Kaminsky and Simchi-Levi (2004) mean that there are three principles that characterise forecasting; a forecast is never correct, meaning it is difficult to combine supply and demand in an effective way. The second principle involves the forecasting horizon and describe that the shorter forecasting horizons the better outcome of the forecasting. Finally Simchi-Levi, Kaminsky and Simchi-Levi (2004) and Chopra and Meindl (2013) say that aggregated forecasts are more likely to be correct, by that they mean that it is easier to prognosticate for a group of products than for a single product. To overcome the fact that forecasts never are completely accurate estimation of the probable forecast error, Mean Absolute Deviation (MAD), should be done (Axsäter 2006). Chopra and Meindl (2013) also mention the bullwhip effect as a characteristic; to exemplify this phenomenon the forecast inaccuracy will be larger the further up in the supply chain the company is. By minimizing the forecast errors the costs that affects the whole supply chain may be reduced (Beutel and Minner 2012).

Many authors mean that the choice of data is of great importance for the outcome of the forecasting. Often only historical order/sales data to the closest customer is used for the forecast, and not any data concerning order/sales to the end-consumer. This can result in errors like misleading information about the accurate demand. (Vlckova and Pata, 2011;

Szozda and Werbińska-Wojciechowska, 2013) According to Gallucci and McCarthy (2009) advantages and other positive effects can be gained by using data collected from the point of the end consumer. They mean that, in order to be successful, it is necessary to review the environment around the organisation and not just look at the own organisation. (Gallucci and McCarthy 2009) According to Jain (2007) forecasting is more than just choosing a model, inserting data and calculating. Forecasting should rather be considered as a process that for example takes into account; the way the choice of model is done, the way of using information and data and how it is analysed and handled, into consideration. The outcome of the forecasting process highly depends on its setup and structure. (Jain 2007) Mentzer et al. (1998) presents a framework with what they call, Seven Keys, to achieve better results from the forecasting. The framework is seen in Table 3.5.

Table 3.5. Seven Keys (Mentzer et al. 1998)

Keys	Issues and Symptoms	Actions	Results
Understand what forecasting is and is not	• Computer system as focus, rather than management processes and controls • Blurring of the distinction between forecasts, plans, and goals	• Establish forecasting group • Implement management control systems before selecting forecasting software • Derive plans from forecasts • Distinguish between forecasts and goals	• An environment in which forecasting is acknowledged as a critical business function • Accuracy emphasized and game-playing minimized
Forecast demand, plan supply	• Shipment history as the basis for forecasting demand • "Too accurate" forecasts	• Identify sources of information • Build systems to capture key demand data	• Improved capital planning and customer service
Communicate, cooperate, collaborate	• Duplication of forecasting effort • Mistrust of the "official" forecast • Little understanding of the impact throughout the firm	• Establish cross-functional approach to forecasting • Establish independent forecast group that sponsors cross-functional collaboration	• All relevant information used to generate forecasts • Forecasts trusted by users • Islands of analysis eliminated • More accurate and relevant forecasts
Eliminate islands of analysis	• Mistrust and inadequate information leading different users to create their own forecasts	• Build a single "forecasting infrastructure" • Provide training for both users and developers of forecasts	• More accurate, relevant, and credible forecasts • Optimised investment in information/communication systems
Use tools wisely	• Relying solely on qualitative or quantitative methods • Cost/Benefit of additional information	• Integrate quantitative and qualitative methods • Identify sources of improved accuracy and increased error • Provide instruction	• Process improvement in efficiency and effectiveness
Make it important	• No accountability for poor forecasts • Developers not understanding how forecasting are used	• Training developers to understand implications of poor forecasts • Include forecast performance in individual performance plans and reward system	• Developers taking forecasts seriously • A striving for accuracy • More accuracy and credibility
Measure, measure, measure	• Not knowing if the firm is getter better • Accuracy not measured at relevant levels of aggregation • Inability to isolate sources of forecast error	• Establish multidimensional metrics • Incorporate multilevel measures • Measure accuracy whenever and wherever forecasts are adjusted	• Forecast performance can be included in individual performance plans • Sources of errors can be isolated and targeted for improvement • Greater confidence in forecast process

According to Axsäter (2006) there are mainly two ways of managing forecasting and inventory control linked to each other. In the first approach the forecast is based on historical data such as former demand data. Statistical methods are used to analyse the data and are well adaptable for computer-based inventory control systems. The second approach concerns forecasts and are based on other factors e.g. demand for other items, a certain sales campaign and seasonality product. (Axsäter 2006) Further, Chopra and Meindl (2013) divide different forecasting methods into Qualitative, Time series, Causal and Simulation. A qualitative method is based on human opinions and tends to be subjective. The method is most suitable when the available historical data is limited. A time-series method is suitable when the demand patterns are relatively constant since the method makes forecasts based on historical data. The casual method bases forecasts on estimations of surrounding factors from the environment such as interest rates and economy status, for example this can be used to estimate the effect on demand from promotions. In the simulation method a simulation is performed based on the created demand from the consumer selection. (Chopra and Meindl 2013)

Table 3.6 displays factors that are discussed as essential for a successful demand management. The concepts serves as a part of the foundation for the theoretical framework for analysis, used for the data gathering for chapter 4 as well as for the analysis in chapter 5.

Table 3.6. Summary of concepts for demand management (Krantz and Sandin Hansson 2014)

Concept	Szozda & Werbińska-Wojciechowska (2013)	Woon & Piplani (2003)	Mentzer et al. (1998)	Chen & Wolfe (2011)	Vlckova & Pata, (2011)	Formánek (2004)	Smith et al. (1998)
Understand Demand Uncertainty	X	X				X	
Qualitative & Quantitative data	X		X	X	X		
Appropriate forecasting techniques, processes, systems and training for forecasting and planning			X			X	X
Cross-functional approach			X				X
Performance metrics			X			X	X

3.4 Theoretical Framework for Analysis

In order to address the purpose and to answer the formulated research questions for this study the previous summary of important factors for each of the sections above; Humanitarian logistics, Responsiveness and Demand management, serve as the foundation for the created theoretical framework for analysis in Figure 3.9. Humanitarian logistics provides the distinguishing features for the context in which the study object operate in, while Responsiveness and Demand Management are tools for an effective balancing of supply and demand. The theoretical framework for analysis gives an outline for the data gathering for chapter 4 and the analysis in chapter 5.

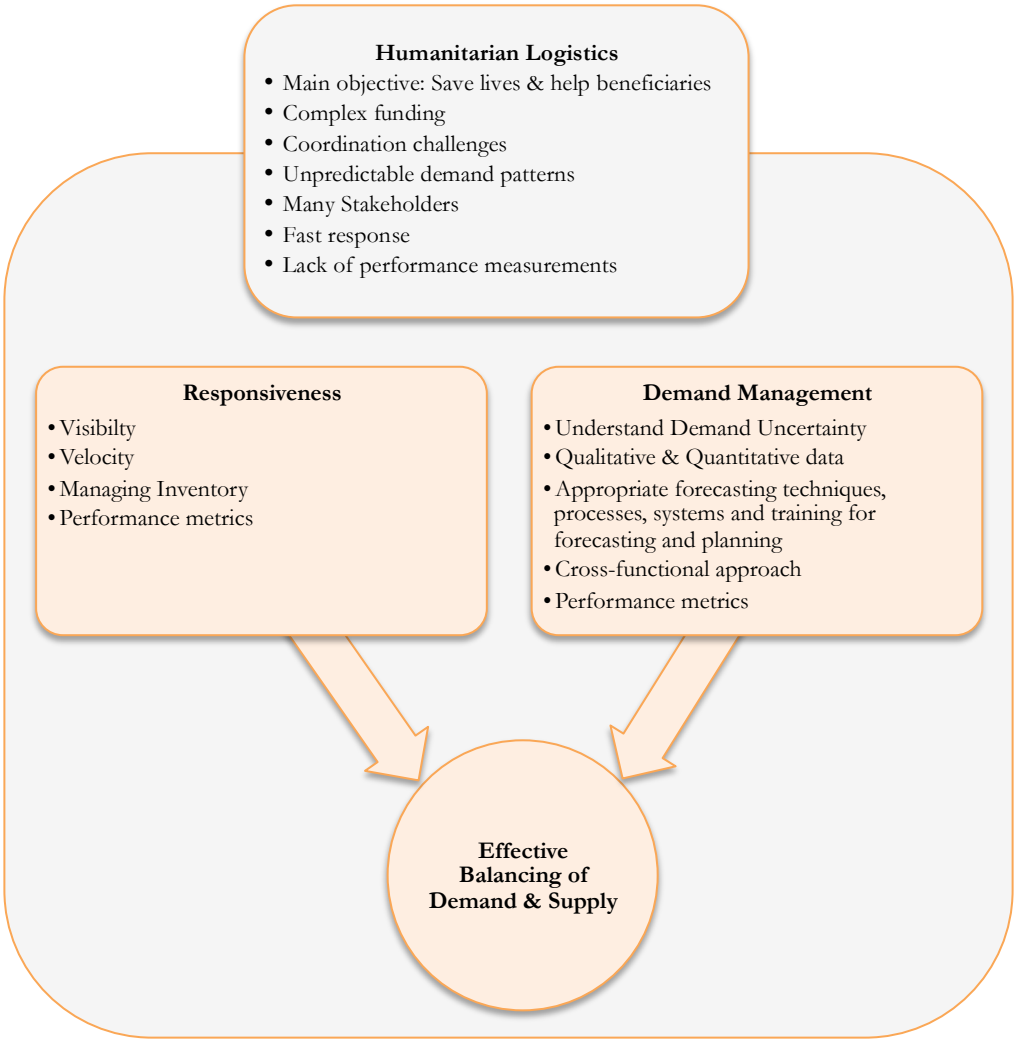

Figure 3.9. Theoretical Framework for Analysis (Krantz and Sandin Hansson 2014)

4 Description of the Emergency Team and its activities

Initially this chapter presents UNFPA, the Emergency Team and its financial set-up. Further the focus is put on the Emergency Team's Supply Chain, which involves ERH-Kits, Customers and Suppliers. Lastly, the Emergency Team's activities related to Demand Management and Inventory Management is presented.

4.1 United Nations Population Fund

United Nations Population Fund, UNFPA, is a subsidiary organ of the United Nations General Assembly. UNFPA is relatively small and therefore collaboration with other UN agencies is required (Internal document 2). UNFPA cooperates and work close to other humanitarian agencies such as World Health Organization (WHO), UNICEF, United Nations Development Programme (UNDP) and The Joint United Nations Programme on HIV and AIDS (UNAIDS) (UNFPA 2014a). UNDP/UNFPA Executive Board is the governing body that UNFPA reports to. UNFPA work with governments, local organisations and other humanitarian partners to provide medical care and social support for sexual and reproductive health. UNFPA is a non-profit making organisation and the main goals are to succeed with a universal access to sexual and reproductive health, reducing maternal mortality, promote reproductive rights and to improve the lives of youths and women by advising on gender equality and human rights. UNFPA's mission read out as follows; *"UNFPA, the United Nations Population Fund, delivers a world where every pregnancy is wanted, every birth is safe, every young person's potential is fulfilled".* (UNFPA 2014b)

Within UNFPA, the Procurement Services Branch (PSB) is managing the procurement operations. One of the team's within PSB handles procurement and transactions connected to emergency supplies and is therefore called the Emergency Team. The hierarchical relation between UNFPA, PSB and the Emergency Team can be seen in Figure 4.1.

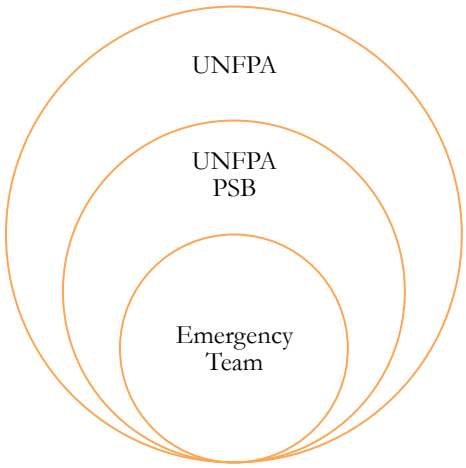

Figure 4.1. Illustration of UNFPA, PSB and the Emergency Team (Krantz and Sandin Hansson 2014)

PSB is the largest public sector procurer for contraceptives and other related goods and has over 30 years of experience with these procurements (UNFPA 2014c). PSB works close to the Commodity Service Branch (CSB), another part of UNFPA, who is responsible for the Global Program and work with funding, planning and forecasting (Interview 1 2014). The mission for PSB procurement is stated: "*To provide access to impartial expert advice, encourage supplier neutrality in procurement; to respond quickly to urgent and emergency requests and to offer quality goods and services in appropriate quantities at the right price, at the right place and RIGHT time for use in projects."* (UNFPA 2014c). The activities performed by PSB are projects related to supply chain management and procurement activities. The procurement activities stands for the biggest part within PSB and are transactional work, meaning placing orders at the supplier, pay for the supply and finally charge the customer for them. (Interview 4 2014) PSB's work also includes managing supplier relations and activities concerning the supply related to logistics, to the port of entry at the destination (Internal document 2). The organisational chart for PSB can be seen in Appendix 1.

4.1.1 The Emergency Team

The Emergency Team manages and distributes pre-packed emergency supplies and equipment to be used in the early stages of a humanitarian emergency for e.g. making childbirth safer when access to proper medical help and support is hampered by the situation, as well as to support medical interventions where necessary (UNFPA 2014d). These supplies and equipment are organised into what is called, Emergency Reproductive Health Kits, ERH-Kits. The ERH-Kits contain essential drugs, supplies and equipment to be used for a limited period of time and for a specific number of people. (UNFPA 2014e) When the situation stabilises and in refugee settings, more comprehensive prevention activities are established (UNFPA 2014f). UNFPA work is aligned with the Programme of Action that was adopted at the International Conference on Population and Development, in Cairo in September 1994, also called ICPD Programme of Action. The aim with the programme was to make reproductive health care, including family planning available for everybody by 2015. The fact that this had not before been considered in combination with emergency aid, the minimal initial service package (MISP) was created in June 1995. (Manual 2010) MISP is a guidance of the minimal requirements that needs to be met in crisis situations and the ERH-Kits are developed with the aim to fulfil this, to provide the necessary reproductive health care. (Interview 2 2014) The first version of the ERH-Kits was agreed upon by the members of the Inter Agency Working Group (IAWG) in June 1997 and available by June 1998 (Manual 2010).

The Emergency Team is based in Copenhagen, Denmark, and consists of three people; One Demand Planner and Inventory Associate and two Emergency Procurement Assistants. In addition one Inventory Management Associate and Global Forecast Associate sets the guidelines in the area of inventory and forecasting for the Emergency Team to work after. (Interview 3 2014) The Procurement Assistants' tasks include communicating with the customers and suppliers when orders regarding ERH-Kits are received. The Demand Planner and Inventory Associate's role is to decide upon which supplier to use, depending on what ERH-Kit the customer orders. Additionally, this role

involves managing the inventory and deciding the size of the Purchase Orders (PO). (Interview 2 2014) Initially when PSB started to offer ERH-Kits one person handled all the activities concerning them. Throughout the years the business with the ERH-Kits has enlarged. This has resulted in a need of more resources and a team that only handles the ERH-Kits has therefore emerged. (Interview 3 2014)

The Emergency Team's activities are today considered as reactive rather than proactive. The organisation tries to continuously improve its operations and activities. As from Spring 2014 UNFPA have new directives that origin from the Executive Director of UNFPA, Dr. Babatunde Osotimehin. The directives spell that the organisation needs to become more active in emergencies and respond faster. This is also strengthen by the fact that there have been complaints from clients in the past for lack of timely delivery of ERH-Kits due to delivery delays and stock-outs. (Internal document 3) Today the Emergency Team steps in as a "second tier" but the future intention is to consequently become more responsive to emergencies. The main activities within the Emergency Team are to procure and manage ERH-kits in stock, and to distribute the ERH-Kits in response to customer demand *"PSB does not have pure emergency operations, we have kits in stock "*. (Interview 3 2014)

In order to improve its operations and align with the new strategy a strategic work plan is composed for the Emergency Team. Examples of actions in the work plan are to develop Key Performance Indicators (KPI) both for the Emergency Team and Inventory Management, developing renewable ERH-Kits and adding for example tents to the ERH-Kits. For the complete work plan see Appendix 3. Another project that is initiated concerns the conflict in Syria and the four countries affected by the conflict where refugee camps are established. The project's purpose is to, since the camps are established, review the possibilities for how to move from delivering ERH-Kits to delivering standard products through the regular procurement catalogue. (Interview 3 2014) The Emergency Team is focused on keeping the cost of the ERH-Kits down and aim to get the most cost efficient supplies at the highest quality. (Interview 1 2014)

4.1.2 Financial Set-up

PSB's role within UNFPA is to support the mandate of UNFPA by procuring all key contraceptives, medicines and pharmaceuticals required for Family planning/Reproductive Health. In addition to the procurement activities, PSB also manage various projects relevant to e.g. Quality Assurance of products, training of field staff in procurement related matters. To enable these activities PSB receives funding. Additionally PSB is funded through two different revolving funds. One of the revolving fund is on US$ 14 million and holds contraceptives and a type of reproductive health kit. The other revolving fund is connected to the ERH-Kits and will further be discussed in the following section. (Interview 4 2014)

To enable respond and supply quickly it is, depending on the lead time and delivery time, necessary for the Emergency Team to plan and preposition inventory. In 1996, due to the fact that UNFPA sometimes need to supply reproductive health commodities quickly, the Executive Board of UNFPA approved the mandate for the creation of a

revolving fund of US$ 5 million, to enable PSB to preposition health commodities in stock to be able to respond to future demand more rapidly. This revolving fund is a way to bypass the basic principle within UN, that UN can only act when there is a mandate, and capital is donated for a purpose, i.e. money cannot be spent unless somebody has given you the money first. Since 2011 the revolving fund of US$ 5 million only holds ERH-Kits. (Interview 4 2014)

The capital in the fund is grouped into different segments, a part of the money is tied up in physical inventory, one part is tied up in POs i.e. incoming future inventory and lastly a part of the capital in the fund is available cash. The revolving fund's function is that when a re-stocking order is placed and a PO created, capital from the fund is directly allocated to that PO, which means that the allocated money has been committed to procuring goods from the supplier. The money is tied up until the customer has made funds available as payment for the goods. The money from the payment becomes available cash and can be used to place new POs. The capital keeps on circulating in the revolving fund. (Interview 4 2014) An illustration of the money flow in the fund can be seen in Figure 4.2 below.

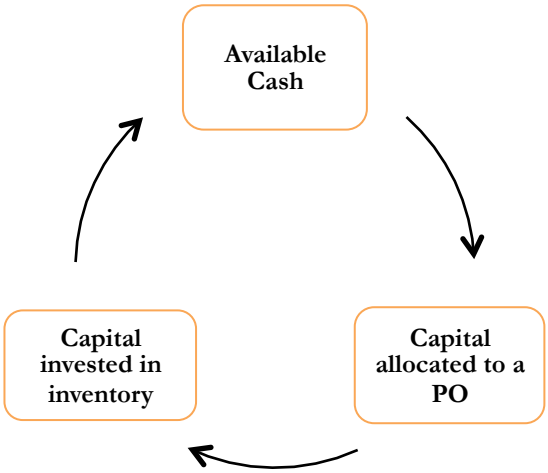

Figure 4.2. Illustration of the revolving fund for the ERH-Kits (Krantz and Sandin Hansson 2014)

The financial ability to hold inventory is driven by the fund, and it is not clear if the fund is managed in the most efficient way. (Interview 4 2014) The historical relation, from 11/2011 to 04/2014, between available cash, capital allocated in PO and capital invested in inventory is presented in Figure 4.3. The chart represents the total amount of US$ 5 million and the relation between the parts of the fund. The value in cash, PO and stock respectively, at the end of each month during the period can be seen in Appendix 4. Historically a PO has seldom been disregarded due to the constraints in the revolving fund, though it has happened. (Interview 4 2014) Along with the new directives regarding becoming more responsive, UNFPA has expressed a willingness to make more funds available for the ERH-Kits operations. However it is not clear to what extent more funds would be available in this case, and PSB are currently analysing the potential need for additional funding in order to further increase the desired stock levels. (Interview 3 2014)

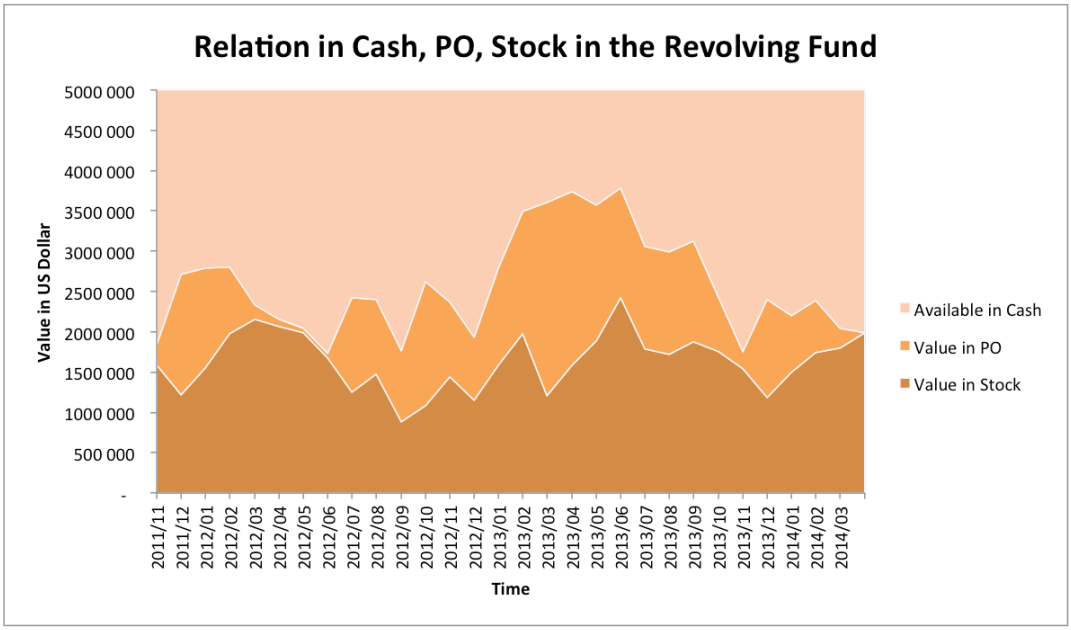

Figure 4.3. The historical relation in value between cash, PO and stock in the revolving fund between 11/2011-04/2014 (Krantz and Sandin Hansson 2014)

If parts of an ERH-Kit expire or an entire ERH-Kit expires it is a loss to the organisation. *"Naturally we are going to have losses on the ERH-Kits since it is emergency. And if we have a correct system we shouldn't be too ashamed if the losses arise as long as we control it properly."* (Interview 4 2014) However, it is seldom that the complete ERH-Kit needs to be scrapped because it is most often only the pharmaceuticals and contraceptives that have expired. This means that expired products can be replaced by new ones to minimise the scrapping of ERH-Kits, this has been done two times since 2010. (Interview 1 2014) When an entire or a part of an ERH-Kit expires it results in that the value of the ERH-Kit needs to be written down and UNFPA needs to put more money into the fund to bring up the amount in the fund to the correct level (Interview 4 2014).

4.2 The Emergency Team's Supply Chain

An important factor for why the ERH-Kits are difficult to manage is the assembly process, as the interviewee from Interview 1 (2014) says, *"…the ERH-Kits are situated in the end of the food chain"*. The main challenges with the ERH-Kits are that the demand is uncertain which comes from the fact that the main purpose with the ERH-Kits is to serve emergencies and these are difficult to predict. In order to respond to the urgent demand the Emergency Team therefore need to hold stock. However the fact that the ERH-Kits have different shelf lives creates a risk every time ERH-Kits are ordered to stock. (Interview 2 2014) Another main challenge for handling the ERH-Kits is described as the visibility of demand. This since there is a lack of historical data for the actual demand, fulfilled as well as unfilled, as the only data available is for dispatched orders. Additionally the Emergency Team does not supply to the end consumer and by that it does not know the actual beneficiaries for the ERH-Kits, it only knows how many ERH-Kits that are distributed. This complicates the follow up of the Emergency Team's overall performance. A complex supply chain and few vendors of the ERH-Kits is another challenge that sometimes results in long lead times. The general lead time is 3

months from ordering until the order is received in to stock. The lead time for the Emergency Team is the time from the placement of a PO until the order is available in stock. Lack of forecasting and planning data makes it difficult to maintain an effective organisation. In addition, due to the relatively short shelf life for some of the ERH-Kits, there are many elements to consider during the emergency response operations in terms of handling ERH-Kits. (Interview 1 2014) The Emergency Team's Supply Chain can be seen in Figure 4.4.

The Emergency Team has two suppliers for the ERH-Kits, Supplier 1 and Supplier 2, and two types of customers, Internal and External. The two suppliers have, in turn, many suppliers for the specific items in the ERH-Kits. The ERH-Kits, the suppliers and the customers will be further discussed in the following sections. The information flow concerns the actors' communication and the financial flow concerns the payment of the ERH-Kits.

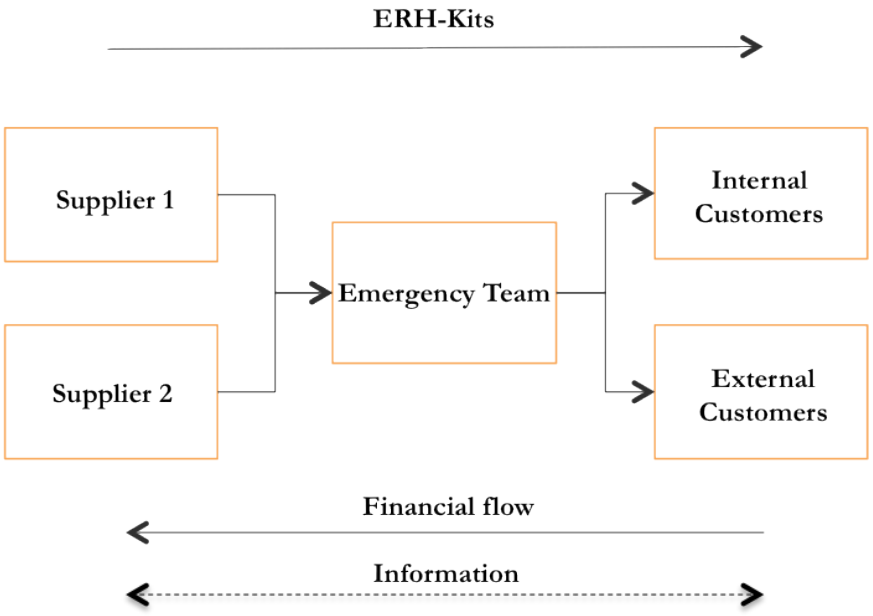

Figure 4.4. Illustration of the Emergency Team's Supply Chain (Krantz and Sandin Hansson 2014)

4.2.1 ERH-Kits

The ERH-Kits are appointed to be used for a certain amount of consumers during a certain period of time and are developed by the Inter-Agency Working Group (IAWG), an independent group from different Non-Governmental Organisations (NGOs). (Interview 1 2014) Currently there are 13 main ERH-Kits, where some ERH-Kits consists of two different parts, which results in that in total there are 17 different ERH-Kits. The ERH-Kits are divided into three categories that target a different health service delivery level, see Table 4.1. (UNFPA, 2014e)

Table 4.1. The ERH-Kits divided into three Blocks (Manual 2010)

Block 1 10.000 people for 3 months	**Block 2** 30.000 people for 3 months	**Block3** 150.000 people for 3 months
ERH-Kit 0 Administration/training supplies	ERH-Kit 6 Clinical delivery assistance (A and B)	ERH-Kit 11 Referral level kit for reproductive health (A and B)
ERH-Kit 1 Condoms (A and B)	ERH-Kit 7 Intrauterine devices (IUDs)	ERH-Kit 12 Blood transfusion kit
ERH-Kit 2 Clean delivery, individual (A and B)	ERH-Kit 8 Management of miscarriage and complications of abortion	
ERH-Kit 3 Post rape treatment	ERH-Kit 9 Suture of tears (cervical and vaginal) and vaginal examination	
ERH-Kit 4 Oral and injectable contraception	ERH-Kit 10 Vacuum extraction delivery	
ERH-Kit 5 Treatment of sexually transmitted infections		

The ERH-Kits consist of a combination of different medical devices, contraceptives and pharmaceuticals (Interview 2 2014). The reason for the large range of various ERK-Kits is that different kinds of emergencies require different type of aid (Interview 2 2014). Key points regarding the ERH-Kits are presented in the following bullets:

- The ERH-Kits are designed for use in the early phase of a crisis situation
- Each ERH-Kit is formulated to be self-sufficient
- Some ERH-Kits are designed to be used only by qualified and trained health personnel
- The ERH-Kits are updated on a regular basis

(Manual 2010)

Depending on the content in the ERH-Kits, the ERH-Kits have various shelf lives. A summary of the ERH-Kits, their shelf life in months and which supplier that supplies each ERH-Kit can be seen in Table 4.2. The ERH-Kits with non-applicable shelf life are marked with N/A in the table. The term shelf life in this matter refers to the product's lifetime; hence the shelf life of an ERH-Kit is the lifetime that the product with the shortest lifetime in the ERH-Kit has. The customer requests that the ERH-Kits have at least one year shelf life left when they receive the ERH-Kits. (Interview 2 2014) As can be seen in Table 4.2 ERH-Kit 12 has a shelf life of 12 months and cannot be kept as inventory more than a short period. The way the Emergency Team manages this is to order ERH-Kit with shorter shelf life in lower quantity. (Interview 1 2014)

Table 4.2. Shelf life and potential supplier per ERH-Kit (Internal document 3)

ERH-KIT	Total Shelf Life (months)	Maximum storage time before shipment according to customer needs (months)	Supplier 1	Supplier 2
0	N/A	N/A	X	
1A	60	48	X	
1B	60	48	X	
2A	N/A	N/A	X	X
2B	N/A	N/A	X	X
3	24	12	X	X
4	36	24	X	X
5	24	12	X	X
6A	N/A	N/A	X	
6B	24	12	X	
7	36	24	X	X
8	24	12	X	
9	36	24	X	
10	N/A	N/A	X	X
11A	N/A	N/A	X	
11B	24	12	X	
12	12	0	X	

In the situations when ERH-Kits in inventory converge towards expiration, but no later than three months before, the Emergency Team work together with the supplier to if possible replace the expiring items into new ones in order to extend the shelf life of the ERH-Kit. The ERH-Kits that solely consist of medical devices can be reused, while the ERH-Kits consisting of both medical devices and pharmaceuticals cannot. The suppliers handle the disposal of the expired goods at the Emergency Team's cost. During a period in 2012 the demand for ERH-Kits was low which resulted in ERH-Kits converging towards expiration. To reduce the loss of ERH-Kits the Emergency Team approached the COs with the aim to get the customers to place orders outside emergency situations. (Interview 2 2014)

The costs for replacing expired items in the ERH-Kits are different depending on the ERH-Kit and supplier and can be seen in Table 4.3. The costs for the ERH-Kits differ extensively depending on the supplier. The reason is that Supplier 1 does not charge for the labour cost in the replacement of expired items but only the items itself, while Supplier 2 charges both for the labour cost and the item cost. (Interview 4 2014)

Table 4.3. Cost in US dollar for replacing expired items for affected ERH-Kit (Internal document 3)

Total	Supplier 1, Cost/ERH-Kit (US $)	Supplier 2, Cost/ERH-Kit (US $)
KIT 3	9.25	281.00
KIT 4	10.50	51.00
KIT 5	14.00	141.00
KIT 6A	1.30	
KIT 6B	23.50	
KIT 7	13.50	51.00
KIT 8	42.00	
KIT 9	21.00	
KIT 11B	29.80	
KIT 12	120.00	

To attain short lead times to the customers ERH-Kits are often shipped by air in response to the urgency of the need, however this is a costly freight mode that makes the total cost of the ERH-Kits higher than if another transportation mode would have been used. (Interview 1 2014) The stakeholders that are allowed to order the ERH-Kits are: UNFPAs Humanitarian Response Branch (HRB), UNFPA's COs, funding agencies, UN system fund/programmes/agencies, international agencies and national authorities. (Manual 2010) If it is an emergency the ERH-Kits are delivered to the customer 2-7 days after finalisation of the budget allocation, (Manual 2010) meaning when the capital is committed to the Emergency Team. (Interview 1 2014) In the case of a non-emergency situation the delivery is 10-12 weeks after finalisation of the budget allocation. (Manual 2010) The costs for the ERH-Kits consist of the purchasing cost and additionally 5 percent for covering the administrative cost for the Emergency Team (Interview 1 2014).

4.2.2 Customers

The Emergency Team separates its customers into internal and external customers. As of today, based on statistics from November 2011 to February 2014 the Emergency Team has twice as many internal customers as external. From 11/2011 to 2/2014 the external customers bought ERH-Kits for US $ 1,8 million and the internal customers for US $ 7,3 million, see Table 4.4. This results in an average sale of US $ 780.000 for the external customers and around US $ 3 million for the internal customers yearly.

Table 4.4. Procurement statistics from November 2011 to February 2014 (Krantz and Sandin Hansson 2014)

Type of Customer	Number of Customers	Spend per type of customer (US dollars)
Internal	52	7 344 671
External	26	1 826 821

The internal customers are the Country Offices (COs) that are a part of and organised by UNFPA. The COs are funded through UNFPA and other donors and the Commodity Security Branch (CSB) coordinates the donations coming from UNFPA. (Interview 4 2014) The process is as follows; the CO approaches CSB with a request for donations and denotes their requirements concerning the needed goods. CSB then decide on the

amount of money to donate to the COs based on the balance between the total capital, the total demand and the stock level at the current CO. (Interview 1 2014) Further the COs at the end of each year have to make sure that they have spent all the donated money that they have received during the year, otherwise there is a risk that the CO will not receive as much donations the following year. This results in that COs sometimes orders ERH-Kits with the aim to spend their money and not because there is currently an actual demand for the ordered ERH-Kits. (Interview 2 2014) The external customers are not linked to UNFPA and can for example be NGOs, or Ministries of Health. A challenge when operating with the external customers is that the different organisations have different guidelines, rules and operations that sometimes complicate the operations and the relationship. (Interview 2 2014) The Emergency Team has recently started to review the possibilities to provide more ERH-Kits to external customers through marketing. A first attempt has been done through surveys that have been sent out to analyse the potential demand, unfortunately with an undesirable result since only 4 of 25 of the receivers responded to the survey. (Interview 2 2014)

ERH-Kits can be ordered for both emergency and non-emergency situations. In the ordering process the customers fill in a request form where they specify if it is an emergency order or not. UNFPA has a formulated definition of what is considered and humanitarian emergency situation, however there is no grading of other urgent situations, which is not a humanitarian disaster. The orders concerning emergency situations are the orders that come in as a result of any kind of emergency, whether it is due to a disaster or that a new type of demand has arisen quickly, for prepositioning supply or that funds need to be spent. The reason why customers order ERH-Kits in non-emergency situations is because they find the ERH-Kits suitable for other purposes and situations than in emergency relief, e.g. for equipping a hospital. Another reason could be that the customer has an urgent need for certain items in the ERH-Kits and therefore orders these. The longer delivery time for the products from the regular procurement catalogue is a reason for why customers decide to order ERH-Kits instead of ordering regular products. However, the ERH-Kits are more expensive than the regular products that can be procured from the UNFPA catalogue, where airfreight is one factor contributing to this. When the customer order a ERH-Kit containing both pharmaceuticals and medical devices when their actual demand is only the pharmaceuticals it results in that many customers holds more medical devices than necessary in stock. Consequently when big orders are placed that are not a result of emergency situations, the Emergency Team informs the customer that it can order goods from the regular procurement catalogue. A situation that has become apparent for the Emergency Team is that external customers sometimes orders ERH-Kits and choose to handle the freight themselves, and in some cases freight the ERH-Kit by cargo. (Interview 2 2014)

4.2.3 Suppliers

The Emergency Team has two suppliers for ERH-Kits. (Interview 1 2014) Supplier 1 is located in Holland and can deliver all of the 17 different ERH-Kits while Supplier 2 is located in China and has only the ability to deliver 7 of the different ERH-Kits (Manual

2010). Due to this restriction Supplier 2 can very seldom deliver a complete order, which sometimes creates problematic situations. (Interview 1 2014) The Emergency Team aims to have a 70-30 split between the two suppliers for the ERH-Kits that are supplied by both of them, where Supplier 1 receives 70 percent of the orders and Supplier 2 get 30 percent of the orders. However, due to the interruptions in Supplier 2´s delivery, this is sometimes difficult to reach. (Interview 1 2014) Table 4.5 displays the historical split of orders delivered from the two suppliers.

Table 4.5. Historical split between delivered orders from the suppliers, November 2011 to April 2014 (Krantz and Sandin Hansson)

ERH-Kit	Total Amount of Orders	Amount of Orders Supplier 1	Amount of Orders Supplier 2	Share Supplier 1	Share Supplier 2
0	4		4	100%	0%
1A	4		4	100%	0%
1B	5		5	100%	0%
2A	27	9	36	75%	25%
2B	11	7	18	61%	39%
3	20	4	24	83%	17%
4	17	8	25	68%	32%
5	14	5	19	74%	26%
6A	18	6	24	75%	25%
6B	17	13	30	57%	43%
7	12	6	18	67%	33%
8	13		13	100%	0%
9	16		16	100%	0%
10A	10		10	100%	0%
10B		13	13	0%	100%
11A	15		15	100%	0%
11B	31		31	100%	0%
12	16		16	100%	0%

The Emergency Team strives to take on several suppliers to secure the supply. There are suppliers that want to deliver the ERH-Kits but many of them lack the experience. It is crucial for the Emergency Team to have reliable suppliers, if not they could become a burden for the Emergency Team. (Interview 2 2014)

Supplier 1 is a medical wholesaler organisation (Supplier 1 2014). The organisation has a large customer base, which gives them the possibility to procure goods in large batches and consolidate into ERH-Kits. The items that are not needed for ERH-Kits can be sold to other customers. Supplier 1 holds the inventory for the Emergency Team and handles the distribution of ERH-Kits from stock on behalf of the Emergency Team. Supplier 2 is a trading company that is not specialised in procuring medical items and lacks experience in that area. Because of this, Supplier 2 does not have as large customer base as Supplier 1, which results in that it cannot always supply accordingly to the ERH-Kits requests from the Emergency Team and delivery becomes delayed. This has resulted in that, in the situation of a real emergency, the Emergency Team only supply ERH-Kits from Supplier 1. Supplier 2 hold inventory of ERH-Kits but does not manage distribution. (Interview 1 2014) It is essential for the Emergency Team to have at least two

performing suppliers for the ERH-Kits. Hence, it is of great importance for the Emergency Team to cooperate and work with their suppliers in order to increase the overall result. (Interview 2 2014) PSB and the Emergency Team cooperate with their suppliers to build the relationship and help the suppliers to build their capacity, something that especially involves Supplier 2. A new initiative from PSB is to strengthen this by inviting the suppliers to the Headquarters in Copenhagen to come up with ideas for improvements to strengthen the collaboration. (Interview 5 2014)

The contracts with the suppliers often runs for 2-3 years of time, and are so called Long Term Agreement, LTA. A year before the LTA terminates the tendering for new contracts become public and the interested organisations are welcome to place bids. (Interview 1 2014) When all the bids are placed for the ERH-Kits a first evaluation is done. The first evaluation concerns the technical and quality aspects and if these are reached the next step is the evaluation regarding the price. (Interview 1 2014) According to the current LTAs the suppliers are obligated to answer to the request from UNFPA within one business day. The supplier shall as well *"maintain sufficient stock of Goods or make other arrangement at its own risk and cost in order to ensure timely delivery of the Goods"*. (Internal document 5) The suppliers have expressed a wish to receive assembled orders ones every quarter, since that helps the supplier to manage their production plans better according to themselves.

One of the reasons for why the Emergency Team only has 2 suppliers for the ERH-Kits, or as they say 1,5 suppliers, is due to the requirements in the contract. Many potential suppliers do not want to get into an agreement with the Emergency Team because they know that they will not be able to deliver according to the agreement. What has been realised after the last contracting process is that Supplier 2 did not realise the characteristics of the Emergency Team's business when they entered into the LTA with the Emergency Team. (Interview 3 2014) Apart from the LTAs regarding ERH-Kits both Supplier 1 and Supplier 2 have other LTA agreements with UNFPA, for example Supplier 1 supplies pharmaceuticals and Supplier 2 supplies medical device. (Interview 2 2014) The lead time of ERH-Kits from the supplier is agreed upon in the LTAs, however sometimes it suits the supplier's production plan to produce the ERH-Kits in another pace, and therefore the ERH-Kits can be in the Emergency Team's ownership after just a few weeks (Interview 1 2014). The agreed lead time for the different ERH-Kits and the average actual lead time can be seen in Appendix 5. The relation in percent between early, on time and late deliveries per ERH-Kit relative the lead times agreed upon in the LTAs are seen in Figure 4.5 and Figure 4.6.

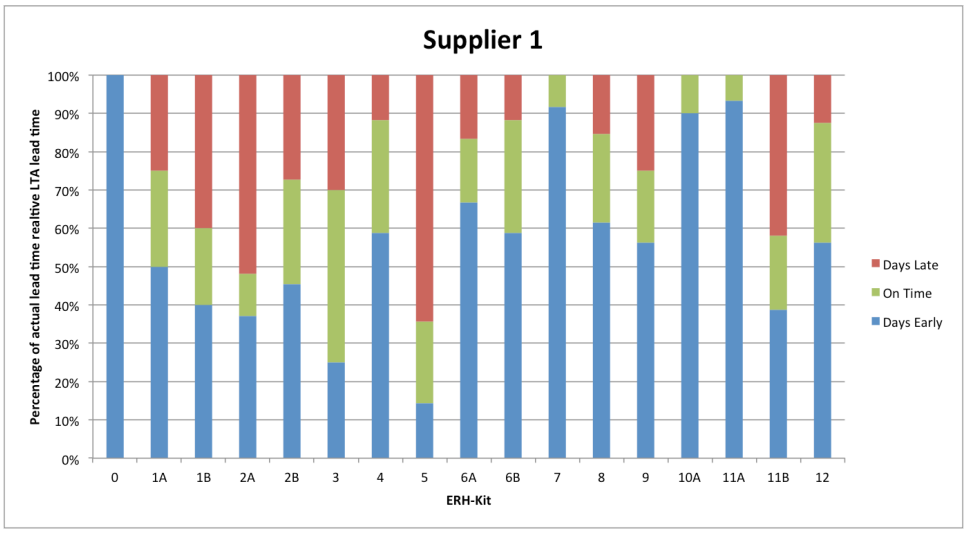

Figure 4.5. Historical lead time relative LTA lead time for Supplier 1, from 11/2011 to 04/2014 (Krantz and Sandin Hansson)

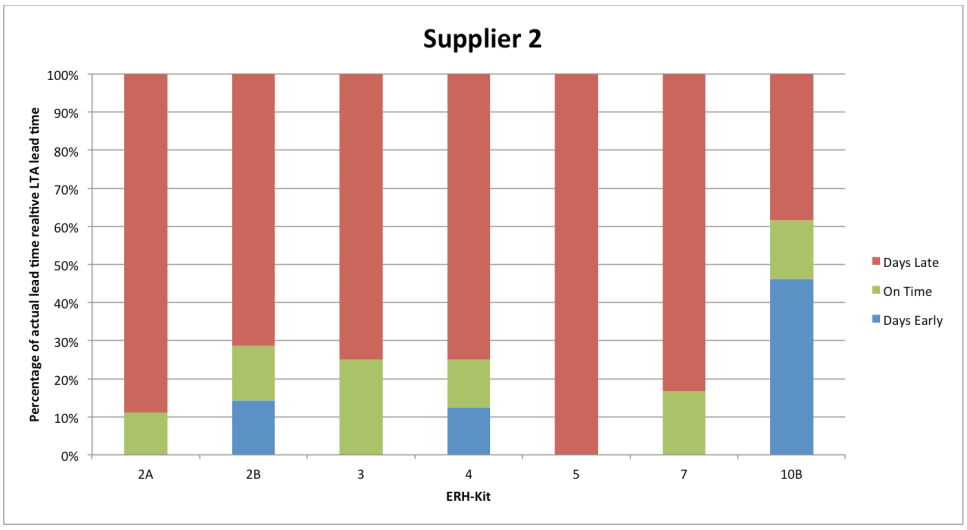

Figure 4.6. Historical lead time relative LTA lead time for Supplier 2, from 11/2011 to 04/2014 (Krantz and Sandin Hansson)

The actual average lead time for the order arriving early respectively late from the two suppliers is displayed in Table 4.6. The empty lines indicates that the current ERH-Kit is not delivered from that supplier and the mark indicates that there are no early respectively late orders for that ERH-Kit during the chosen time period.

Table 4.6. Average days early respectively late relative LTA lead time in the time period 11/2011- 04/2014 (Krantz and Sandin Hansson 2014)

	Supplier 1		Supplier 2	
ERH-Kit	**Average Days Early**	**Average Days Late**	**Average Days Early**	**Average Days Late**
0	39	-		
1A	38	113		
1B	35	32		
2A	37	31	-	20
2B	-	34	20	27
3	17	10	-	131
4	18	64	22	34
5	17	15	-	123
6A	25	8		
6B	16	14		
7	28	-		54
8	14	16		
9	36	18		
10A	42	-		
10B			32	63
11A	43	-		
11B	13	41		
12	24	27		

4.3 The Emergency Team's activities

The Emergency Team is a procurement division within UNFPA where the activities performed are of transactional character and involve managing demand and inventory. (Interview 1 2014)

4.3.1 Demand Management

The Emergency Team's policy is to always respond to customer requests for ERH-Kits as fast as possible (Interview 1 2014). The main challenges stressed regarding the ERH-Kits are that the demand is uncertain so it is difficult to predict what amount to keep in stock at any time, bearing in mind the risk of expired supply, which is a loss to the organisation (Interview 2 2014). The demand statistics from 11/2011 to 02/2014 is summarised in Table 4.7 and is based on depleted orders and not real demand statistics. In the table it can be seen that ERH-Kits 2A and 2B are the most ordered ERH-Kits in terms of quantity. ERH-Kit 6A and ERH-Kit 2A are most frequently ordered. The ERH-Kits that is ordered least times and in least quantity is ERH-Kit 0. Further the trends in the demand for ERH-Kit 2A, 2B and 10 are decreasing. The rest of the ERH-Kits are increasing. However, ERH-Kit 2A and 11B are almost constant.

Further it can be seen in Table 4.7 that ERH-Kit 3 has a high number of orders but a relatively low ordered amount of ERH-Kits where the average amount of ERH-Kits per order is 1,4 ERH-Kits. ERH-Kit 2A has the highest average of ERH-Kits ordered per order namely 18,3 ERH-Kits. Additionally, the demand is volatile for the entire ERH-Kit portfolio, see Appendix 6 for further graphs representing the demand statistics regarding the ERH-Kits.

Table 4.7. Customer demand statistics 11/2011-02/2014 (Krantz and Sandin Hansson 2014)

ERH-KIT	Number of Orders (units)	Number of orders (% of total orders)	Amount of ERH-Kits ordered (ERH-kits)	Amount of ERH-Kits ordered (% of total ordered ERH-Kits)	Average ERH-Kits/ order	Demand Trends (Increase/Decr-ease/Constant)
0	25	1,1 %	137	0,8 %	5,5	I
1A	168	7,2 %	985	5,4 %	5,9	I
1B	50	2,1 %	374	2,1 %	7,5	D
2A	186	8,0 %	3401	18,7 %	18,3	D (almost C)
2B	123	5,3 %	1908	10,5 %	15,5	D
3	164	7,0 %	233	1,3 %	1,4	I
4	138	5,9 %	1221	6,7 %	8,8	I
5	170	7,3 %	1747	9,6 %	10,3	I
6A	190	8,1 %	1561	8,6 %	8,2	I
6B	173	7,4 %	1476	8,1 %	8,5	I
7	86	3,7 %	609	3,3 %	7,1	I
8	148	6,3 %	998	5,5 %	6,7	I
9	157	6,7 %	1206	6,6 %	7,7	I
10	110	4,7 %	687	3,6 %	6,2	D
11A	166	7,1 %	680	3,7 %	4,1	I
11B	175	7,5 %	584	3,2 %	3,3	I (almost C)
12	103	4,4 %	407	2,2 %	4,0	C

The suppliers are required to respond to the Emergency Team's request within one business day with a proposed schedule and estimated freight costs. Further the ERH-Kits that are already produced and placed in stock must be positioned for shipment at the forwarder the same day as the request from the Emergency Team is received. (Internal document 5) According to the interviewee from Interview 1 (2014) the supplier should respond at the latest two days after a PO is placed. In situations when the suppliers are unable to deliver what the Emergency Team requests, the Emergency Team is consequently unable to deliver to its customers in turn. Most of the time it is possible to deliver a full customer order and by that meet the demand, but sometimes it is not. In the situations when it is not possible to deliver a full order, but parts of it, the Emergency Team negotiates with the customer about the amount to deliver and at what time. For example the situation may be that it is possible to deliver 50 percent of the demanded quantity at a certain time and the remaining 50 percent later in time. Another situation that might occur is that it is not possible to deliver anything at all and the customer needs to wait for the order, and receive the full order later in time. If the Emergency Team is unable to deliver an order, or parts of an order, the orders are sometimes cancelled. An issue is that no data regarding unfulfilled orders or divided orders is saved, it is therefore not possible to measure how many orders the Emergency Team are able to deliver and not in relation to the real demand. (Interview 1 2014)

In order to plan for and predict future demand the Emergency Team, in the beginning of each year, turns to its customer and ask them to approximate the amount and type of orders that they are going to place during the coming year and compile this in a web based procurement planning tool. Currently the COs are asked to approximate all of the

orders they are going to place, from products like pens and laptops to pharmaceuticals and ERH-Kits. The response to this forecasted demand from the customers varies, and from a planning point of view and for enabling prepositioning of ERH-Kits it is often inadequate. For 2014 only two COs completed the forms in the procurement planning tool. The fact is that in some cases the COs makes well developed forecasts for future demand, but these forecasts are seldom communicated to PSB and further on to the Emergency Team. Another factor that makes the demand planning difficult is that the COs do not want to make actual forecasted plans before they are assured that they will receive funding to be able to procure the demand of goods. (Interview 3 2014) In addition, another part within UNFPA, CSB, also asks the COs to approximate their future demand and the two different processes, one performed by PSB and one by CSB are not coordinated within UNFPA. Further the COs are typically partnering with the Minister of Health, and usually it is the Minister of Health that performs the forecasts for the specific country. (Interview 1 2014)

4.3.2 Inventory Management

Inventory for UNFPA is defined as *"stocks of reproductive health commodities and other programme related goods under the control of UNFPA"* (Internal document 1). UNFPA maintains stock of inventory to respond to specific needs and in pursuance of its mission as an international development agency. (Internal document 1) The inventory is held by the suppliers but managed by UNFPA, meaning that the supplier manages the warehouse where the ERH-Kits are held but are obliged to only take actions concerning the goods, e.g. ship, replenishment and stock level, based on a mandate from UNFPA. (Interview 1 2014) The replenishment is done based on common sense, experience and a planning tool for ERH-Kits which is constructed based on historical data (Interview 2 2014).

Shadow stock is a type of stock that the suppliers can hold with components to secure supply when a PO arrives from the Emergency Team. Supplier 1 is known for holding shadow stock, supplier 2 also claims that they hold shadow stock, nonetheless the Emergency Team cannot be certain of the existence of shadow stock since it is incapable of control it. The shadow stock is in the ownership of the suppliers, which means that the risk lies with them. (Interview 1 2014) The shadow stock consists of components for the ERH-Kits. Often managed goods in the shadow stock are goods with no shelf-life and frequently sold products like certain pharmaceuticals. Shadow stock can result in an important decrease in lead time because of the reduction in production time for the ERH-Kits. 2010 was a critical year due to the catastrophes in Pakistan, Haiti and Sudan and at the same time the Emergency Team was under contracting with their potential suppliers. Supplier 1 told the Emergency Team that they did not want to hold shadow stock since they were unsure about the outcome of negotiation and potentially be unable to sell the goods already in stock. This situation put the Emergency Team in a challenging position. (Interview 2 2014)

As of today there are no specific guidelines or rules for how to specify the level of inventory neither the frequency of when to place POs (Internal document 3). Appendix

7 shows that the volatile demand has resulted in unstable inventory levels and it can also be seen that the POs are random distributed. (Interview 1 2014)

The average value in stock for each of the ERH-Kit for the period from 11/2011 to 04/2014 can be seen in Table 4.8. Note that ERH-Kit 10 is divided into A and B because of the significant price difference, 10A is delivered from supplier 1 and 10B is delivered from supplier 2. Table 4.8 does only illustrate the total average inventory level in value and does not demonstrate the difference between the two suppliers. Therefore Figure 4.7 below, demonstrates the inventory transactions, withdrawal and replenishment for ERH-Kit 2A. The full range of graphs for all of the ERH-Kits is found in Appendix 7. Even though it does not demonstrate the actual inventory level, the differences between the two suppliers, the frequency of received POs, withdrawals, and the difficulties in maintaining a stable inventory level can be seen.

Table 4.8. Average inventory value from 11/2011 to 04/2014 (Krantz and Sandin Hansson 2014)

ERH-Kit	Average inventory value US $
0	7 854
1A	70 410
1B	39 731
2A	438 972
2B	83 658
3	133 824
4	63 084
5	108 811
6A	82 334
6B	73 163
7	32 093
8	85 794
9	53 651
10A	9 016
10B	43 990
11A	42 534
11B	233 105
12	34 837

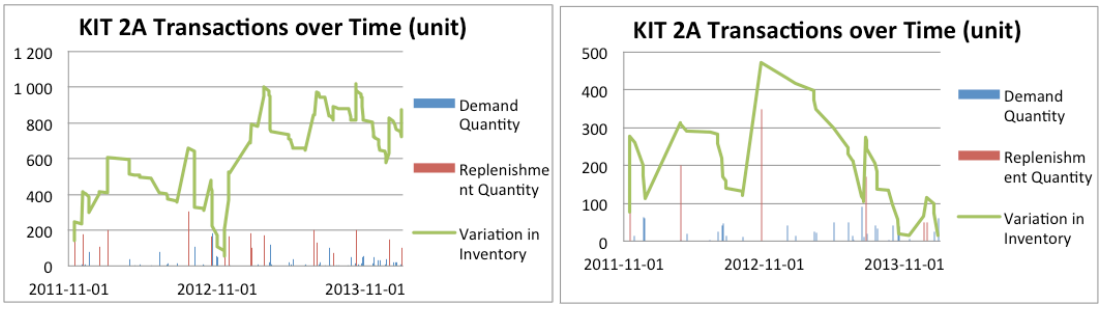

Figure 4.7. Transactions for Supplier 1 (left figure) and Supplier 2 (right figure) (Krantz and Sandin Hansson 2014)

When it is time for replenishment the Emergency Team send a PO to the supplier and for the dispatch the Emergency Team send an authorisation for shipment. (Interview 2 2014) The suppliers send monthly reports over stock level and for the ERH-Kits'

expiration dates for each batch. If the items go below 50 percent of the total shelf life they mark this goods to let the Emergency Team know. The customers do not want to receive goods that are close to expiration. (Interview 2 2014)

To manage the order requests the Emergency Team uses two IT tools in combination to each other; an ERP system and a planning tool for the ERH-Kits in Microsoft Excel. (Interview 2 2014) The planning tool in Microsoft Excel is necessary because the ERP system is not entirely customised for UNFPA's business and the Emergency Team's activities. The reason for the lack of customisation is that the system is owned by another UN agency and as well shared with a number of other agencies. (Interview 1 and Interview 2 2014)

All the transactional operations are performed in the ERP system and the system is used when managing the stock requests, allocating the stock, cancelling or putting orders on hold, issue the pick plan and confirm that the goods have been shipped. (Interview 2 2014) The ERP-system is practical for the part of dispatching the orders and keeps track of the inventory levels in terms of its amount and value. (Interview 2 2014)

To enable a dynamic process with the customers, the planning tool is used as a complementary. The planning tool keeps track over the goods, the orders, lot ID and the communication between the Emergency Team and the customers until the order is placed in the ERP system. The planning tool is also helping the Emergency Team to manage the inventory level, deciding upon the POs and prioritise between customers. As of today the internal customers that places an emergency order are first prioritised and thereafter the internal customers with non-emergency orders. Followed by the external customers first for emergency orders and then non-emergency. (Interview 2 2014)

When an order is received the first thing the Emergency Team does is to look in the ERP system's reporting tool and the planning tool in Microsoft Excel were the pending orders are kept, see Appendix 8. The pending orders are also committed even though they are not in registered in the ERP-system. In disaster situations the planning tool makes it possible to handle the situation and free up stock for this type of urgent matter. (Interview 2 2014)

5 Analysis of the Emergency Team's operations

In this chapter an analysis between the theory and the activities performed by the Emergency Team concerning Responsiveness and Demand Management are presented. Also the data regarding Demand and Inventory Management are further analysed and conclusions are made. The outcome of this chapter is the answer to RQ 1.

The Emergency Team is operating in a complex humanitarian environment. It is important to fully understand this context and the difficulties it is facing in order to analyse and find improvement for the Emergency Team. Therefore the authors have identified the most important elements of humanitarian logistics, see Figure 5.1. It is of significance to have these elements in mind while reading every part of the analysis.

Figure 5.1. Humanitarian Logistics from Theoretical Framework for Analysis (Krantz and Sandin Hansson 2014)

5.1 Responsiveness

The most important factors for Responsiveness identified in chapter 3 and brought to the theoretical framework for analysis, Figure 5.2, are Visibility, Velocity, Managing Inventory and Performance metrics. These factors are further analysed in this chapter. For the Emergency Team today, the key objective for Responsiveness is to respond to demand as fast as possible. There are currently no guidelines or measurements from top management in terms of hours or days in which they are obliged to respond to customer orders. However, new directives from the Executive Director of UNFPA, suggest that UNFPA should respond in the very early stages of humanitarian situations, which in turn would mean that the Emergency Team need to be more responsive and act fast in response to any emergency in the future. This strategy is in accordance with the endeavour within the humanitarian sector to move towards more responsive and agile supply chain operations.

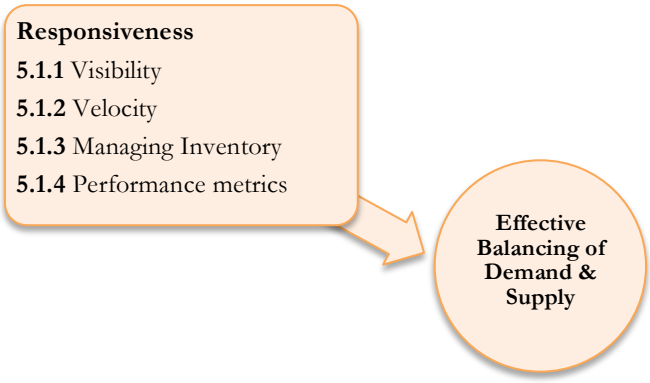

Figure 5.2. Responsiveness from Theoretical Framework for Analysis (Krantz and Sandin Hansson 2014)

5.1.1 Visibility

The most important factors identified from literature for visibility are customer and supplier relationship, and internal integration. The importance of communication, cooperation and collaboration is one of the keys to enable good forecasting which is discussed in theory by Mentzer et al. (1998). One problem for the Emergency Team is the uncertainty in demand and the lack of access to qualitative and quantitative data, both due to that historical demand data is not saved internally but also that data collected from the customers is poor. This is due to that many of the customers do not make forecasts, while others just do not communicate the forecasts to the Emergency Team. A reason for this might be that it is difficult for the COs to understand why it is important that they communicate the demand in time and collaborate with the Emergency Team. Hence, it may be hard for them to see the whole picture of the supply chain and the importance in providing the data. The incentives for creating forecasts and making sure that the performed forecasts are communicated to the Emergency Team are probably not clear to the customers. Another factor may be that it is too difficult for the customers to perform the forecasts.

Another reason for the lack of collaboration considering forecasts is undoubtedly because of the CO's constraints regarding funding. The COs are anxious about giving the Emergency Team clear information regarding their demand before they are 100 percent sure of that they will receive donations for the desired demand. Forecasting is further complicated as PSB and CSB collect different demand data at different times of the year from the COs and do not compile and validate the aggregated data. The challenges for performing successful operations due to the funding mechanism within humanitarian logistics are stressed in the theory, as well as that the complexity of the large amount of actors involved causing various motives.

Being close to the suppliers enables a better ability to have an agile supply chain and being flexible due to uncertainties in demand according to Christopher (2011). The PSB's and contracting team's aim is to improve the collaboration with the suppliers, which can be understood from that they recently have started to invite the suppliers to Copenhagen in order to cooperate and learn from each other. Another example is the focus on helping and pushing the performance of the suppliers who needs it the most. A problem that has occurred is that one of the suppliers did not understand the characteristics of the Emergency Team's business before entering the LTA. This has led to that it has not performed as agreed, which has made the coordination of placing orders to the suppliers complicated for the Emergency Team. The fact that the Emergency Team manages supplies that need to be available at the right time and the right quantity whenever there is a demand, further stresses the importance of a good relationship with the suppliers. There are only a few numbers of suppliers that are able to meet the early requirements of the contracting process. This may imply that UNFPA is in a tough position to negotiate in a desirable way to achieve better LTAs.

5.1.2 Velocity

The second key driver for Responsiveness is velocity that concerns the important factors affecting the speed in the ability to respond to demand. The theory presents three

important factors for velocity, namely, reducing in-bound lead time, streamlined processes and reducing non-value-adding time.

The theory discusses the importance of strategic sourcing to set the right prerequisites in the agreements from the beginning. This is of extra significance when the pace needs to be high while the environment is constantly changing. The lead time for ERH-Kits from the supplier is determined in the LTAs. Sometimes this lead time is shorter in reality due to how the supplier plans its production. The opportunity to lower the determined lead time from the suppliers is during the bidding process for new contracts. In the process of selecting suppliers the Contracting Team first put emphasis on quality, which seems obvious since the ERH-Kits contains pharmaceuticals and medical devices and is aimed to help people. Thereafter the price for the ERH-Kits is considered. The result of this is interesting, for example the price for ERH-Kit 10, differs significantly between the suppliers. The price for ERH-Kit 10 from supplier 2 is ten times higher than from supplier 1. Comparing with theory the factors quality and price are not consistent with the important factors for Responsiveness that rather emphasise the importance of lead time. The appreciation is that the focus on lead time is low prioritised by the contracting team in the contracting process compared to quality and price. It also seems to be unclear what the potential decrease in lead time from the suppliers could be, which also put emphasis on performing better forecasts for the performance of the planning for the Emergency Team. The suppliers do not manufacturer the items in the ERH-Kits, nevertheless the suppliers procure the goods and assemble the different items into ERH-Kits. This fact implies that the long lead time of ERH-Kits is driven by the inbound lead time to the supplier and not the "production" time.

In Table 5.1 that displays the relation in percent between early, on time and late deliveries per ERH-Kit relative the LTA lead times it is seen that for supplier 1 most of the orders are received before the determined lead time in the LTA. For ERH-Kits 0, 7, 10A and 11A all orders are received early or on time while for ERH-Kit 5 many are late. This implies that the lead time for many of the ERH-Kits most likely could be shortened in case of that the LTA agreement is renewed with supplier 1. Supplier 2 does not have as satisfactory statistics as supplier 1. ERH-Kit 5 have always been delivered late and ERH-Kit 2A and 3 have most of the times been delivered late, notably is that ERH-Kit 5 has all times been delivered early. It is clear that supplier 2's overall performance significantly deviates from the LTA lead times. Further intriguing is that the orders that are early or late are often not just early or late with a couple of days, but the deliveries are significantly early or late. As can be seen the orders for ERH-Kits 11A from supplier 1 are on average delivered 43 days prior to what is agreed upon. The late orders for ERH-Kit 1A from supplier 1 are in average delivered 113 days after the agreed lead time. From supplier 2 the orders for ERH-Kit 10B that are early are in average 32 days early. The orders for ERH-Kit 5, where all have been delivered late within the measured time period, have been delivered on average 123 days late. One reason for the early orders are known to be that, it is suitable for the suppliers to produce the ERH-Kits in a certain time or/and that the goods are already available from the supplier due to the shadow stock. Possible reasons for the late orders are however unidentified. If speculating, it

could be due to problems further up in the supply chain and that the suppliers receive their goods late. Further notably considering the lead time is that the average lead time from supplier 1, which can be seen in Appendix 5, is substantially lower for all ERH-Kits relative to the LTA lead time. The average actual lead time relative to the LTA lead times, also seen in Appendix 5, from supplier varies depending on ERH-Kit. Some of the ERH-Kits have an average actual lead time that is much lower than the LTA lead times and some ERH-Kits have an average lead time that is extensively longer than the LTA lead time.

Table 5.1. Average days early respectively late according to LTA agreement during the period 11/2011-04/2014 (Krantz and Sandin Hansson)

	Supplier 1		Supplier 2	
ERH-Kit	**Average Days Early**	**Average Days Late**	**Average Days Early**	**Average Days Late**
0	39	-		
1A	38	113		
1B	35	32		
2A	37	31	-	20
2B	-	34	20	27
3	17	10	-	131
4	18	64	22	34
5	17	15	-	123
6A	25	8		
6B	16	14		
7	28	-		54
8	14	16		
9	36	18		
10A	42	-		
10B			32	63
11A	43	-		
11B	13	41		
12	24	27		

Streamlined processes concerns to simplify operations through a reduction of number of stages or activities involved. As of today, the suppliers perform the physical activities of managing inventory since they run the warehouse. The Emergency Team manages the transactional operations for the warehouse since it decides on when and what to dispatch and when and what to replenish. Further the Emergency Team's tasks focus on procurement and vending of ERH-Kits. There is a number of second tier suppliers that supplies the goods to the first tier and it seems that the Emergency Team are not aware of how this cooperation is organised. Therefore there might be potential improvements in the simplification of processes early on in the supply chain. Considering a reduction of batch size, which is also a factor for streamlined processes, the suppliers have expressed desire for receiving POs once every quarter for the different ERH-Kits to enable better production planning. This is though in contradiction to literature, that stresses the reduction of batch sizes. However if this could result in a shorter lead time from the supplier it could be worth to investigate further into.

The third driver; Reduce non-value-adding time concerns the value the activity bring to the customer. A non-value adding activity within the Emergency Team is considered being linked to the ERP-system. The ERP system is not perfectly customised for the Emergency Team's operations since it is complicated to change registered orders. The result is that the Emergency Team needs to work with Excel as a parallel system, which increase the workload as well as the risk of mistakes. Another concept of reducing non-value-adding time is postponement. Pushing the decision point close to the delivery point is desirable for the Emergency Team, due to the unpredictable demand pattern, requirement for short lead time to the customer and constraints regarding shelf life. The current lead time from the supplier pushes the decision point, of what and how much to order, backwards in time and forces the Emergency Team to place order long before it is certain that the ERH-Kits will be sold. The decision point towards the other end, i.e. against the customers is considered more flexible since the Emergency Team have a priority system where they prioritise emergency orders.

5.1.3 Managing Inventory

According to theory the strive is to keep the lead time to the beneficiaries in humanitarian logistics as short as possible since the demand often is needed immediately. Enabling a short lead time to the beneficiaries is evident and therefore dependent on that inventory is prepositioned. In the Emergency Team's case the aim is to keep the lead time from the Emergency Team to the customers as low as possible which is why the chosen transport mode is often air freight. This contributes to that the cost of the ERH-Kits is higher than if shipped with an alternative transport mode.

Holding inventory in relation to Responsiveness is however a discussed topic within research. There are spokesmen for inventory's positive impact on Responsiveness as well as spokesmen for its negative impact. The opinions against inventory mean that synchronous scheduling is more beneficial than holding inventory. However because of the lead time for the ERH-Kits from the suppliers, holding inventory of the ERH-Kits is currently required because of the need for fast delivery to the customer when an order is received.

In the graphs in Appendix 7 the historical inventory transactions can be viewed, they display that during the measured time period the received replenishment orders from the suppliers has arrived in a sporadic frequency, and with a quantity variation. Also the customer POs have been placed in a sporadic frequency and quantity variation. It can be seen that the large amount of low or inexistence activity and the placement of few POs, especially for supplier 2, demonstrates some of the difficulties for the Emergency Team to manage these operations effectively. Managing inventory level is according to theory one of the tasks to maintain the desired service level. The Emergency Team does not use min and max levels for the managing of inventory. Neither is there a distinct number for what service level the Emergency Team should aim for. The expressed goal is to respond as fast as possible to as many orders as possible. Nevertheless there are polices for what orders that should be prioritised based on if it is an emergency situation or not and type of customer.

A tool for inventory control discussed in theory is the EOQ-model. The Emergency Team does currently not use any kind of formula or numerical model for the Inventory Management of ERH-Kits and does not have a distinct process for this. To strengthen the managing of inventory a simple model such as the EOQ-model could be used to assist and standardise the tasks. However, the original state of the EOQ-model formula and the Emergency Team's characteristics does not entirely correlate. This since e.g. the EOQ-model assumes that the demand is continuous and constant while the demand is highly volatile for the Emergency Team. The Emergency Team also needs to define the ordering cost for the formula to be useful. Nevertheless, with the right modifications the EOQ-model may be helpful and give guidelines for how to manage inventory.

Other features for Inventory Management mentioned in theory are perishable goods and safety stock. The last mentioned could be used to secure a service level despite unexpected situations. Since the Emergency Team on a day-to-day basis copes with unforeseen events, such as sudden increase in demand and longer lead times than estimated on certain orders due to the lack of performance from the suppliers of ERH-Kits, safety stock could help the Emergency Team to sustain the wanted service level. However, a problem with the ERH-Kits is that parts of the content in many of the ERH-Kits are perishable, meaning that they lose value over time. So if an ERH-Kit defaults there is a risk that invested capital will be lost. The more goods in inventory the higher the risk there is for expired inventory and loss of capital, which results in that UNFPA must replenish the cash and bring the fund up to the correct level. It is clear that the funding mechanism within the area, also stressed in theory, complicates the operations for the Emergency Team.

To reduce the damage in the situations when the ERH-Kits or parts of the ERH-Kits are close to expiration the Emergency Team replaces those ERH-Kits or parts to avoid stock out. It can be discussed how well optimised the PO operations are due to the fact that there are no system or model that the Emergency Team can use in their task of placing orders. Over book sales is not considered to be an option for The Emergency Team since they deal with emergency situations where humans are involved. Dynamic pricing is neither practiced, but in the situations when the ERH-Kits have gotten close to expiration, the Emergency Team has tried to reach out to the customers to sell ERH-Kits. One option to further attract the customers to buy these ERH-Kits could be to lower the price for these ERH-Kits, however the risk with this may be, that once the customers have paid a lower price for an order this can be assumed to happen in the future as well. This could result in that customers wait for the ERH-Kits to lose value, meaning that they wait until the ERH-Kits have a lower price before placing an order. Dynamic pricing regarding a higher price might not be suitable because the Emergency Team is not allowed to make profit. On the other hand it should be allowed to make a lower or a negative profit by lowering the selling price of the goods when they are closing up on the expiration date. This could be a substitute to replacing expired goods in the ERH-Kits. After all it should be better to use the ERH-Kits than to scrap them or at least parts of them.

When deciding inventory levels it is important to take the demand patterns into consideration and understand the drivers for the demand. The authors chose to divide the ERH-Kits in different groups depending on the shelf life for the different ERH-Kits when calculating the inventory levels. In Table 5.2 the five groups are presented. The calculated inventory level is based on the expected demand during the lead time, which is calculated as an average expected demand per day multiplied by the expected lead time per order. Hence, the lead time per ERH-Kit is approximated by the lead time per order. The calculated inventory level is thereafter calculated as the expected demand during the lead time added with the highest demand value from the given data.

Table 5.2. An example for how to calculate inventory levels for respective ERH-Kit (Krantz and Sandin Hansson 2014)

	Highest value	Expected Demand (units/day) $E[D2] = \frac{1}{N} * (\sum_{1}^{N} d_N)$	Expected Lead Time (days)	Expected Demand during the lead time (units)	Calculated Inventory Level (units)
Group 1	**N/A shelf life**				
0	30	0,2	39	7,8	37,8
2A	185	4,28	95	406,6	591,6
2B	120	2,4	84	201,6	321,6
6A	63	2	68	136	199
10A	36	0,63	42	26,46	62,46
10B	30	0,26	69	17,94	47,94
11A	25	0,86	39	33,54	58,54
Group 2	**60 months shelf life**				
1A	110	1,24	94	116,56	226,56
1B	90	0,48	78	37,44	127,44
Group 3	**36 months shelf life**				
4	50	1,53	88	134,64	184,64
7	49	0,79	81	63,99	112,99
9	69	1,51	70	105,7	174,7
Group 4	**24 months of shelf life**				
3	47	1,83	93	170,19	217,19
5	71	2,19	124	271,56	342,56
6B	50	1,85	74	136,9	186,9
8	70	1,26	78	98,28	168,28
11B	25	0,73	101	73,73	98,73
Group 5	**12 months shelf life**				
12	30	0,53	70	37,1	67,1

In Table 5.3 a comparison between the calculated average value in stock and the historical average value in stock is presented. Due to that the cost per ERH-Kit differs between the suppliers, the cost per ERH- Kit is calculated as the percentage of delivered order per supplier multiplied by the specific cost. Since the cost for ERH-Kit 1A and B

are not available for supplier 2, the cost of supplier 1 is approximated as the cost. It is assumed not to affect the recommended inventory level notably. It can be seen that the calculated average value in stock results in a total increase with 15 percent from the historical average value in stock.

Further on, a suggested average value in stock is presented in Table 5.3. The cost per ERH-Kit is calculated based on the share of delivered ERH-Kits per supplier, see Appendix 10. For group 1 it is recommended to have a higher inventory level than calculated though there are no shelf life issues. Therefore the historical average level is approximated as suitable. However, it is recommended to further investigate in these levels, as an example ERH-Kit 0 is ordered seldom and ERH-Kit 2 is decreasing with time. Group 2 consists of ERH-Kit 1A and 1B which have a shelf life of 60 months. Because of the relatively long lead time it is recommended to keep the historically high inventory levels. Group 3 consists of the ERH-Kits with a shelf life of 36 months. An interested number is the historical average value of US dollar 63 084 which is 632 % more than calculated. This seems to be extremely high and a reason for this might be that the low cost for ERH-Kit 4 implies a larger willingness to invest in inventory. It is though recommended to invest in the higher inventory level for group 3 with the motivation that all of the ERH-Kits in the group have a demand that is increasing with time and write-offs has not been a problem in the past. Looking at the result in group 4 and group 5 the calculated inventory levels are consistent larger than the historical ones. It might be these ERH-Kits the customers have been forced to wait for and therefore it is for these ERH-Kits the Emergency Team can make changes to become more responsive. It is recommended to take more risk since it is known that the inventory levels have been too low in the past. More risk is necessary to take to meet the criticism from customers which regarding late deliveries and from information from the Emergency Team implying that far from all of the requested demand is fulfilled. The concluded recommendation is that the inventory levels should be increased with 27%.

Table 5.3. An illustration for the difference between calculated, historical and suggested inventory levels (Krantz and Sandin Hansson 2014)

ERH-Kit	Cost per ERH-Kit (US dollar)	Calculated average value in stock (US dollar)	Historical average value in stock (US dollar)	Difference in percentage between calculated and historical value in stock (%)	Suggested average value in stock (US dollar)	Difference in percentage between suggested and historical value in stock (%)
Group 1						
0	123	4 653	7 854	-69 %	7 854	0 %
2A	531	313 970	438 972	-40 %	438 972	0 %
2B	91	29 166	83 658	-187 %	83 658	0 %
6A	477	95 003	82 334	13 %	95 003	13 %
10A	75	4 706	9 016	-92 %	9 016	0 %
10B	997	47 800	43 990	8 %	47 800	8 %
11A	518	17 357	42 534	-145 %	42 534	0 %
Group 2						
1A	517	60 262	70 410	-17 %	70 410	N/A

1B	368	13 778	39 731	-188 %	39 731	N/A
Group 3						
4	47	8 617	63 084	-632 %	63 084	0 %
7	155	17 478	32 093	-84 %	32 093	0 %
9	377	65 836	53 651	19 %	65 836	-19 %
Group 4						
3	582	199 384	133 824	33 %	199 384	33 %
5	426	146 043	108 811	25 %	146 043	25 %
6B	503	93 917	73 163	22 %	93 917	22 %
8	573	96 399	85 794	11 %	96 399	11 %
11B	3 769	634 247	233 105	63 %	634 247	63 %
Group 5						
12	1 080	72 491	34 837	52 %	72 491	52 %
Total		1 921 109	1 636 861	**15 %**	2 238 473	**27 %**

The strategy for the inventory level calculations is chosen by the authors in order to give a simple illustration of how to calculate inventory levels but at the same time taken the extreme values into consideration. It can be discussed if this is the right way to go as well as what will happen if more than one extreme value occurs within the lead time. To lower the negative impact if this occurs a higher inventory level for the first group of ERH-Kits are recommended. In addition the demand has increased during the latest years and the calculated inventory levels are only dimensioned for one extreme value and thereby it could be suitable to increase the inventory level even more. In reality peaks could be connected to each other because an emergency has often several actors helping relief the disaster. This could therefore also be supported by an increase in inventory levels.

As seen in the graph in Figure 5.3, the relation between available cash, PO and stock has varied quite much between 11/2011 and 04/2014. Appendix 4 demonstrates that during a period from February 2013 and July 2013 the amount of available cash fell below US$ 2 million, the lowest level turned at around US$ 1.2 million in available cash in June 2013. During the same period the value in inventory oscillated between US$ 1.2 million and US$ 2.4 million and the value tied up in PO varied between US$ 1.1 million and US$ 2.4 million. The fact that the value was so high both for inventory and POs during the same period is the reason for the low level of available cash. The highest inventory level was in June 2013 when the inventory value counted for US$ 2.4 million, and it is one of three times during the measured period when the total value of inventory has exceeded US$ 2 million. The peak for the amount of capital tied up in POs is similar, US$ 2.4 million dollars and that was reached in March of 2013. With the current inventory level the revolving fund, based on the mentioned figures, is not considered to be a constraint when managing ERH-Kits. Even though the Emergency Team has expressed that the amount of available cash has never been insufficient for placing a required PO there is a risk for this to occur in the future if the inventory levels increase.

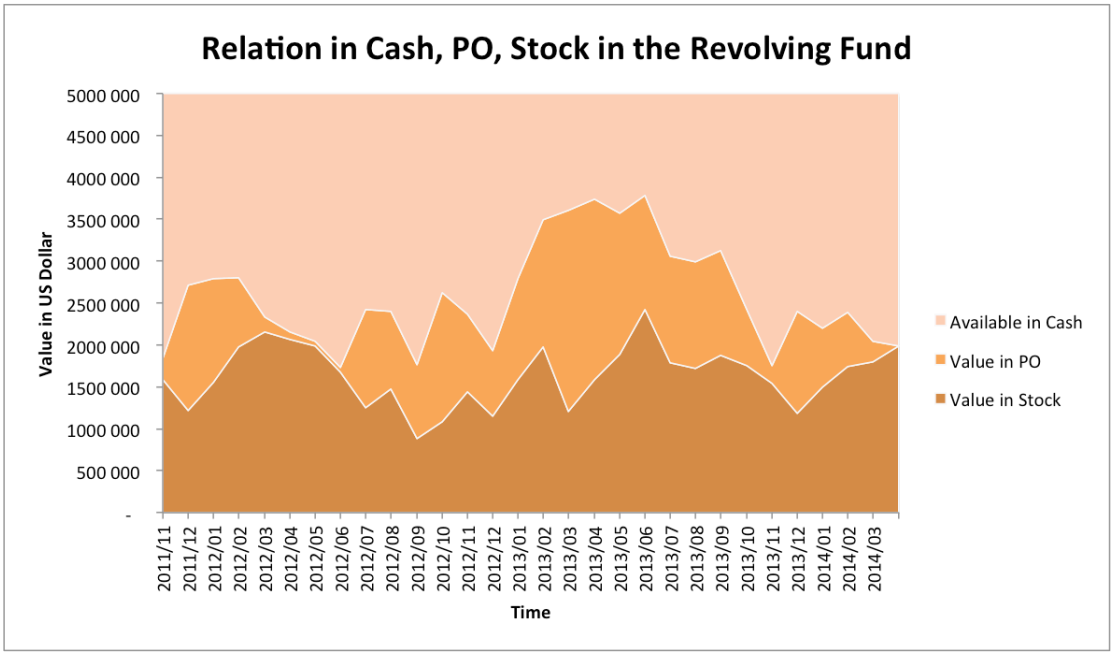

Figure 5.3. The historical relation in value between cash, PO and stock in the revolving fund between 11/2011-04/2014 (Krantz and Sandin Hansson 2014)

The effect of the two calculated increased inventory levels for the revolving fund can be seen in Figure 5.5 and Figure 5.5. Based on the historical balance between available cash, value in PO and value in stock, it can be seen in both of the graphs that the increased stock level entails a lower level of available cash. With a 17 % increase in stock level the lowest amount of available cash, would reduce to US$ 847 536, see Appendix 4. With an increase in stock level with 27 % the lowest amount of available cash would reduce to US$ 556 257. The PO value is unchanged in the graphs. This is due to that the greatest factor affecting the PO value in this matter is considered to be the lead time since this effects the amount of time the capital is allocated in a PO. An increase in demand would probably increase the value allocated in PO, but since it is assumed that there is a possibility to lower the average lead time the PO value is not assumed to affect the balance in the revolving fund in a noticeable way. However, to achieve a reduced lead time from the suppliers it is important to track the lead time performance. A reduced lead time could result in an increase in inventory level without increasing the total amount of capital in the revolving fund. From the graphs in Appendix 6 it is shown that the demand of several ERH-Kits is increasing with time. If this increase will continue there will come a day, not far from now, where the revolving fund could become a constraint. But as for today the revolving fund will probability not be a constraint if the inventory level is increased with the recommended 27 %.

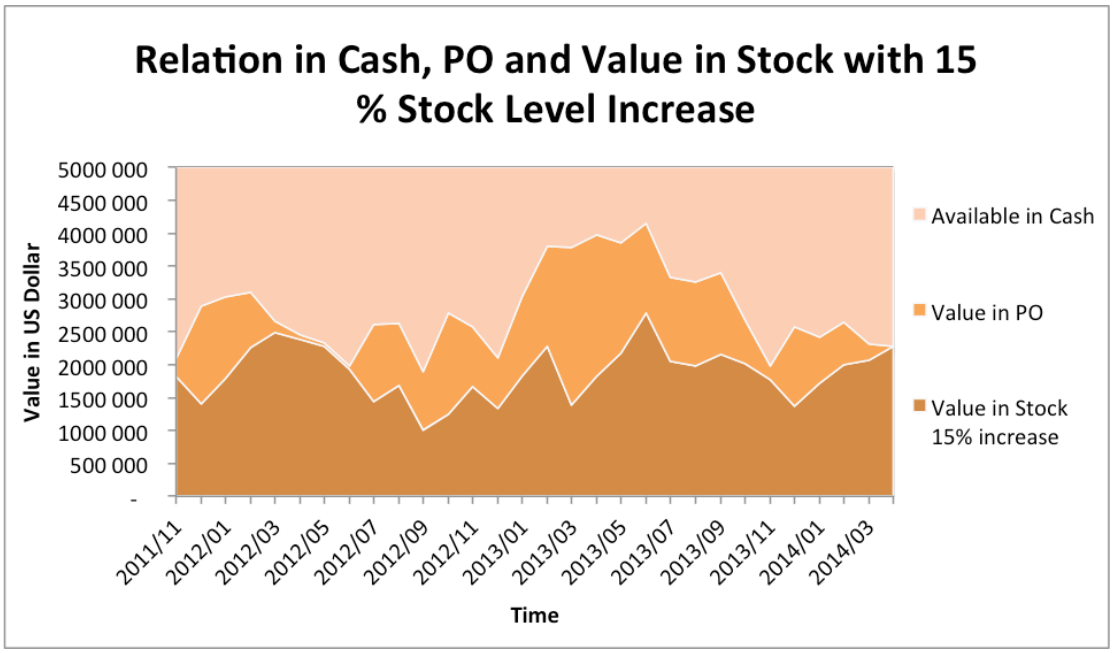

Figure 5.4. An illustration for the revolving fund if the inventory levels increase with 15% (Krantz and Sandin Hansson 2014)

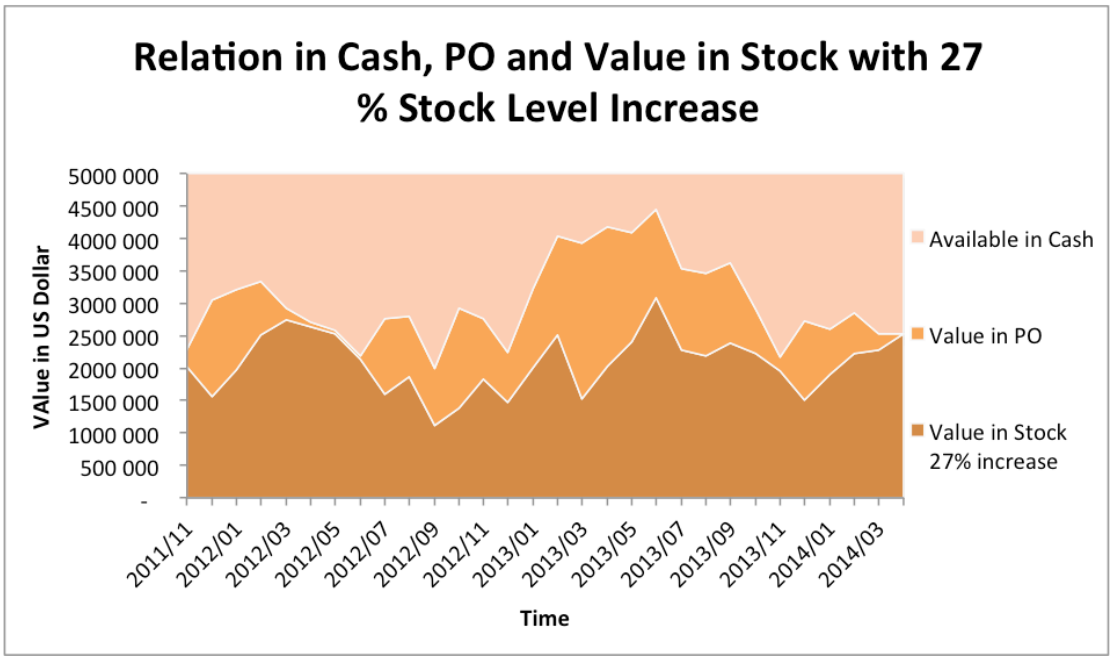

Figure 5.5. An illustration for the revolving fund if the inventory levels increase with 27% (Krantz and Sandin Hansson 2014)

According to theory, risk taking is a factor that has an increasing impact on the decision and control management within organisations today, which also can be seen in the Emergency Team's case. Every time the Emergency Time places a PO and invests in inventory a risk is taken due to the uncertainty of demand and the fact that much of the inventory is perishable. The risk is considered to be further more challenging to handle due to the fact that the organisation is financed through funding and constrained with the revolving fund. In relation to theory UNFPA's and the Emergency Team's risk management approach is inadequate. The theory discusses the importance of Risk

Identification, Risk Analysis and Risk Evaluation. Various types of methods for identifying risk in order to understand where and what risk that might occur are suggested in theory. Currently the risk identified by the Emergency Team in their tasks is the risk of losing capital if it invest in inventory that are not sold and by that being forced to write down the expired inventory. Risk Analysis is considered to be touched upon regarding the risk severity where the Emergency Team takes into account the potential loss of capital when investing in inventory. However, the probability of the risk occurrence is not identified. The Risk Evaluation concerns the level of risk and the appetite and tolerance of risk. The Emergency Team's risk appetite and tolerance are currently not explicitly defined in numbers but rather expressed as something that should be as low as possible. However, the Emergency Team's strategy is currently under transformation towards becoming more responsive and willing to take on a greater financial risk and invest in a larger amount of inventory than before. However, since the strategy origins from a higher level within UNFPA and since the prerequisites are not specified for in what extent the Emergency Team will be given possibilities to become more responsive, it is unclear exactly what the Emergency Team is allowed to do to increase its Responsiveness. Nevertheless it is certain that the more capital invested in inventory the greater the risk for expired goods and loss of capital it is. The authors' interpretation is that, due to lack of a clearly articulated risk management policy for UNFPA, PSB and by that the Emergency Team, has adopted a conservative approach to risk and therefore have held relatively low levels of stock of ERH kits.

5.1.4 Performance Metrics

Measuring the performance is considered to be of high importance when managing a responsive supply chain according to theory. It is so, since it is difficult to know if the performance meets the desired level. The Emergency Team does not measure any of its performance, which is common for humanitarian organisations. It would be interesting to know how fast the Emergency Team generally responds to customer demand and how many of the arrived inquiries the Emergency Team is able to respond to. If this type of data could be compared in time and against a target level, the Emergency Team's performance could be measured and by that evidently make the activities more transparent. This would result in knowledge and hard facts about the operations and activities where the performance is not as good as desired.

5.1.5 A summary of the analysis for Responsiveness

In Table 5.4 the most important gaps from theory and the Emergency Team's activities are summarised. This summary aims to help the reader to conclude upon the written text.

Table 5.4. A summary of the difference in theory and the activities within the Emergency Team regarding Responsiveness (Krantz and Sandin Hansson 2014)

Concept	Theory	The Emergency Team
Visibility	▪ Collaborate with customer ▪ Collaborate with suppliers ▪ Internal integration	▪ Problem with access to demand ▪ Few number of supplier ▪ Uncoordinated forecast processes between CSB and PSB

Velocity	▪ Reduce inbound lead time ▪ Streamlined processes ▪ Reducing Non-value adding time	▪ Not clear how much the lead time can be decreased
Managing inventory and the associated risk	▪ Using safety stock to secure service level ▪ Determine service level ▪ EOQ could be applicable to calculate the optimal order quantity ▪ Managing risk effectively	▪ Place POs from experience while taking risk for stock out and expired goods into consideration ▪ No determined service level ▪ Lack of methods to calculate on appropriate Inventory Levels ▪ Lack of a Risk Management approach
Performance metrics	▪ Very important	▪ Not adopted yet though there is a aim to do so in the future

5.2 Demand Management

The Emergency Team is well aware of the importance of demand planning but is constrained by the management of ERH-Kits through a number of reasons. As already mentioned the uncertainty in demand is an issue which origins both from the emergency context but also from the lack of accurate forecasting data provided by the customers. This oppose a factor for the ability for Responsiveness stressed by Christopher (2011) in theory, namely access to real demand. The Emergency Team also lacks the possibility to review the true historical demand since the only data that is saved is the data for the actual depleted orders. The theory emphasises that misleading demand planning will pass on and amplify through the processes. The way the Emergency Team manages the demand of ERH-Kits is through holding inventory of ERH-Kits. Demand planning is identified as the first activity in a company's business planning and serves as a foundation for a number of operations, according to theory. The Emergency Team is a part of a procurement organisation and therefore the planning of demand is very crucial for the Emergency Team's performance.

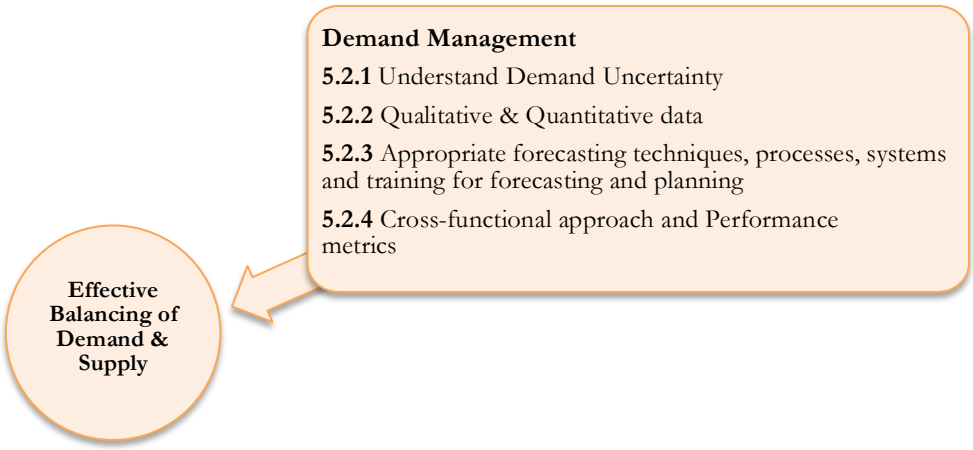

Figure 5.6. Demand Management from the Theoretical Framework for Analysis (Krantz and Sandin Hansson 2014)

5.2.1 Understand Demand Uncertainty

To understand the real demand and why there is such a grave uncertainty the authors analysed the demand statistics more thorough. However a source of error is that the historical depleted orders are assumed to represent the real demand. This means that the analysed data only is an approximation of the historical demand and the source of error is unknown. Further the fact that there is a lack of data for what orders that are connected to emergency situations and not, results in difficulties in the analysis of the data. Since the labelling of, if it is an emergency order or not, is done by the customer it is considered to be subjective as this on occasion results in that ERH-Kits are ordered when it is not an emergency situation and thereby complicate the planning for true emergency situations.

In Appendix 6 all 17 ERH-Kits are plotted in graphs displaying demand frequency and quantity. Important to remember is that every type of emergency require different aid and therefore also different ERH-Kits. A further analysis can be seen in Table 5.5 where the orders are analysed for the frequency of number of orders, the average order quantity, and the extreme values. The order frequency is divided in seldom, medium and often demanded orders to be able to structure and draw conclusions. The seldom demanded orders are those between 0-100 orders during the measured period, which spans over approximately 2,5 years. The medium demand is defined as those between 101-160 orders and the often is 161-190 orders during the period. The next column describes the average order quantity, which means the average number of ERH-Kits per order. This data is separated into small, medium and large orders. The definitions for the different frequency groups are, small orders are the orders with a quantity of 0-5 ERH-Kits, medium 6-10 ERH-Kits per order and large is 10 or more ERH-Kits per order. The conclusion is that the demand for the ERH-Kits varies and to gain a better understanding of the demand it would be interesting to investigate the drivers for the extreme values further.

Table 5.5. Analysis of the Demand Pattern of the ERH-Kits (Krantz and Sandin Hansson 2014)

ERH-Kit	Seldom/ medium or often demanded	Average of Small/medium or large order	Extreme values
0	Seldom	Small	Largest peak of 30 units, then 3 on 20
1A	Often	Medium	6 orders of 25 ERH-Kits
1B	Seldom	Medium	One extreme value of 90 units
2A	Often	Large	One extreme value of 185
2B	Medium	Large	One extreme value of 120
3	Often	Small	No significant extreme value
4	Medium	Medium	No significant extreme value
5	Often	Medium	One extreme value of 70 ERH-Kits
6A	Often	Medium	One extreme value of 50 ERH-Kits
6B	Often	Medium	No significant extreme value

7	Seldom	Medium	One extreme value of 50 ERH-Kits
8	Medium	Medium	One extreme value of 70 ERH-Kits
9	Medium	Medium	One extreme value of 70 ERH-Kits
10	Medium	Medium	No significant extreme value
11A	Often	Small	No significant extreme value
11B	Often	Small	No significant extreme value
12	Medium	Small	One extreme value of 70 ERH-Kits

Many of the graphs have extreme values that stand out relative to the other order points in terms of amount of ERH-Kits. It is therefore important to have in mind that the extreme values very much affects the order trends, which is seen in Appendix 6. The extreme values were kept in the analysis, it is not investigated what the effect would be if the extreme values were taken out, since the causes of the peaks are uncertain. If the peaks exist due to large-scale emergency situations a possibility could be to disregard the peaks and only consider the more constant and probable demand. However, the peaks can also exist due to other reasons, such as that the customer needs to spend their funds and therefore buys a large quantity of ERH-Kits or that the inventory was close to expiration and the Emergency Team therefore emphasised a rapidly vending of these. The conclusion from this analysis is that the different ERH-Kits have different demand pattern whereas the ERH-Kits are ordered at different frequency and at different order size. These different demand patterns are important to understand and draw conclusions from. As an example ERH-Kits is on average ordered 1,3 items per order. In order to minimising the risk for loss of capital an idea could be to reducing the size of this ERH-Kit if it is possible.

The initial purpose of the ERH-Kits is to be provided in emergency situations, but currently there are no clear directives on what is considered as an emergency situation and not except from the definition of a humanitarian emergency disaster. Understandably an emergency situation can be defined in different ways. An emergency situation can be a natural or man-made disaster or it can be due to other circumstances such as a smaller crisis or e.g. that the demand suddenly has arisen and there is an urgent need for ERH-Kits.

It is clear that the Emergency Team tries to inform the customers about ordering from the regular procurement catalogue when it is believed that the situation is not a "true" emergency, nevertheless it is hard for someone outside the situation to actually judge if it is an emergency situation or not. To ease the demand planning for the Emergency Team as well as to maximise the delivery of ERH-Kits to the situation where there is a truly need, it is essential to develop guidelines. The guidelines should give directives for the purpose of the ERH-Kits and what type of situation that is considered as an emergency situation. Another mentioned issue with the customer is that they sometimes order a whole ERH-Kit without needing its entire content. This disguises the actual demand of the ERH-Kits and aggravates the demand planning for the Emergency Team. If the customers that order the ERH-Kits with the intention of not using all different types of

items in the ERH-Kit, had ordered these items through the regular procurement at PSB instead the demand pattern would probably turn out differently. Due to the lack of knowledge within the demand pattern it is important to continuously analyse this to learn the drives for the demand.

5.2.2 Various sources of data

According to theory the quality of data is important. This implies using both qualitative and quantitative data in the demand planning. Today, the Emergency Team use mostly qualitative methods based on experience and try to use quantitative data as much as possible. However, the fact that only data on actual depleted orders is saved and not the original demand makes this task complicated. This together with the already mentioned low response from the customers regarding what orders they plan to place in the coming year, the quantified data is lacking.

5.2.3 Appropriate forecasting techniques, processes, systems and training

The Emergency Team does not perform its own forecasts of the demand in terms of collecting data of analysis directly from the end consumer. Instead the Emergency Team collects data from its customers in the procurement planning tool and compiles the data. This results in a type of aggregated forecast with data from many different customers, which according to the forecasting principles from theory increases the chance of a good outcome. However an important issue is, as already mentioned, that not many of the customers communicate the information regarding future demand in the procurement planning tool, which complicates the forecasting for the Emergency Team.

Another problem is that different actors perform the forecasts, which results in that different tools are used for the forecasting. The data output from the different forecasts may therefore be different, e.g. in horizon and in quality, and by that difficult to draw conclusions from. The Emergency Team aims to make forecasts with a longer time horizon but the customers are not always able to deliver this. The forecasting outcome according to theory is improved by a shorter horizon, however due to that the lead time for ERH-Kits are considerably long the Emergency Team aims to perform longer forecasts than what may be optimal.

The Emergency Team lacks proper systems and processes for forecasting since it is unable to collect them. The theory mention the importance of building a single "forecasting infrastructure" and provide training in this and in understanding what poor quality can lead to both for users and those who develops the forecasts. The Emergency Team attempts to perform a type of forecast while asking the customers to communicate what orders they are going place in the coming year in the procurement tool. Consequently the Emergency Team tries to perform forecasts, although it is not considered to be a highly prioritised task within the Emergency Team in the extent the theory argues it should be. This may be because of that the focus is stronger on procurement due to the organisation's culture, that the knowledge within the area is not thoroughly developed or/and due to bureaucracy.

In order to investigate in forecasting approaches, the authors compiled and analysed given order statistics from the Emergency Team. In theory it was found that the number

of disaster is increasing with time following an exponential distribution. It was also found that the waiting time between airline disasters is a negative exponential function. The authors found pretty easily that the order statistics did not seem to follow an exponential distribution, see Appendix 6. The times between the orders neither seemed to follow a negative exponential function, see Appendix 9. However, the given data is a too small data range for making this type of analysis and therefore this becomes a quite vague analysis. However, the conclusion from this analysis is that no apparent demand pattern was found.

5.2.4 Cross functional approach and Performance measures

Cross functionality and performance measurements have been discussed in the first section of the analysis regarding Responsiveness. The theory emphasise the importance of communication, collaboration and cooperation, these areas could be improved within the Emergency Team, as well as within PSB. This is a typical problem for humanitarian organisations though the number of stakeholders is many and they all have different motives. If the Emergency Team could improve this both within the organisation but also with customers it might result in a better understanding of the customers and thereby also improved forecasting. Performance measures are also important for Demand Management to measure the performance and improvements in this area and as mentioned before the Emergency Team lacks this system but strives to adapt it in the future.

5.2.5 A summary of the analysis regarding Demand Management

Table 5.6 displays a summary of the most important gaps between theory and the Emergency Team's activities regarding Demand Management.

Table 5.6. Summary of the differences between theory and the activities within the Emergency Team (Krantz and Sandin Hansson 2014)

Concepts	Theory	The Emergency Team
Understand demand and uncertainty	▪ Understand customer segments ▪ Identify key factors influencing the demand level	▪ Communicates with customer regarding the purpose of the demand ▪ The customers fills in if it is an emergency or not when placing the order ▪ The demand of ERH-Kits is volatile
Various sources of data	▪ Qualitative and Quantitative data	▪ Mostly use qualitative data through the experience of the demand planner
Appropriate forecasting techniques, processes, systems and training	▪ Build a single "forecasting infrastructure" ▪ Training developers to understand implications of poor quality	▪ The customers uses different methods for forecasting ▪ Forecasting is not the most prioritised task in the Emergency Team

Cross functional approach	▪ Communicate, cooperate and collaborate ▪ Establish a cross-functional approach to forecasting	▪ Not many customers communicate their estimated plans for future orders. ▪ Potentially there are forecasts that are being done that are not shared with the Emergency Team
Performance measures	▪ Establish multidimensional metrics ▪ Measure accuracy whenever and wherever forecasts are adjusted ▪ Measure, measure and measure	▪ The Emergency Team is not measuring the performance today, but aims to do so in the future

5.3 Answer to RQ1

From the analysis in this chapter several gaps between theory and the Emergency Team's activities are identified. The gaps identified are related to the concepts from the Theoretical Framework for Analysis. Findings from this chapter show that all of the concepts are important to the Emergency Team since there are potential improvements that can be made within all of the areas. Therefore the answer to RQ1 (What is important to consider in order to strengthen the balance of supply and demand regarding the ERH-Kits, while managing the uncertainty in demand and the risk of having expired goods in stock?) is summarised and displayed in Table 5.7. The following chapter, chapter 6 presents potential improvements that are believed to reduce the identified gaps between theory and the Emergency Team's activities.

Table 5.7. Identified concepts for effective balancing of demand and supply (Krantz and Sandin Hansson 2014

Concepts to consider for an effective balancing of demand and supply for the Emergency Team	**Potential results if improvements are done in each area**
Visibility, meaning collaboration with suppliers and customers	• Access to real demand • Larger and better performing supplier base • Improved forecasting and demand planning
Velocity, meaning reduce lead time and non-value adding time	• A reduction in inbound lead time
Managing inventory and the associated risk	• Placing optimal POs and Inventory Levels • Using service level as a guideline • Using a risk management approach to set guidelines for the Emergency Team
Performance metrics	• Measure the performance in order to improve the operations
Understand demand and uncertainty	• Easier to forecast and plan the demand
Various sources of data	• Using more quantitative data can result in more accurate demand planning
Appropriate forecasting techniques, processes, systems and training	• Improved demand planning
Cross functional approach	• More customers communicates its forecasting plans

6 Creating a Support Tool

This chapter discusses the take away from the identified important factors for the Emergency Team in the previous chapter. Improvements for the factors are suggested and serve as a start point to the creation of a support tool. Finally, the developed support tool is presented and explained thoroughly followed by an Action Plan containing what to do and how to do it.

This chapter answer the formulated RQ2, (What factors are important in the development of a support tool and how could this be put together to help the Emergency Team to manage the ERH-Kits?). The outcome from chapter 5 provides gaps between theory and the Emergency Team in the area of Responsiveness and Demand Management. This chapter starts by suggesting improvements for the concepts that are identified as essential for balancing of supply and demand from Table 5.7. Table 6.1 and Table 6.2 demonstrate the suggested improvements and the decision level that these improvements are linked to. These suggestions are separated in the three decision levels; strategic, tactical and operational. Thereafter the chapter presents the support tool and provides an explanation for each of the parts in the support tool.

Table 6.1. Suggested improvements and the level of decision linked to the improvement (Krantz and Sandin Hansson 2014)

Concepts for responsiveness	Potential improvements for responsiveness	Strategic decisions	Tactical decisions	Operational decisions
Visibility	• Simplify the requirement on forecasts			X
	• Coordinate forecasting processes with CSB	X		
Velocity	• Investigate the possibility to decrease the lead time from the suppliers		X	
	• Postpone decisions as much as possible			X
Managing inventory and the associated risk	• Investigating in optimal PO frequency			X
	• Determine service level	X		
	• Dynamic pricing	X		
	• Identify and manage the risks effectively	X		
Performance metrics	• Establish a Performance Measurement system for responsiveness	X		

Table 6.2. Potential improvements and linked decision levels for Demand Management (Krantz and Sandin Hansson 2014)

Concepts for Demand Management	Potential improvements for Demand Management	Strategic decisions	Tactical decisions	Operational decisions
Understand demand and uncertainty	• Perform thorough continuous analysis of the demand			X
	• Separate the demand in emergency and non-emergency			X
	• Define what is an emergency and what is not	X		
Various sources of data	• Strengthen the collection of quantitative data			X
Appropriate forecasting techniques, processes, systems and training	• Standards and processes for forecasting tasks			X
Cross functional approach	• Working more cross-functional and closer to customers regarding forecasting		X	
	• Communicate the incentives for forecasting to the customers		X	
Performance measures	• Create measures to track the performance	X		

6.1 The developed support tool for the Emergency Team

The developed support tool for the Emergency Team is presented in Figure 6.1. The support tool is divided into three different decision levels; strategic, tactical and operational. The suggested improvements are positioned into the support tool and further described.

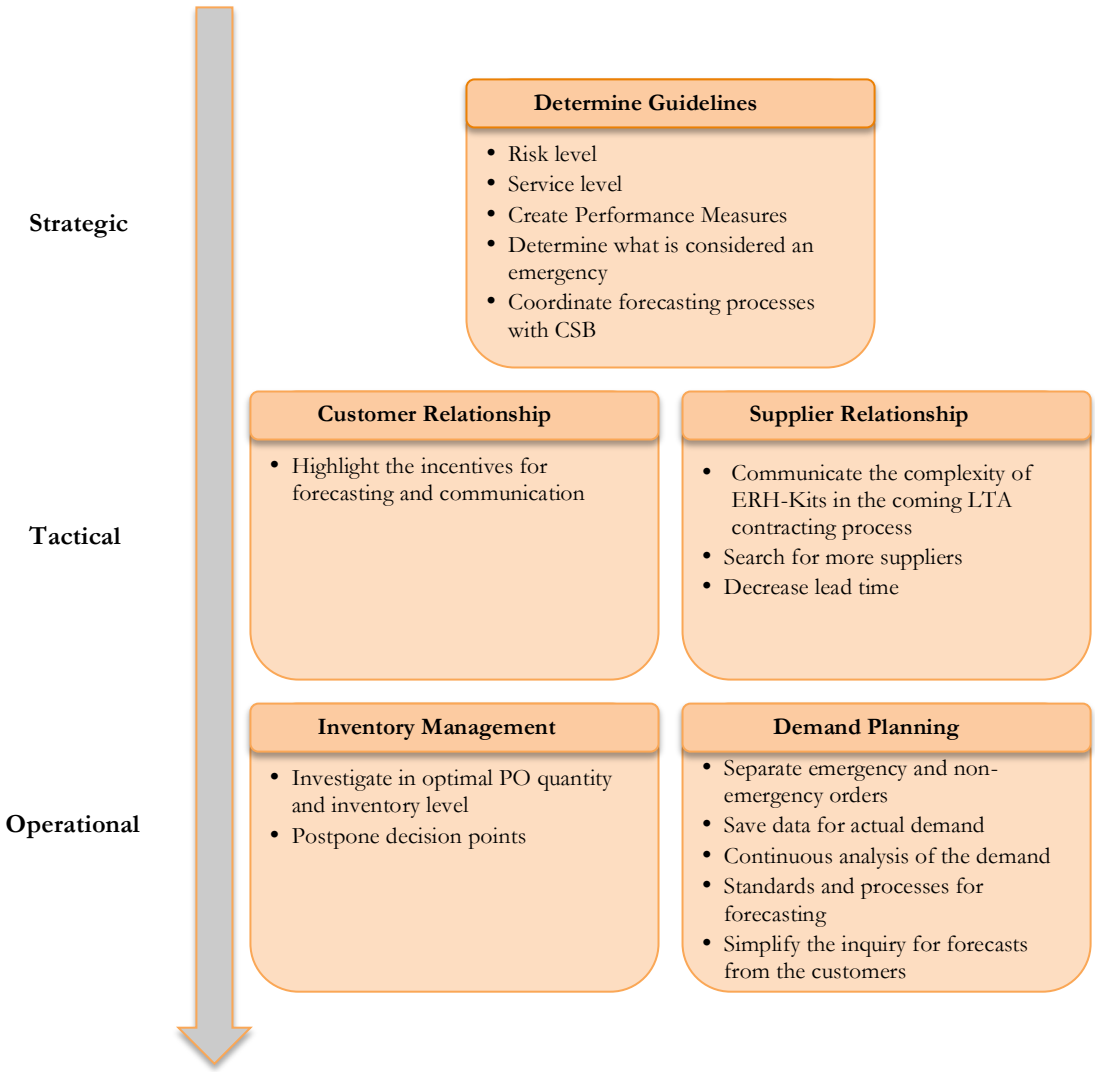

Figure 6.1. Support Tool for the Emergency Team (Krantz and Sandin Hansson 2014)

6.1.1 Determine Guidelines

From the analysis in chapter 5 an identified problem for the Emergency Team is the demand uncertainty due to the characteristics of the ERH-Kits. Further several important factors have been identified and some of these involve strategic guidelines that have to be established before the tactical or operational activities can be improved. Due to the uncertainty in demand it is as mentioned obvious that investing in inventory is connected to risk taking. Since no guidelines regarding risk exists today the Emergency Team is recommended to establish guidelines for this. The guidelines could be established by identifying the risk, then analysing the impact of the risk followed by evaluating the impact of the risk. With this done the level, or range of level of risk taking is established. The risk level shall be decided and aligned with the overall strategy for the Emergency Team and with directives from UNFPA. Determine the risk level highly correlates with another important guideline to decide upon, the service level e.g. how fast the Emergency Team aims to respond to its customers. The Emergency Team is therefore recommended to determine a service level so that everybody involved are aware of the prerequisites and what is expected from their performance. In the work plan for the Emergency Team it is denoted that a development of Performance Measures,

(PM), for inventory and the Emergency Team needs to be done. The author's recommendation is to develop several PMs, to be able to track the organisations performance. Since the new directive from UNFPA is to become more responsive it is important to measure how responsive the Emergency Team is and how well the suppliers perform which highly affects the responsiveness. Further, suitable PMs measuring important activities in demand planning and Inventory Management should be established.

An important identified problem area is, although a definition of humanitarian emergency exists, there is no grading of other urgent situations, which is not a humanitarian disaster. Today, this is defined from the customer's perspective since the customer indicates if the order is due to an emergency or not when ordering. The word emergency can be interpreted differently e.g. an emergency for a customer could be a situation of stock-out. If the purport for emergency could be defined for the Emergency Team as well as clear to its customers it would be easier to priorities the orders. It would also be beneficial for the forecasting performance to know which orders that have arisen due to an emergency and which orders that are placed for other reasons. Unpredictable demand pattern is typical in the humanitarian context. Although it is difficult it is recommended to discuss and determine the definition for an emergency event for the purpose of the ERH-Kits. Further a recommendation for the Emergency Team is to coordinate and validate collected demand data with CSB so that can help the Emergency Team to perform better.

Another recommendation for the maintenance of perishable goods is to discuss and decide upon the use of lowering the price of the ERH-Kits when they are getting towards expiration dates. This recommendation can however be separated from the support their tool and be discussed later in time, isolated from the earlier mentioned recommendations. A decrease in price could be a method to reduce the consequence of the risk of loss of capital. This since it allows a potential increase in sales when the price is low i.e. when the goods are closing up on their expiring date. However, as discussed this type of dynamic pricing can also result in negative consequences and therefore it is recommended to perform further analysis before a decision is being made. This decision should also be decided on a high level within UNFPA and could also be discussed for other teams or parts of UNFPA.

6.1.2 Customer Relationship

The collaboration between the Emergency Team and the customers, especially the COs, could be strengthened by making the customers understand why it is important for them to make an effort to create forecasts and communicate them with the Emergency Team. Also the external customers need to understand the same thing that the Emergency Team's performance highly depends on the ability to plan for future demand. The customers need to become aware of the whole situation and understand the overall picture, hence that they are in the end of the supply chain and there are several actors that are involved before the ERH-Kits reaches the customers. All actions taken by the customers affect the prerequisites for all the precedent actors in the supply chain. The incentives need to be obvious, forecasts and communication increases the chance of

receiving the needed ERH-Kits in time and at the right quantity. With better communication and collaboration with the customers the visibility can be improved and the chance for access to real demand increases. The customers' understanding could be improved through training and information meetings. Consequently the recommendation is to increase the collaboration with the customers and to clearly communicate the incentives for the customers to make forecasts and communicate them.

6.1.3 Supplier Relationship

As mentioned, better demand planning generates benefits regarding the supplier relationship since it increases the ability to communicate in an earlier stage to improve their performance. Based on the fact that the Emergency Team has difficulties with one of the current suppliers and have realised that the problems in many ways depend on that the supplier did not understand the context of supplying ERH-Kits. It is very important that the Contracting Team in the early phase of the bidding process clearly communicates the complexity involved in the handling of ERH-Kits. Further to develop the supplier relationships, a recommendation is to integrate the supplier to increase the understanding of the demand uncertainty. Another suggestion is to give the suppliers incentives to become more flexible in the delivering of ERH-Kits. Improving the Visibility through collaboration and communication is important and therefore recommended for a greater supplier relationship, which will enhance the supplier performance.

Another improvement regarding Visibility is to find more suppliers that meet the requirements of the LTA agreements. With more potential suppliers the competition would probably be tougher, which could generate benefits such as shorter lead times, higher flexibility and lower costs. Further this could generate that the selected suppliers would have the ability to deliver the whole range of ERH-Kits, something that would make it easier for the Emergency Team to coordinate in the planning and ordering of ERH-Kits.

Further it is recommended to review the possibility to decrease the lead time for some of the ERH-Kits. From the analysis it is seen that from supplier 1 the average lead time between 11/2011 and 04/2014 is shorter relative the LTA lead times and therefore there should be a potential to reduce the lead times from this supplier if supplier 1 places a bid in the next LTA process. Interesting to investigate regarding a decrease in lead time from the supplier is how much the lead time could be decreased if the cost of the ERH-Kits is increased. In addition a discussion of what cost level that is reasonable for acquiring a shorter lead time should be made. The relationship to the customers is also important for this through a consideration and a raise of a discussion with the customers regarding the price they are willing to pay to be faced by a higher service level.

6.1.4 Inventory Management

Inventory Management is considered as an operational activity although both strategic and tactical decisions needs to be taken in order to set guidelines for managing inventory. Investigating in optimal PO frequency is one of the recommendations, which is closely linked with inventory level and also demand planning. The theory recommends the

EOQ-formula. One assumption with the formula is that the demand is continuous and constant, but to adjust the formula for the study object the demand can be approximated with an expected demand per time unit. Moreover safety stock is often used to secure the service level due to disturbances. In the Emergency Team's case it is assumed that the volatility in demand is high and the lead times relatively long that safety stock may lose its purpose. A recommendation is to look further into if safety stock should be held for some of the goods or for the ones without constraints in shelf life. To enable more flexible operations it is recommended to postpone the decision points for placing POs to the suppliers. When the inventory levels are defined it is important to investigate if the revolving fund could be a limitation for the Emergency Team in the future.

6.1.5 Demand Planning

Within the area of planning and forecast of demand there is much to improve for the Emergency Team. It is recommended to, when an emergency event is defined within the Emergency Team, separate the emergency orders and non-emergency orders when analysing the historical demand. It is believed that this could make it easier to find a pattern in the demand if these two different kinds of orders are analysed separately. This study has analysed the available data and it is concluded that the demand for ERH-Kits is random. If the data becomes more transparent, e.g. if the outstanding demand could be analysed and the actual reason for the demand, the forecasting could be improved. Further it is recommended to register the entire demand and not just the depleted orders. Due to the limitations in the ERP-system this is not feasible in the system today, but most likely it is possible in the planning tool in Excel.

Another recommendation is to analyse the demand pattern more thoroughly. There is theory regarding random demand that could be a suitable solution. However, due to the time constraints for this study, this was not further investigated. It is recommended to calculate and simulate the demand patter in order to find the most suitable forecasting techniques. With this done proper forecasts processes and standards could be established.

To manage the problem with not receiving quantitative information from the customers, the Emergency Team is recommended to simplify the inquiry for the forecasts to only include the products where the supply is limited, such as the ERH-Kits and pharmaceuticals. Moreover the Emergency Team should investigate if more forecasts would be communicated if the customers were asked to only forecast their relatively constant yearly demand for the ERH-Kits.

6.1.6 Action Plan

Today the Emergency Team is working after a developed work plan with the aim to make several improvements within the team. This is strongly recommended by the authors. However, through the analysis within this project the authors found a handful of areas for improvements that are not in the already existing work plan, see Appendix 3. Therefore the recommendation is to add these activities to the work plan. The Action Plan is seen in Table 6.3. To simplify the recommendation four of the activities are highlighted as the most crucial and they are also the ones that need to be performed first.

These four activities are also further developed and explained, not only what to do but also how it should be done. The other recommended activities are also important but many of these require additional investigation to find the most optimal solutions.

Table 6.3. Action Plan for the Emergency Team (Krantz and Sandin Hansson 2014)

To be used with the Work Plan for the Emergency Team			ACTION PLAN					Created 2014-07-07
	Activity	**What**	**Responsible (Who is filled in by the Emergency team)**	**Q1**	**Q2**	**Q3**	**Q4**	**Meaning**
Emergency Team	**1**	Define Risk and Service Level	Emergency Team Who:					How much financial risk is the Emergency Team willing to take and which service level is the Emergency Team willing to have, i.e. how fast should the Emergency Team respond to its customers and how many orders should be fulfilled.
	2	Define an emergency or let the customers define the emergency and decide upon the prioritisation	Emergency Team Who:					What is an emergency is defined by customers today. This needs to be defined by the Emergency Team in order to take over the control of the demand planning
	3	Create KPIs for the Emergency Team	Emergency Team Who:					With Key Performace Indicators the team's performance is meassured and improvements can be tracked.
Communication	**4**	Decide upon the tactics for an increase in collaboration with customers and suppliers	Emergency Team Who:					An increased collaboration throughout the supply chain could result in a number of beneficiaries, such as shorter in bound lead time and more accurate forecasting.
	5	Decide upon improvements for a more coordinated process with collecting forecasts	Emergency Team Who:					How could PSB and CSB coordinate its task with forecasting. Today this processes are uncoordinated which makes them inefficient for all parts involved.
	6	Investigate in a decrease in Lead Time	Contracting Team Who:					It is shown that supplier 1 has been delivering very often earlier than agreed in the LTA. This means that probably there is a possibilty to lower the lead time in the contract. It is important to give incentives to the supplier to reduce the lead time, e.g. financial benefits.
	7	Search for new suppliers and decide upon how to communicate the complexity of supplying ERH-Kits in the coming LTA contracting process	Contracting Team Who:					The contracting team is within the process of collecting inquieries from potential suppliers. Today the Emergency Team only has 2 suppliers whereas one of them has not been performing. This lack of performance makes it diffcult for the Emergency Team to plan. A larger base of performing suppliers could generate shorter lead time and improved delivery reliability.
Operational	**8**	Decide upon how to save the caracteristics of an order and the orders that are rejected	Emergency Team Who:					It is important to save and register the rejected orders and the reason for this to be able to track the performance. In order to further analyse the demand pattern the incoming orders should be separated into emergency and non emergency orders. A recommendation is to during a trial period save all of the historical transactions in order to understand the whole picture.
	9	Investigate in optimal PO quantity and inventory level	Emergency Team Who:					When data has been saved the imventory levels and optimal PO can be reanalysed in order to find demand patterns or indications for how the inventory levels ought to be.
	10	Decide upon new methods and processes to manage forecasts	Emergency Team Who:					This area needs further research and work. But it is seen as an important area for the improvement of demand planning. As an suggestion scenario planning that is perfomed within the UNFPA could also be taken inte consideration when forecasting future demand.

Activity 1

What: Determine how much financial risk the Emergency Team is willing to take in order to be responsive, e.g. the Risk Level.

How: A Risk Management approach involves the identifying, analysing and evaluating of the risk and concerns processes, techniques and tools in order to do this. Due to the restriction in time it was not possible to give recommendations within this area. However it is possible to give guidance of how the determination of the willingness of taking financial risk regarding investing in inventory could be done. As an example the financial risk regarding inventory could be defined as, a PO to the supplier could maximum consists of X % of the total historically sales or demand. And adjust this amount of capital in time depending on its accuracy. This is seen as the easiest and a proactive way to decide the risk level. The risk level could also be set reactive, by determine a maximum cost level for the goods that needs to be scrapped, this should also include the cost of replacing the scrapped items. The aim should then be to stay below that level. This level could also be used as a performance measurement. For the proactive recommendation the historical sales or alternatively demand needs to be determined. If the demand is being used it is important to be clear about the source of error that comes with using an approximate demand. The suggested Activity 8 in the Action Plan deals with the importance of saving the actual demand. The X % of the historical sales/demand needs to be decided within UNFPA and aligned with the willingness of becoming more responsive. For the second alternative the cost of scrapped goods and replacing items in ERH-Kits need to be tracked and saved.

What: Determine the service level.

How: A service level could be formulated as, X % of the customer demand should be responded to, i.e. from the final customer demand to when the goods leave the warehouse, within X number of days. To be able to measure and promise the customers this service level there is a need to track the orders, meaning the time between the placements of the order in the ERP-system until the order leaves the warehouse and are shipped to the customers. Since it is the suppliers that in most cases handles/coordinates the shipping the service level to the customers therefore need to be discussed with them.

Activity 2

What: Define what an emergency is and how the different types of emergency could be prioritised.

How: This is a truly complicated activity but that the authors found crucial for the Emergency Team's ability to manage the balancing of supply and demand. This concerns understanding the demand and make the right prioritizes. The customers must understand why this is important and understand the advantages of giving correct information regarding every single demand to the Emergency Team. A suggestion from the authors is to divide the type of demand not only in emergency and non-emergency but in more different kinds of demand, e.g. in type of emergency e.g. due to war, natural

disaster, low stock levels and so on, other type of demand such as equipping a hospital, in number of people affected. If the customer receives their ordered ERH-Kits in time and in the right quantity the customers will probably eventually fill in the correct type of demand from the beginning. The purpose with the ERH-Kits is to serve in emergency although customer orders this in non-emergency situation. It is difficult for the Emergency Team to decide if a demand is due to a real emergency situation or not and thereby the recommendation is to serve all the customers but to work on understanding the demand better and make the right prioritizes regarding this. This activity requires a break down in different kind of demands and setting the drivers for the prioritization. The ordering form that the customers fill in this today needs to be extended with the new alternatives.

Activity 3

What: Create Performance Measurements for the Emergency Team.

How: Depending on the first activity PMs can be developed. It is suggested to set a PM regarding the service level, to measure how well this is fulfilled. The second PM should measure write offs or how well the determined risk level is followed. The third PM should measure the inbound lead time from the suppliers, to measure their performance in numbers and make them clear. It is important to benefit performing suppliers and penalise not so well performing suppliers. A decrease in lead time could both generate a better Service Level and a lower Risk Level. The last measurement concerns the accuracy between the forecasted and the actual demand. This is closely connected with Activity 8 and 10 in the Action Plan.

1. Service Level
2. Risk Level/ write offs
3. Inbound lead time
4. Forecast in relation to actual demand

Data needed in order to measure the four mentioned PMs above is the same data that is needed for performing Activity 1. Further the inbound lead time is calculated using the data sheets, Supplier Metrics. The last measurement is dependent on that the forecasting methods that compiles the data or that the results from the forecasts are comparable with the actual outcome which is found in the ERP-system.

Activity 4

What: Increase the collaboration with suppliers and customers.

How: An increase in collaboration can be done in many ways, some suggestions are;

- Organising face to face meetings with the suppliers, e.g. invite the suppliers to the Headquarters in Copenhagen and go visit the supplier to learn how they work.
- Let the suppliers get to know the end-customer. Be open about potential improvements area and how this could benefit all parts involved.

- Be the most important customer for your suppliers and try to set up a partnership with these.
- Agree on how to manage the relationship and set up processes for how to share information.

7 Conclusions

This chapter presents the answers to the formulated RQs and gives the reader a summary of the most important findings. Finally, the chapter specify recommendations for future research and presents the academic contribution this study provides.

7.1 Answer to the Research Questions

In the first chapter the authors formulated two RQs that served as the foundation throughout the study. The progression of the study through the different chapters, methodology, theoretical framework, empirical description and the analysis has made it possible for the authors to answer RQ 1. The first RQ concerns the factors for balancing demand and supply and is formulated as, (What is important to consider in order to strengthen the balance of supply and demand regarding the ERH-Kits, while managing the uncertainty in demand and the risk of having expired goods in stock?).

There are many variables affecting the Emergency Team's operations, such as funding constraints, demand uncertainty, collaboration complexity, strive for fast response and lack of measuring the performance. Therefore these factors were considered to be important when analysing the Responsiveness and Demand Management within the Emergency Team. After reviewing existing literature the most important concepts regarding Responsiveness and Demand Management were found. These were thereafter analysed in comparison to the Emergency Team. The outcome of this chapter answers RQ1 and is summarised in Table 7.1.

Table 7.1. Important factors to enable the balancing of demand and supply for the ERH-Kits

Concepts to consider for an effective balancing of demand and supply for the Emergency Team	Potential results if improvements are done
Visibility, meaning collaboration with suppliers and customers	• Access to real demand • Larger and better performing supplier base • Improved forecasting and demand planning
Velocity, meaning reduce lead time and non-value adding time	• A reduction in inbound lead time
Managing inventory and the associated risk	• Placing optimal POs • Using service level as a guideline • Using a risk management approach to set guidelines for the Emergency Team
Performance metrics	• Measure the performance in order to improve the operations
Understand demand and uncertainty	• Easier to forecast and plan the demand
Various sources of data	• Using more quantitative data can result in more accurate demand planning
Appropriate forecasting techniques, processes, systems and training	• Improved demand planning
Cross functional approach	• More customers communicates its forecasting plans

The second RQ, (What factors are important in the development of a support tool and how could this be developed to help the Emergency Team to manage the ERH-Kits?), is answered through the support tool in Figure 7.1. The purpose with the support tool is to give guidance for the Emergency Team to improve its balancing of supply and demand. The support tool is based on three different decision levels; Strategic, Tactic, and Operational. The idea behind the tool is to first set the strategic guidelines in order to further improve the tactical and operational activities.

From the analysis the authors found that the lack of guidelines and measurements make the activities within the Emergency Team difficult to manage effectively. The identified guidelines are risk level, service level, create PMs, determine what is considered an emergency and create more coordinated forecasting tasks with CSB. The tactical activities are customer and supplier relationship. The tactical decisions for the customers concerns to increase the collaboration and highlight the incentives for forecasting and communication. For the supplier relationship the decisions involve, increasing the collaboration, communicating the complexity of ERH-Kits, increase the visibility and decrease the lead time. Finally improvements for the operational activities are suggested. For inventory management these are, investigating in the optimal PO quantity and postpone decision points. The decisions for demand planning concerns separating emergency and non-emergency orders, save data for actual demand, perform continuous analysis of the demand, establish standards and processes for forecasting and finally to simply the inquiry for forecasts.

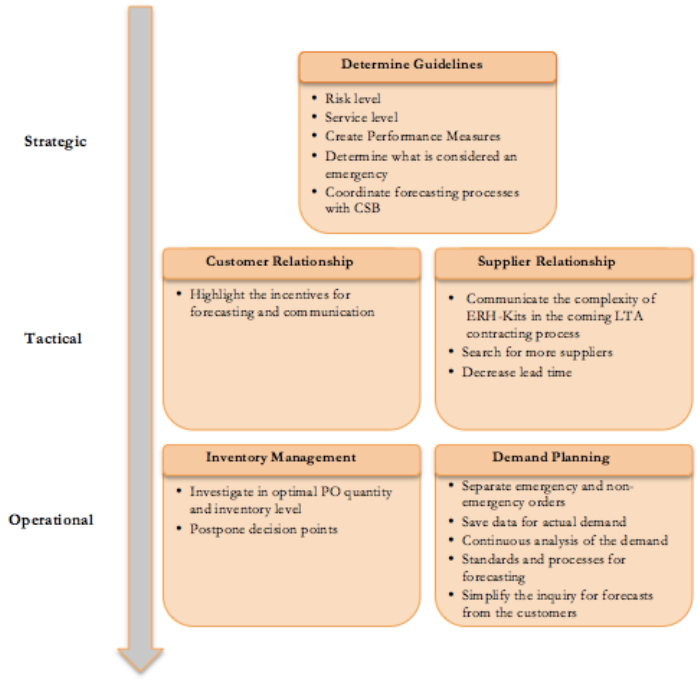

Figure 7.1. Support tool for the Emergency Team (Krantz and Sandin Hansson 2014)

In order to give the Emergency Team concrete recommendations an Action Plan was constructed to fit the already existing work plan. The Action Plan can be seen in Figure 7.2. The focus is on the four first presented activities, which are also more explained in detail, and for those activities concrete recommendations are made. The purpose with

the Action Plan is to give clear recommendation of what and how the Emergency Team could improve its activities. It is also conducted to match the already existing work plan for the Emergency Team.

To be used with the Work Plan for the Emergency Team			ACTION PLAN				
	Activity	What	Responsible (Who is filled in by the Emergency team)	Q1	Q2	Q3	Q4
Emergency Team	1	Define Risk and Service Level	Emergency Team Who:				
	2	Define an emergency or let the customers define the emergency and decide upon the prioritisation	Emergency Team Who:				
	3	Create KPIs for the Emergency Team	Emergency Team Who:				
Communication	4	Decide upon the tactics for an increase in collaboration with customers and suppliers	Emergency Team Who:				
	5	Decide upon improvements for a more coordinated process with collecting forecasts	Emergency Team Who:				
	6	Investigate in a decrease in Lead Time	Contracting Team Who:				
	7	Search for new suppliers and decide upon how to communicate the complexity of supplying ERH-Kits in the coming LTA contracting process	Contracting Team Who:				
Operational	8	Decide upon how to save the caracteristics of an order and the orders that are rejected	Emergency Team Who:				
	9	Investigate in optimal PO quantity and inventory level	Emergency Team Who:				
	10	Decide upon new methods and processes to manage forecasts	Emergency Team Who:				

Figure 7.2. Action Plan created for the Emergency Team (Krantz and Sandin Hansson 2014)

7.2 Future Research and Academic Contribution

There are several areas within the Emergency Team's operations that would be interesting to further investigate in. Because of the great volatility in demand it could be interesting to further analyse the demand data more thoroughly e.g. by analysing the extreme values as well as taking several aspects into consideration such as the frequency and range of the disaster occurrences. It would also be interesting to investigate the processes of collecting forecasts to understand why the quality of data differs. An improved understanding of the demand could make it easier for the Emergency Team to plan and forecast and by that a more effective management of the balance between supply and demand.

This study was delimited to the Emergency Team and therefore it would be interesting to compare the performance with other PSB teams. Valuable insights could be obtained by benchmarking the Emergency Team with other humanitarian organisations that manages similar products. In theory there are a few inventory models that potentially could suit the Emergency Team and therefore it could be interested to explore this area further. Since there is not as much literature regarding the area of humanitarian logistics as concerning commercial logistics it is believed that there are great possibilities to further explore and continuously work with making humanitarian organisations more effective. It would also be interesting to investigate if and how UNFPA work with

scenario planning and how this could improve the demand planning for the Emergency Team.

This study was based on a single team within a humanitarian organisation. This means that the situations and conditions in this study limit the academic contribution. However, it is believed that several humanitarian organisations face the same challenges as the Emergency Team, e.g. uncertainty in demand and financial risk taking. This means that the theory, the analysis and the support tool could be suitable and may be modified to fit other humanitarian organisations.

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Exploratory Interview

Interview 1: Nielsen, Kristian. Inventory Management Associate and Global Forecast, UNFPA PSB. 2014. Interview [2014-02-05] and [2014-03-17]

Interview 2: Andries, Daniela. Demand Planner and Inventory associate, UNFPA PSB Emergency Team. 2014. Interview [2014-02-05] and [2014-03-17]

Interview 3: Nordin, Ingegerd. Procurement and supply coordinator, UNFPA PSB. 2014. Interview [2014-03-17] and [2014-04-03]

Interview 4: Cuddihy, Richard. Financial Specialist, UNFPA PSB. Interview [2014-04-03]

Interview 5: Toschi, Giovanni. Contracting Assistant, UNFPA PSB. Interview [2014-04-16]

Internal documents

Internal document 1: *Revised Inventory PPM*

Internal document 2: *UNFPA Logistics Setup (freight) Review*

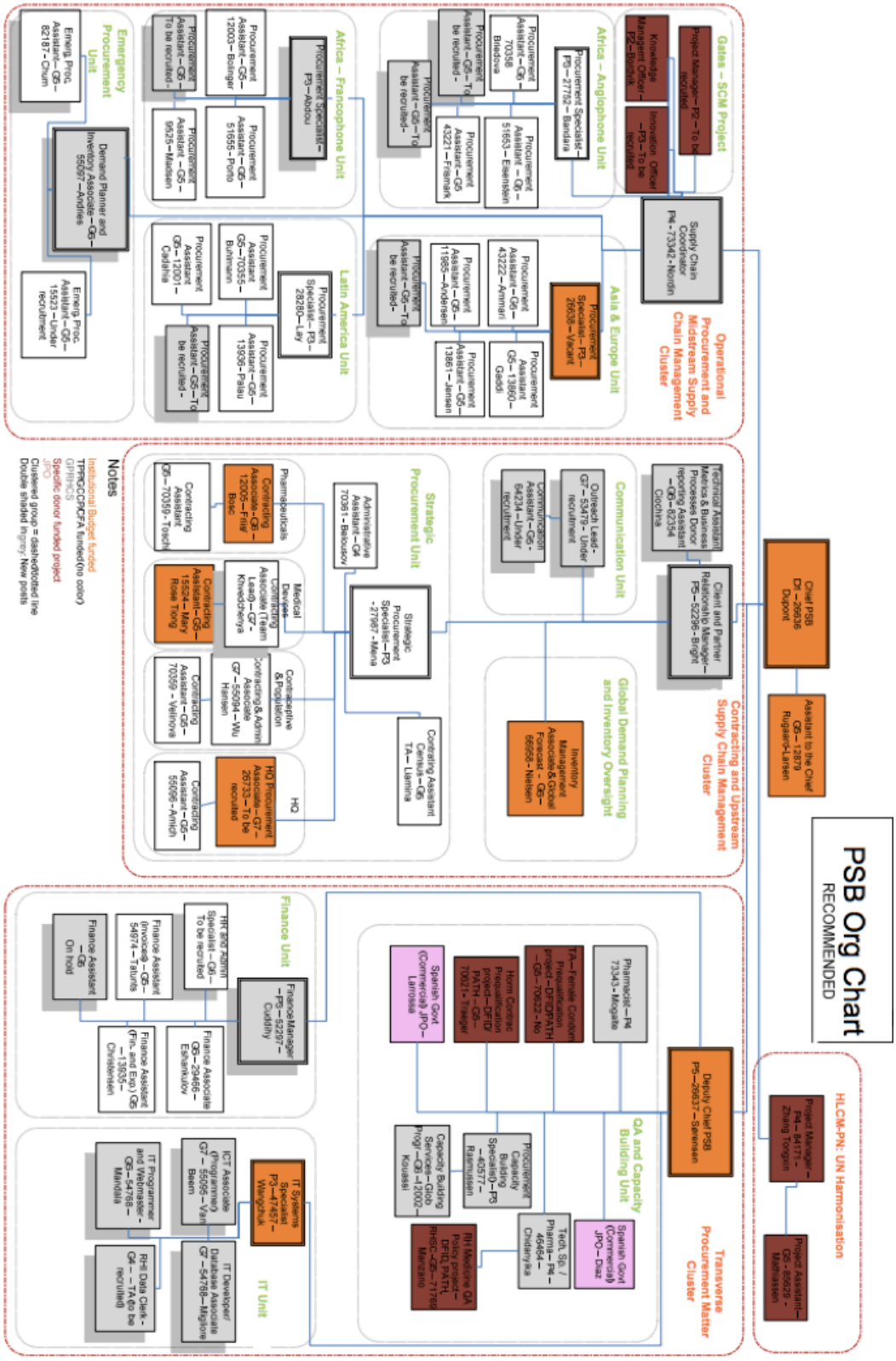
Internal document 3: *Write up kits stock*

Internal document 4: *Work plan*

Internal document 5: *Long Term Agreements*

9 Appendix

Appendix 1- Organisational chart of UNFPA PSB



Appendix 2- Interview guides

Interview 1- Semi Structured

Interviewee: Inventory Management Associate and Global Forecast
Years at UNFPA PSB: 4 years
Date: 2014-02-05
Location: Copenhagen
Interviewed by: Emelie Krantz and Emma Sandin Hansson

Personal
1) How long have you been working at UNFPA?
2) What is your role within the organisation?
3) How long have you had this position?
Specific for the project
4) What is the background problem? Is it true that UNFPA have had problems with not responding rapidly enough to requests for ERH kits, due to for example stock-out?
5) You write in your paper that: *"There have also been audit observations criticizing the Procurement Services Branch of the UNFPA for exposing the organization to financial risk by holding perishable items in stock, which may cause inventory write-off"*. Can you please explain this further?
Demand planning
6) How do you handle funds and donors? Is there anyone responsible for this? Who?
7) Are there any problem areas in the planning/inventory processes today?
8) Do you work with any kind of scenario analysis today? And if, how?
7) Can you please explain the planning processes?
Overall emergency team/UNFPA
9) How does the overall strategy looks like for UNFPA.
10) Mission, vision and policies for the emergency team of UNFPA.
11) Can you explain a bit about the organisation of the emergency team?

Interview 2- Semi Structured

Interviewee: Demand Planner and Inventory Associate
Years at UNFPA PSB: 8 years within UNFPA and 4 years within PSB
Date: 2014-02-05
Location: Copenhagen
Interviewed by: Emelie Krantz and Emma Sandin Hansson

Personal
1) How long have you been working at UNFPA?
2) What is your role within the organisation?
3) How long have you had this position?
Demand planning/Procurement
4) What is the most challenging tasks in your work?
5) Can you please explain the procurement activities?
6) Are there any problem areas in the planning/inventory processes today?
7) What is the main focus today within this business area?

Interview 3- Structured

Interviewee: Inventory Management Associate and Global Forecast and Demand Planner and Inventory Associate
Date: 2014-03-17

Location: Copenhagen
Interviewed by: Emelie Krantz and Emma Sandin Hansson

- Can you explain how you work with Atlas and the Excel sheets?

1. What is the minimal initial service package (MISP) and how is it connected to the ERH-kits?
2. The PSB Business Processes, do you work with these processes also in the Emergency Team?
3. How long have you been working as an Emergency Team?
4. Who develops the kits?
5. In your planning process, how do you face contingency and managing disasters?
6. How often do you place orders of ERH-Kits?
7. How many suppliers do you have for other products than emergency kits?
8. The pharmaceuticals in the ERH-Kits can all of them be procured from you regular catalogue? It is the same for the medical devices?
9. How do you keep track of your stock? Daniela spoke last time about monthly reports, is that your only way to keep track?
10. Do get a better understanding about the lead times, how come the Lead times are so long and are the longer/shorter for certain products? Has anything being done to try to shorten these lead times?
11. Is it a wish or demand/requirement from the COs side that the Kits need to have at the minimum one year of shelf life left?
12. The COs, do you have contract with them or can they choose from what humanitarian agency to procure supply from?
13. Do you use any Re-ordering model to manage inventory?
14. Do you have safety stock? If, how do you calculate this in that case?
15. Regarding the Vendor managed inventory, have you had thoughts on/investigated in other options?
16. The problem regarding the Chinese quality control can this also affect the products from Supplier 1 or does this only regard Peak?
17. What does you customer base look like? Size of customer segmentation? Type of customers and so on?
18. How do you think the COs work with forecasting, scenario analysis, disaster management? Are you familiar with these processes?
19. Can you describe the steps in detail, from that you receive an order until the order is dispatched?
20. We have understood that there are mainly two situations when the Kits are ordered, emergency and non-emergency. Can you please describe what situations that go into each of these types?

Interview 4- Unstructured

Interviewee: Procurement and Supply Coordinator
Years at UNFPA PSB: 14 years within UNFPA
Date: 2014-03-17
Location: Copenhagen
Interviewed by: Emelie Krantz and Emma Sandin Hansson

1: Is there any overall strategy for the Emergency Team?
2. Can you explain the challenges the Emergency Team is facing?
3. How is the Emergency Team cooperating with the rest of PSB?
4. How do PSB work with forecasting and scenario planning?

Interview 5- Semi-Structured

Interviewee: Procurement and Supply Coordinator
Years at UNFPA PSB:
Date: 2014-04-03
Location: Copenhagen
Interviewed by: Emelie Krantz and Emma Sandin Hansson

1. What is your role in PSB and what are your most important tasks?
2. What are the strategic guidelines for the Emergency Team?
3. How do the Emergency Team interact or cooperate with the rest of the PSB?
4. Has the Emergency Team have had problems with not being able to respond rapidly enough to requests for ERH-Kits?
5. What do you believe are the main problems/challenges within the Emergency Team? And how are you facing these challenges?
6. Do you know how the Emergency Team work with planning for how the probable demand will be during the nearest future?
7. In what way are the Emergency Team affected by the donors? Why is that?
8. Are stakeholders pushing UNFPA about detailed information regarding the organisation's performing?
9. It is not possible to use historical data to analyse the performance of the Emergency Team? Is it the same for regular products?
10. Regarding the Vendor managed inventory do you have this on all of the products, include regular products? Have you had thoughts on/investigated in other options?
11. Is Atlas used all over UNFPA? And how do UNFPA work with improving Atlas?

Interview 6- Semi Structured

Interviewee: Financial Specialist for PSB
Years at UNFPA: 4 years
Date: 2014-04-03
Location: Copenhagen
Interviewed by: Emelie Krantz and Emma Sandin Hansson

Personnel

1. What is you role within PSB?
2. How long have you been working at UNFPA? In your current role?
3. What tasks are involved in your role?

Organisation

4. Can you please describe how PSB is financed in relation with UNFPA?
5. What is the role of CSB, and how do you communicate in between PSB and CSB?
6. What are the financial constraints for ERH-Kits?
7. Are there special donors just for ERH-Kits? - Or special donated money for them?
8. Is it central UNFPA that handles the contact with the donors?
9. We have understood that there is a "revolving fund" for the ERH-Kits, how does that work?
10. Why is the revolving fund on five millions?
11. Who controls this fund? And how?
12. Is it possible to increase the fund? Is this difficult?
13. What do you see are the main challenges with the current set-up with the revolving fund?

Financial policies

14. What is the view/opinion regarding write offs?
15. Are there certain constraints/policies for just PSB or are there general ones for UNFPA?

Interview 7- Semi structured

Interviewee: Contracting Assistant
Years at UNFPA PSB: 2-3 years
Date: 2014-04-16
Location: Video call-Interview.
Interviewed by: Emelie Krantz and Emma Sandin Hansson

Personnel

1. What is you role within PSB?
2. How long have you been working at UNFPA? In your current role?
3. What tasks are involved in your role?
4. What are the main challenges for you in your tasks?

Contracts

5. Do you handle the contracting?
6. How does the contracting work?
7. Can you please describe the process of the tendering of the Kits and the negotiation of the contracts?
8. And also the contract management in a day to day basis?
9. How do you reach out to potential suppliers?

Suppliers

10. We have understood that you currently have 2 suppliers for ERH-Kits, supplier 1 and supplier 2, do you use them equally?
11. What are the requirements for being a supplier of ERH-Kits?
12. Why do you only work with two suppliers?
13. How does the communication between the suppliers and you work?
14. What are the challenges for the suppliers?
15. Is it favourable to be a supplier of ERH-Kits? Is it an attractive business?

Appendix 3- Work plan for the Emergency Team

	No.	Activity	Output	Current Status	Timeframe for Implementation
Emergency	1	Review and update of EPP templates	RFQ, ITB, RFP templates updated	Ongoing	Q1
	2	Issue one pager on lessons learned from PHL Emergency	Doc finalized and shared with PSB and HFCB	Ongoing	Q1
	3	Finalize the Guidelines for COs on Prepositioning	Finalized doc shared with HFCB and the COs	Ongoing	Q1
	4	Provide feedback and follow-up with SPC on the new LTA for ERH kits	Feedback provided for the LTA to be in place at end of 2014 and ready to use starting 2015	Ongoing	Q1-Q2-Q3-Q4
	4,1	Review the current LTA stipulations on leadtimes for production and dispatch	Recommendations for SPC for future LTA	Pending	Q1-Q2
	5	Launch Survey on Inventory and ET performance for TPP customers for 2013 year	Survey launched and report on results issued.	Ongoing	Q1-Q2
	6	Carry out a research on the potential external customers for RH kits (on the web, existing humanitarian networks) and compile a list with the identified parties and their contact details	List of potential customers compiled	Pending	Q2-Q3
	7	Contact existing TPP customers in order to collect tentative procurement plans for RH kits for 2014 year	Procurement plans collected and data used for demand forecasting and stock planning	Pending	Q1-Q2
	8	Develop KPIs for Inventory and Emergency Team	KPIs developed and included in the 2014 PAD	Pending	Q1
	9	Engage with HFCB on the UNFPA Tents in Stock - obtain specifications for the tents, including the list of items needed to be provided with the tents, indetify the best option to procure the tents (use of existing LTAs, launch a new bid etc.). Identify possible locations for storage of the stocks of tents. Contract a consultant if necessary to assist with the project (HFCB to provide funding)	Specifications obtained, bid launched, production PO placed	Pending	Q1-Q2-Q3-Q4
	10	Add the line on the Client Feedback Form in the Email Template for sending shipping docs to the CO and external customers	Email templates updated and used	Pending	Q1
	11	Carry out a study on the TPP small orders and potential solutions for optimizing the workload on these	Study completed and actions taken	Pending	Q1-Q2-Q3-Q4
	12	Discuss with HFCB (Wilma) and Jonathan on solutions for orders which are shipped as emergency and not distributed, or shipped for emergencies and not customs cleared	Potential solutions identified and communicated to the COs	Pending	Q1-Q2-Q3-Q4
	13	Discuss with HFCB (Wilma) on Renewable RH kits -if possible to include in the current LTA that shall be launched for RH kits.	pending for identification - depending on the response from Wilma	Pending	Q1-Q2-Q3-Q4
Communication	1	Review the content of the RH kits page in internet and intranet	Revised & more attractive content is published on the PSB portal and UNFPA public website	Pending	Q1-Q2
	2	Regular emails to COs on the COP on issues related to RH kits: where to find the info and forms, how the costs are charged in Atlas, how to issue a REQ etc.	Emails sent via the COP - at least 1 email every Q	Pending	Q1-Q2-Q3-Q4
	3	Create a one-page info leaflet on RH Kits to be shared with internal and external customers	maybe on an ad-hoc basis, when we have some news to communicate	Pending	Q1-Q2-Q3-Q4
Inventory	1	Review and update the inventory related Cognos Reports	Cognos reports ready to use for Inventory reports and statistics	Pending	Q1-Q2-Q3-Q4
	2	All stock manager excel docs to be updated and harmonized	Updated excel docs operational	Pending	Q1-Q2
	2,1	Develop SOPs on how to use the stock manager excel docs	SOPs developed	Pending	Q1-Q2
	2,2	Initiate discussions with IT and other relevant parties in order to indentify a smarter tool for inventory tracking - consider lookig at what is used in other agencies - WFP Brindisi?		Pending	Q1-Q2-Q3-Q4
	3	Develop SOPs on how to calculate the prices for the RH kits replenishment POs in Atlas	SOPs developed	Pending	Q1-Q2
	4	Prepare the Statistics report on RH kits	Statistics report prepared	Pending	Q1-Q2
	5	Initial discussions with suppliers on how to improve the timely and quality supply		Pending	
	6	Contact UNICEF and investigate if they can be a kit supplier to UNFPA		Pending	
Travel (CSB funded)	1	ASRO workshop on FTPs and including EPPs		Pending	TBC
	2	Mission to UNHRD Brindisi - discussing possible cooperation opportunities and benefits for UNFPA		Pending	TBC
	3	Participation of ET in the HFCB retreat		Pending	TBC
	4	Participation in the DIHAD 2014		Pending	March, 2014
Operational	1	Recruitment of G5 Emergency Proc Asst	new staff on board		
	2	Recruitment of G6 maternity leave replacement	replacement identified		
	3	PAD 2014 Panha	PAD Phase 1 finalized		
	4	PAD 2014 Daniela	PAD Phase 1 finalized		
	5	PAD 2013 Daniela	PAD Phase 1 finalized	Pending	15-feb
	6	CIPS 3 training for Panha	Certification	Pending	

(Internal document 4)

Appendix 4 – Revolving Fund Data

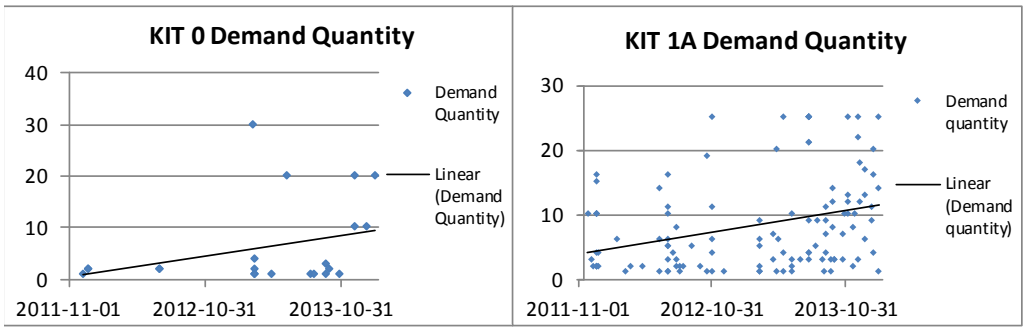
Month end	Value in Stock	Value in PO	Available in Cash	Value in Stock 15% stock increase	Available in Cash 15% stock increase	Value in Stock 27% stock increase	Available in Cash 27% stock increase
2011/11	1 590 046	253 681	3 156 273	1 828 553	2 917 766	2 019 358	2 726 961
2011/12	1 223 761	1 491 894	2 284 345	1 407 325	2 100 781	1 554 177	1 953 930
2012/01	1 552 012	1 238 213	2 209 775	1 784 814	1 976 973	1 971 055	1 790 732
2012/02	1 974 131	827 577	2 198 291	2 270 251	1 902 172	2 507 147	1 665 276
2012/03	2 159 716	172 934	2 667 351	2 483 673	2 343 393	2 742 839	2 084 227
2012/04	2 071 616	78 709	2 849 675	2 382 358	2 538 933	2 630 952	2 290 339
2012/05	1 987 166	51 700	2 961 134	2 285 241	2 663 059	2 523 701	2 424 599
2012/06	1 680 836	51 700	3 267 464	1 932 961	3 015 339	2 134 662	2 813 638
2012/07	1 256 585	1 168 381	2 575 034	1 445 073	2 386 546	1 595 863	2 235 756
2012/08	1 470 211	936 033	2 593 756	1 690 743	2 373 224	1 867 168	2 196 799
2012/09	880 035	880 890	3 239 074	1 012 041	3 107 069	1 117 645	3 001 465
2012/10	1 086 825	1 535 240	2 377 934	1 249 849	2 214 911	1 380 268	2 084 491
2012/11	1 445 350	919 960	2 634 690	1 662 152	2 417 888	1 835 594	2 244 446
2012/12	1 156 787	773 238	3 069 975	1 330 305	2 896 457	1 469 120	2 757 642
2013/01	1 585 684	1 207 989	2 206 327	1 823 537	1 968 474	2 013 819	1 778 192
2013/02	1 980 409	1 516 586	1 503 005	2 277 470	1 205 943	2 515 119	968 294
2013/03	1 202 046	2 407 310	1 390 644	1 382 353	1 210 337	1 526 599	1 066 091
2013/04	1 589 757	2 153 716	1 256 527	1 828 221	1 018 063	2 018 992	827 293
2013/05	1 891 735	1 682 368	1 425 898	2 175 495	1 142 137	2 402 503	915 129
2013/06	2 427 325	1 361 040	1 211 635	2 791 424	847 536	3 082 703	556 257
2013/07	1 791 270	1 264 398	1 944 332	2 059 960	1 675 641	2 274 912	1 460 689
2013/08	1 720 802	1 274 131	2 005 067	1 978 922	1 746 947	2 185 419	1 540 451
2013/09	1 872 397	1 248 674	1 878 929	2 153 257	1 598 070	2 377 944	1 373 382
2013/10	1 758 677	666 249	2 575 074	2 022 478	2 311 272	2 233 520	2 100 231
2013/11	1 542 909	213 857	3 243 233	1 774 346	3 011 797	1 959 495	2 826 648
2013/12	1 186 588	1 211 311	2 602 102	1 364 576	2 424 114	1 506 966	2 281 723
2014/01	1 493 665	707 637	2 798 698	1 717 714	2 574 649	1 896 954	2 395 409
2014/02	1 745 891	643 125	2 610 984	2 007 774	2 349 101	2 217 281	2 139 594
2014/03	1 799 162	243 289	2 957 549	2 069 036	2 687 675	2 284 935	2 471 775
2014/04	1 985 096	-	3 014 904	2 282 860	2 717 140	2 521 072	2 478 928

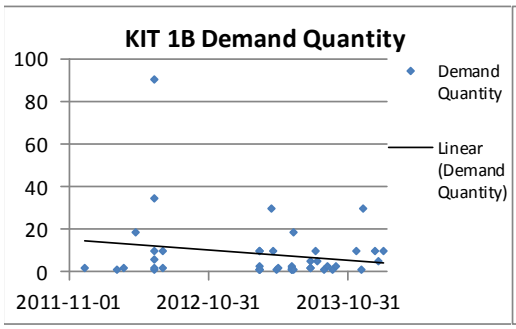
Appendix 5 – Lead Time

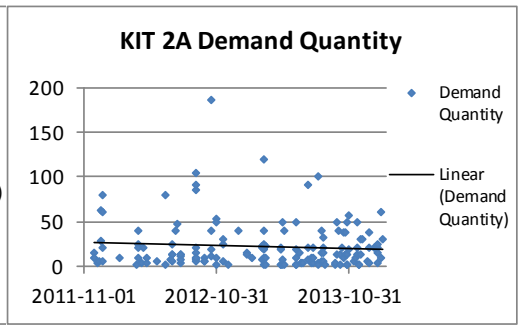
ERH -Kit	**Supplier 1** (LTA weeks)	**Supplier 1** (LTA days)	**Supplier 1** (actual average days)	**Supplier 2** (LTA weeks)	**Supplier 2** (LTA days)	**Supplier 2** (actual average days)
0	12-14	84-98	39			
1A	N/A	N/A	94	N/A	N/A	N/A
1B	N/A	N/A	78	N/A	N/A	N/A
2A	12-14	84-98	93	12	84	102
2B	12-14	84-98	73	12	84	100
3	12-14	84-98	79	13	91	167
4	12-14	84-98	77	13	91	112
5	12-14	84-98	99	13	91	195
6A	12-14	84-98	68			
6B	12-14	84-98	74		91	
7	12-14	84-98	54	13		136
8	12-14	84-98	78			
9	12-14	84-98	70			
10	12-14	84-98	42	11	77	69
11A	12-14	84-98	39			
11B	12-14	84-98	101			
12	12-14	84-98	70			

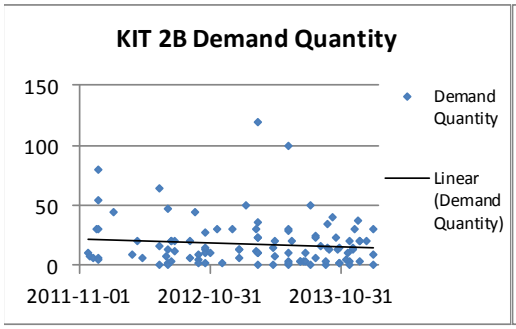
Lead time according to the LTA in weeks and recalculated in days. Also average actual lead time is displayed. Recalculation to days for supplier is done by assuming all order arriving before 12 full weeks are early, the order arriving after 14 full weeks are late and the order arriving in between are on time. The recalculation for supplier 2 is done by assuming all orders arriving before the determined amount of weeks (full) are early, the orders arriving after are late and the orders arriving on the day after the full weeks are on time.

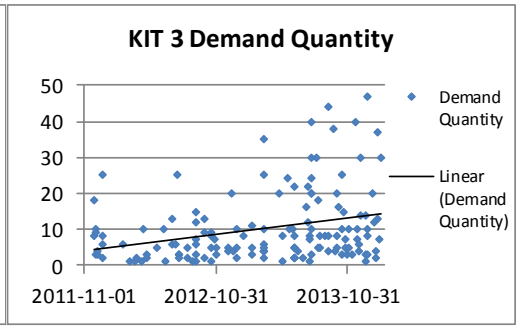
Appendix 6 - Graphs for the Data Analysis of the ERH-Kits

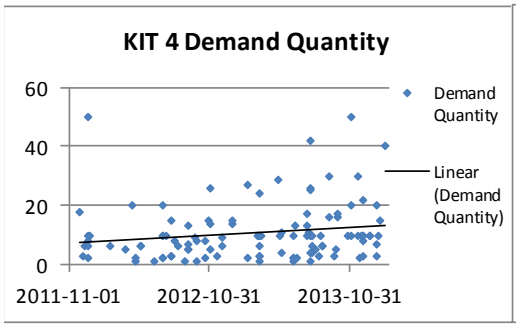


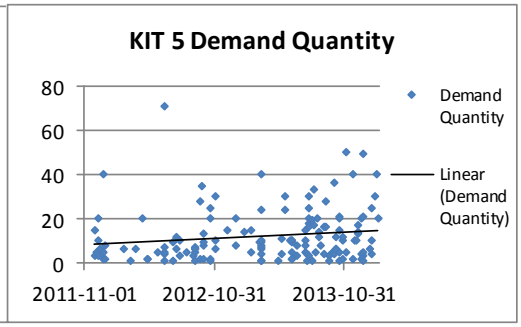


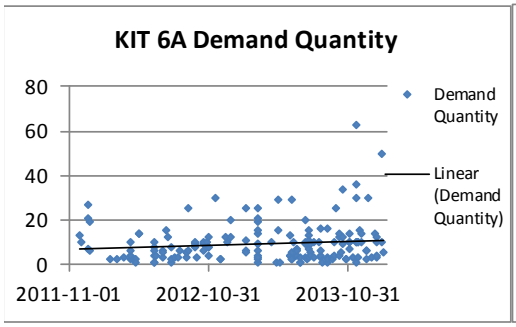








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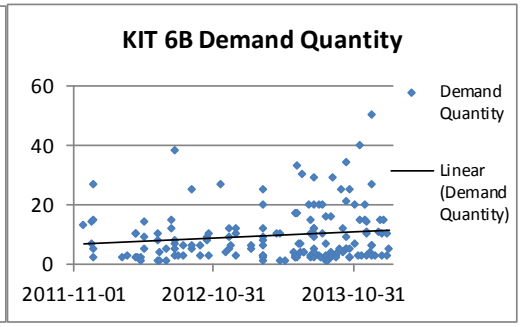
2013-10-31
Demand Quantity
Linear (Demand Quantity)


KIT 6B Demand Quantity
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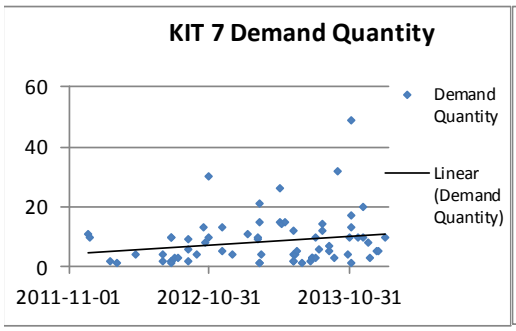
0
2011-11-01
2012-10-31
2013-10-31
Demand Quantity
Linear (Demand Quantity)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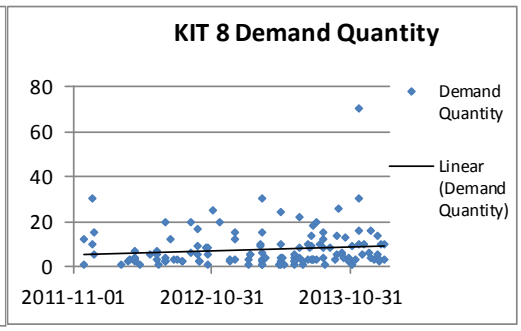
2013-10-31
Demand Quantity
Linear (Demand Quantity)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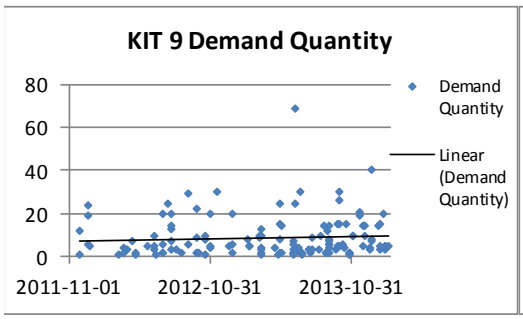
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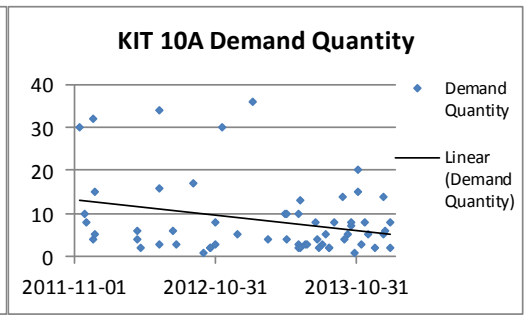
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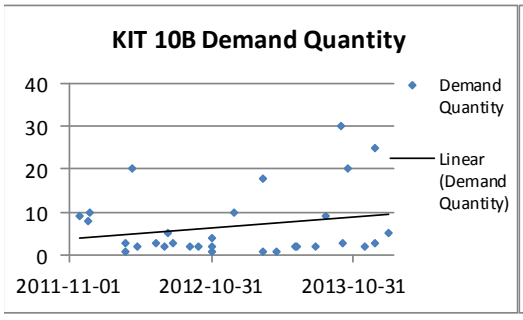
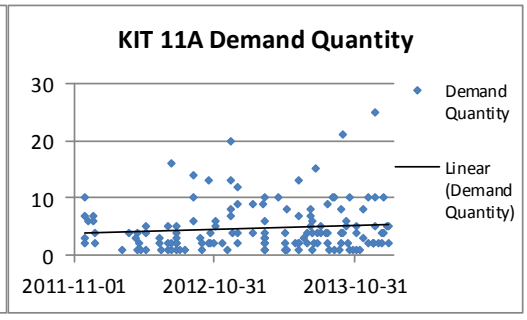
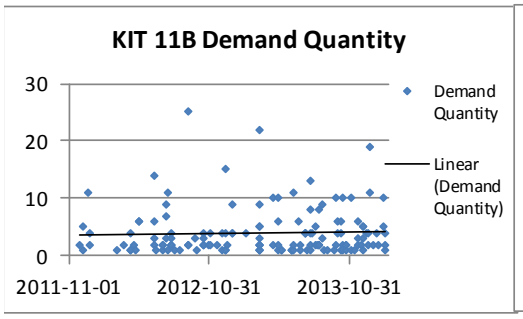
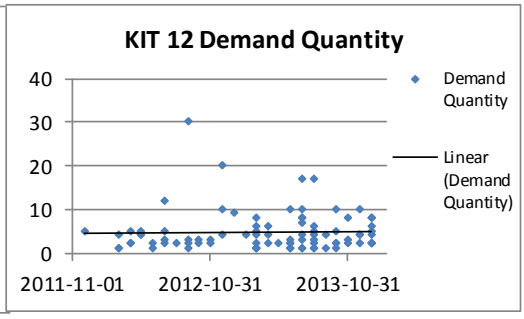
2012-10-31
2013-10-31
Demand Quantity
Linear (Demand Quantity)


KIT 10B Demand Quantity
40
30
20
10
0
2011-11-01
2012-10-31
2013-10-31
Demand Quantity
Linear (Demand Quantity)

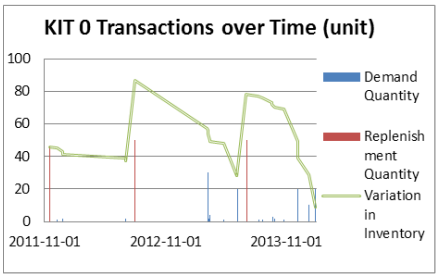

KIT 11A Demand Quantity
30
20
10
0
2011-11-01
2012-10-31
2013-10-31
Demand Quantity
Linear (Demand Quantity)

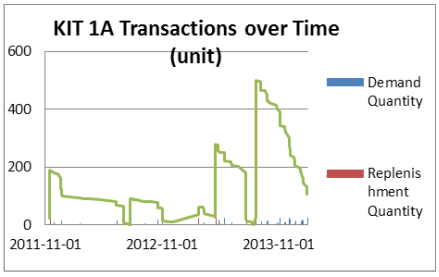

KIT 11B Demand Quantity
30
20
10
0
2011-11-01
2012-10-31
2013-10-31
Demand Quantity
Linear (Demand Quantity)

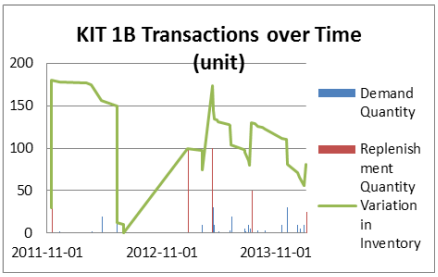

KIT 12 Demand Quantity
40
30
20
10
0
2011-11-01
2012-10-31
2013-10-31
Demand Quantity
Linear (Demand Quantity)

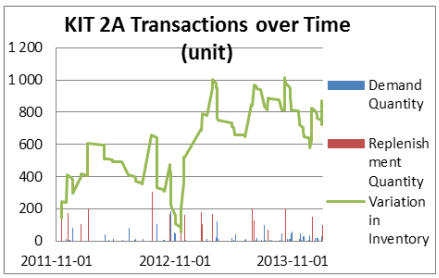
Appendix 7- Inventory Transactions over time for the different ERH-Kits

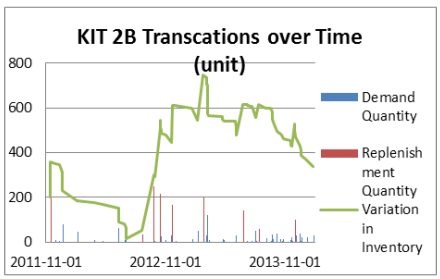
Supplier 1

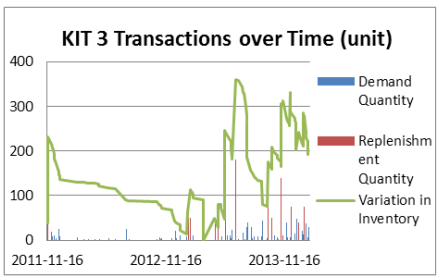


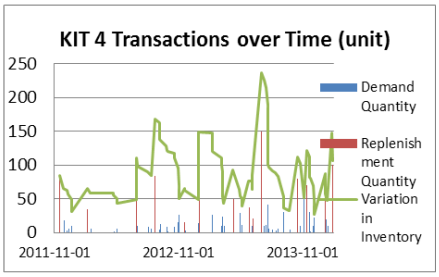


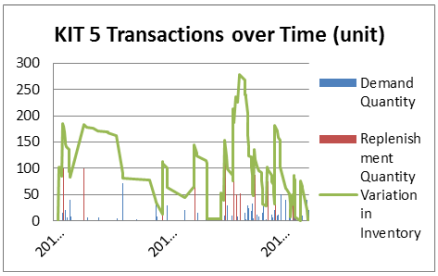


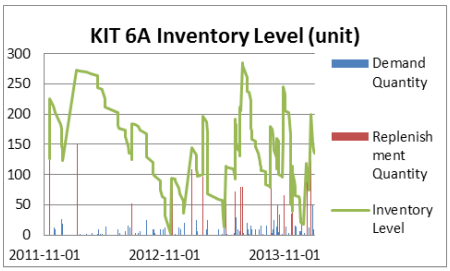


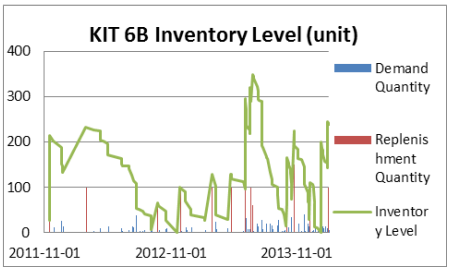


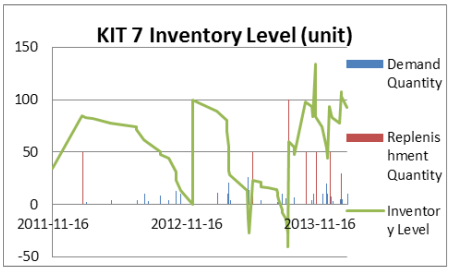


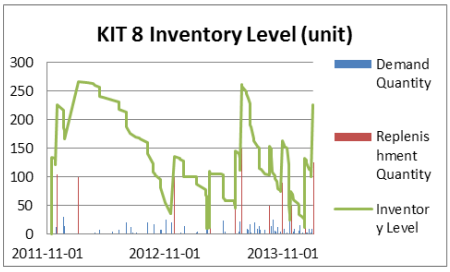


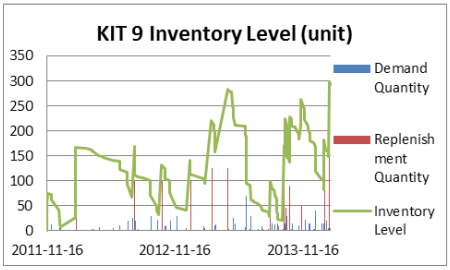


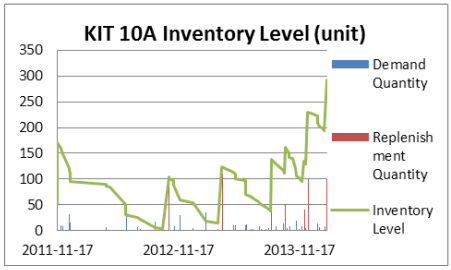

KIT 6A Inventory Level (unit)
300
250
200
150
100
50
0
2011-11-01
2012-11-01
2013-11-01
Demand Quantity
Replenishment Quantity
Inventory Level

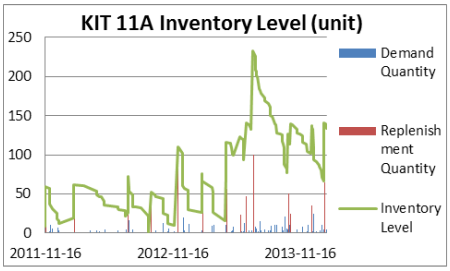

KIT 6B Inventory Level (unit)
400
300
200
100
0
2011-11-01
2012-11-01
2013-11-01
Demand Quantity
Replenishment Quantity
Inventory Level

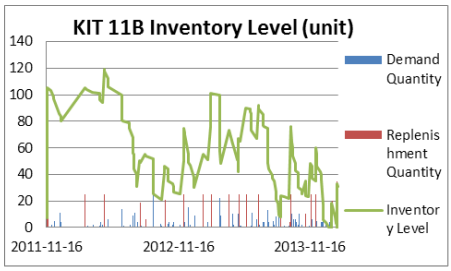

KIT 7 Inventory Level (unit)
150
100
50
0
-50
2011-11-16
2012-11-16
2013-11-16
Demand Quantity
Replenishment Quantity
Inventory Level

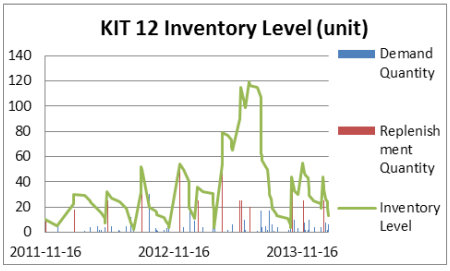

KIT 8 Inventory Level (unit)
300
250
200
150
100
50
0
2011-11-01
2012-11-01
2013-11-01
Demand Quantity
Replenishment Quantity
Inventory Level


KIT 9 Inventory Level (unit)
350
300
250
200
150
100
50
0
2011-11-16
2012-11-16
2013-11-16
Demand Quantity
Replenishment Quantity
Inventory Level

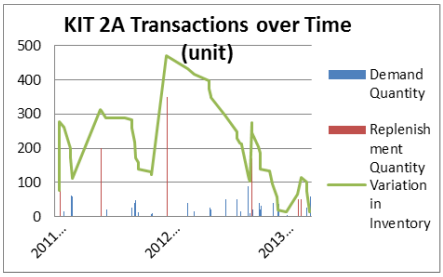

KIT 10A Inventory Level (unit)
350
300
250
200
150
100
50
0
2011-11-17
2012-11-17
2013-11-17
Demand Quantity
Replenishment Quantity
Inventory Level

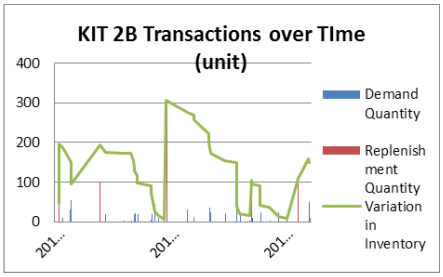

KIT 11A Inventory Level (unit)
250
200
150
100
50
0
2011-11-16
2012-11-16
2013-11-16
Demand Quantity
Replenishment Quantity
Inventory Level

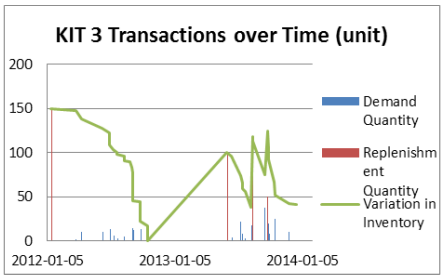

KIT 11B Inventory Level (unit)
140
120
100
80
60
40
20
0
2011-11-16
2012-11-16
2013-11-16
Demand Quantity
Replenishment Quantity
Inventory Level

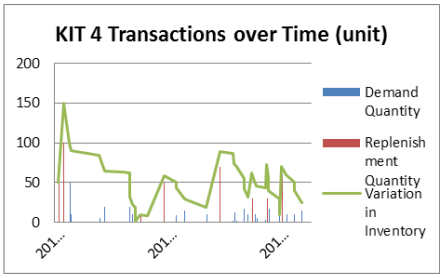

KIT 12 Inventory Level (unit)
140
120
100
80
60
40
20
0
2011-11-16
2012-11-16
2013-11-16
Demand Quantity
Replenishment Quantity
Inventory Level

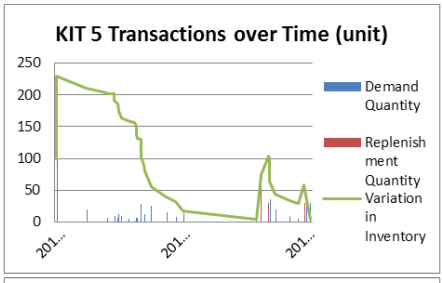
Supplier 2

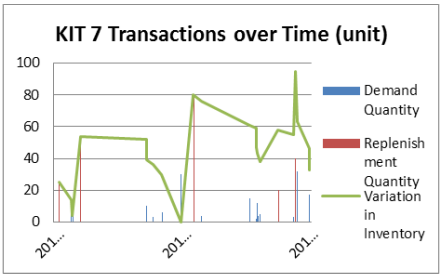

KIT 2A Transactions over Time (unit)
500
400
300
200
100
0
2011...
2012...
2013...
Demand Quantity
Replenishment Quantity
Variation in Inventory

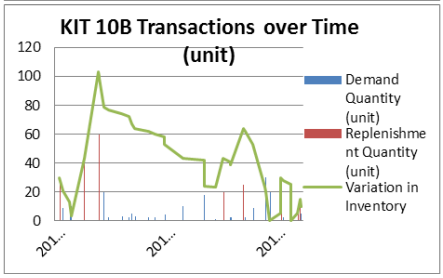

KIT 2B Transactions over TIme (unit)
400
300
200
100
0
201...
201...
201...
Demand Quantity
Replenishment Quantity
Variation in Inventory


KIT 3 Transactions over Time (unit)
200
150
100
50
0
2012-01-05
2013-01-05
2014-01-05
Demand Quantity
Replenishment Quantity
Variation in Inventory


KIT 4 Transactions over Time (unit)
200
150
100
50
0
201...
201...
201...
Demand Quantity
Replenishment Quantity
Variation in Inventory


KIT 5 Transactions over Time (unit)
250
200
150
100
50
0
201...
201...
201...
Demand Quantity
Replenishment Quantity
Variation in Inventory


KIT 7 Transactions over Time (unit)
100
80
60
40
20
0
201...
201...
201...
Demand Quantity
Replenishment Quantity
Variation in Inventory


KIT 10B Transactions over Time (unit)
120
100
80
60
40
20
0
201...
201...
201...
Demand Quantity (unit)
Replenishment Quantity (unit)
Variation in Inventory

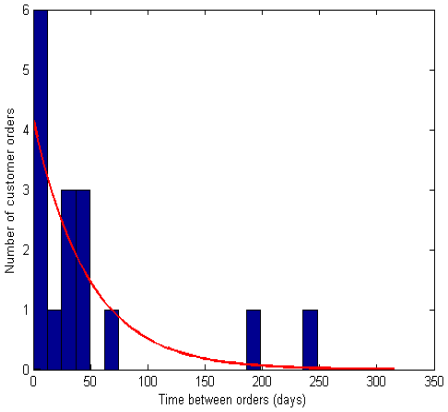
Appendix 8- Picture of the Reporting Tool in the ERP-system and a picture of the Planning tool in Microsoft Excel

	Item Group	Item	Warehouse	Total Stock	Total Allocated	Available Qty	Current Average Cost
1	ERH	RH KIT 0	IMRNL	134.0000	0.0000	134	123.1000
2	ERH	RH KIT 11A	IMRNL	164.0000	17.0000	147	525.4987
3	ERH	RH KIT 11B	IMRNL	71.0000	31.0000	40	3801.0000
4	ERH	RH KIT 1A	IMRNL	109.0000	60.0000	49	516.5606
5	ERH	RH KIT 1B	IMRNL	181.0000	5.0000	176	367.8730
6	ERH	RH KIT 2A	IMRNL	850.0000	320.0000	530	525.5982
7	ERH	RH KIT 2A	PEACN	65.0000	16.0000	49	525.5982
8	ERH	RH KIT 2B	IMRNL	313.0000	170.0000	143	97.4652
9	ERH	RH KIT 2B	PEACN	149.0000	24.0000	125	97.4652
10	ERH	RH KIT 3	IMRNL	120.0000	41.0000	79	613.8252
11	ERH	RH KIT 3	PEACN	60.0000	0.0000	60	613.8252
12	ERH	RH KIT 4	IMRNL	86.0000	0.0000	86	457.1462
13	ERH	RH KIT 4	PEACN	125.0000	10.0000	115	457.1462
14	ERH	RH KIT 5	IMRNL	116.0000	75.0000	41	564.9671
15	ERH	RH KIT 5	PEACN	4.0000	0.0000	4	564.9671
16	ERH	RH KIT 7	IMRNL	208.0000	2.0000	206	190.2951
17	ERH	RH KIT 7	PEACN	33.0000	0.0000	33	190.2951
18	ERH	RH KIT 8	IMRNL	211.0000	25.0000	186	572.8500
19	ERH	RH KIT 9	IMRNL	283.0000	45.0000	238	376.8500
20	ERH	RHKIT12	IMRNL	24.0000	15.0000	9	1088.2000
21	ERH	RHKIT6A	IMRNL	413.0000	23.0000	390	484.4000
22	ERH	RHKIT6B	IMRNL	261.0000	43.0000	218	512.0000
23	ERH	RH_KIT_10A	IMRNL	293.0000	2.0000	291	82.3485
24	ERH	RH_KIT_10B	PEACN	60.0000	20.0000	40	999.8800

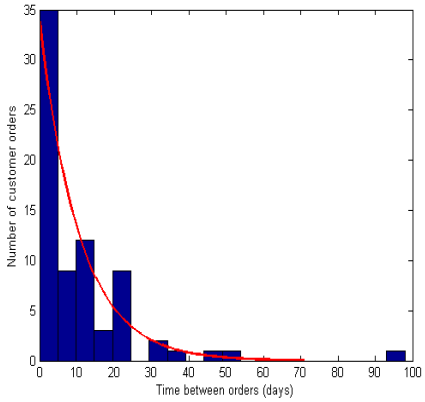
By Supplier	Kit	Supplier	Physical stock	In production	Orders	Allocated in Atlas	Theoretically Available	Physically Available	Theoretical Value	Physical value
0-IMRES	0	IMRES	130	0	10	0	120	120	$ 14 772	$ 16 003
1A-IMRES	1A	IMRES	42	0	33	0	9	9	$ 4 649	$ 21 696
1B-IMRES	1B	IMRES	171	0	3	0	168	168	$ 61 803	$ 62 906
2A-IMRES	2A	IMRES	346	0	310	5	36	36	$ 18 922	$ 181 857
2B-IMRES	2B	IMRES	126	0	5	5	121	121	$ 11 793	$ 12 281
3-IMRES	3	IMRES	164	0	113	0	51	51	$ 30 809	$ 99 072
4-IMRES	4	IMRES	121	0	0	0	121	121	$ 54 819	$ 54 819
5-IMRES	5	IMRES	192	0	3	0	189	189	$ 113 301	$ 115 099
6A-IMRES	6A	IMRES	356	0	102	7	254	254	$ 123 038	$ 172 446
6B-IMRES	6B	IMRES	334	0	72	7	262	262	$ 134 144	$ 171 008
7-IMRES	7	IMRES	173	0	10	0	163	163	$ 31 018	$ 32 921
8-IMRES	8	IMRES	150	0	44	3	106	106	$ 60 722	$ 85 928
9-IMRES	9	IMRES	225	0	43	2	182	182	$ 68 587	$ 84 791
10A-IMRES	10	IMRES	276	0	102	1	174	174	$ 14 329	$ 22 728
11A-IMRES	11A	IMRES	144	0	23	1	121	121	$ 63 585	$ 75 672
11B-IMRES	11B	IMRES	87	0	24	1	63	63	$ 239 463	$ 330 687
12-IMRES	12	IMRES	56	0	18	1	38	38	$ 41 352	$ 60 939
2A-PEAK	2A	PEAK	49	0	33	0	16	16	$ 8 410	$ 25 754
2B-PEAK	2B	PEAK	125	0	123	0	2	2	$ 195	$ 12 183
3-PEAK	3	PEAK	61	50	53	5	58	8	$ 35 038	$ 36 850
4-PEAK	4	PEAK	115	0	29	8	86	86	$ 38 962	$ 52 100
5-PEAK	5	PEAK	104	0	68	19	36	36	$ 21 581	$ 62 345
7-PEAK	7	PEAK	53	0	5	0	48	48	$ 9 134	$ 10 086
10B-PEAK	10	PEAK	95	0	22	1	73	73	$ 72 991	$ 94 989
									$ 1 273 415	**$ 1 895 161**

Appendix 9- Probability distribution for the times between order arrivals

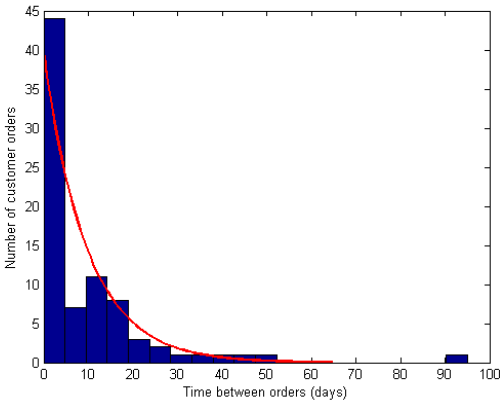
KIT 0



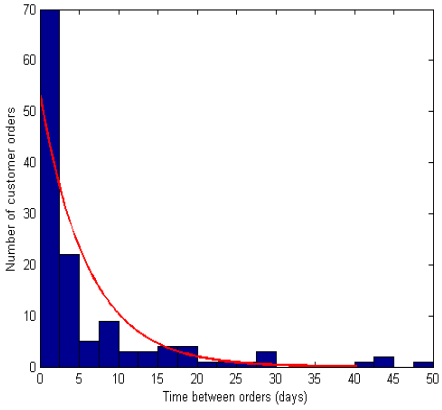
KIT 1



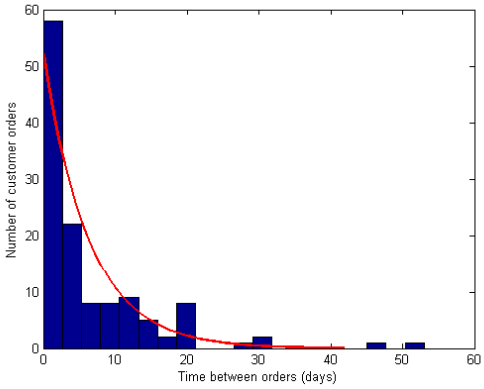
KIT 2A



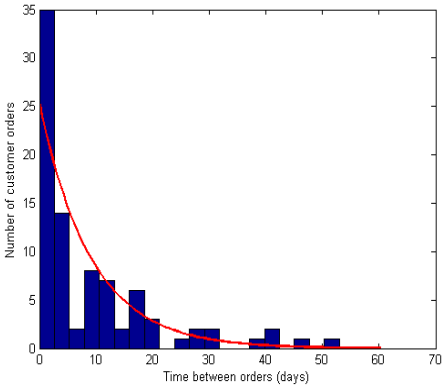
KIT 2B



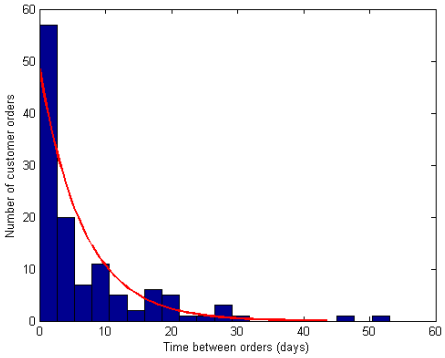
KIT 3



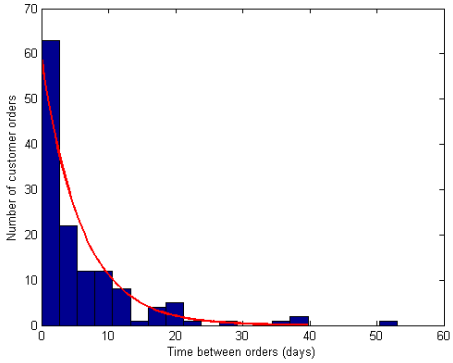
KIT 4



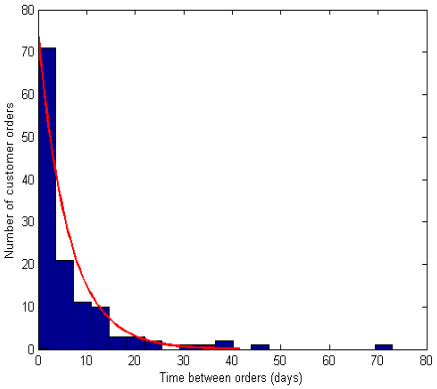
KIT 5



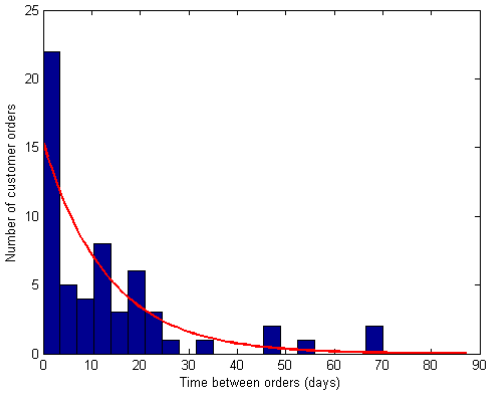
KIT 6A



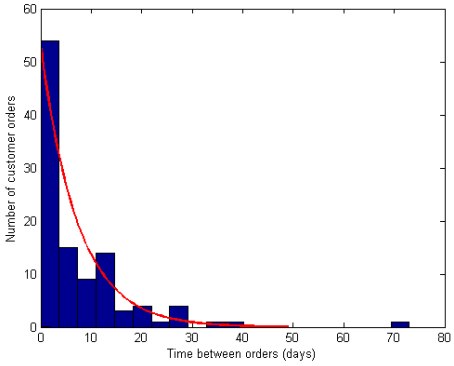
KIT 6B



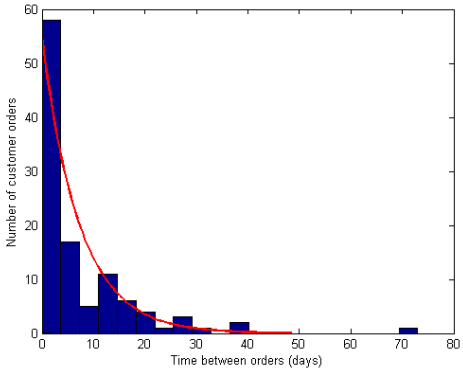
KIT 7



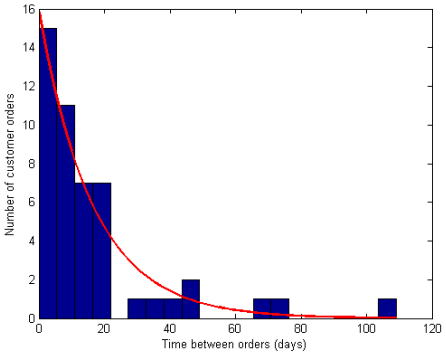
KIT 8



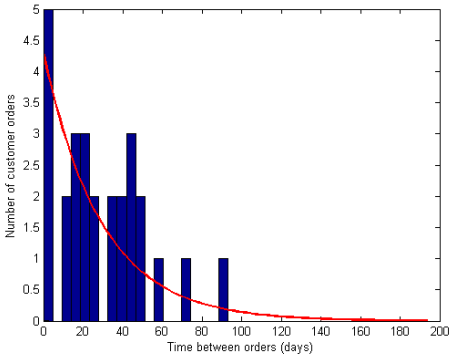
KIT 9



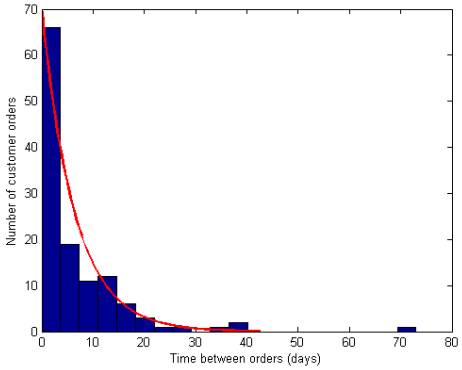
KIT10A



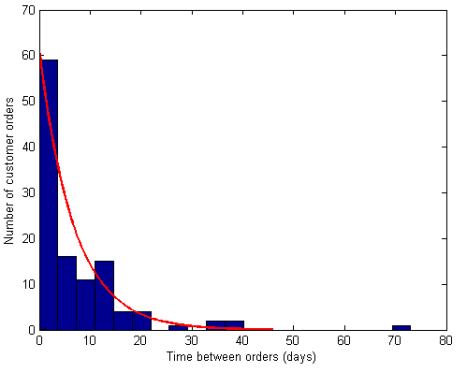
KIT 10B



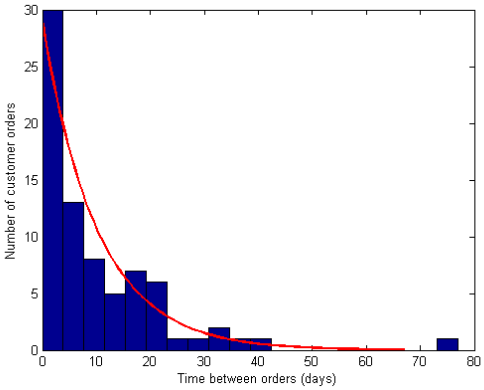
KIT 11A



KIT 11B



KIT 12



Appendix 10- Share of ERH-Kits delivered by respective supplier

ERH-Kit	Supplier 1; Number of ERH-Kits delivered (unit)	Supplier 2; Number of ERH-Kits delivered (unit)	Total Amount of ERH-Kits delivered (unit)	Share of ERH-Kits delivered supplier 1	Share of ERH-Kits delivered supplier 2
0	225		225	100 %	0 %
1A	900		900	100 %	0 %
1B	375		375	100 %	0 %
2A	3 430	1220	4 650	74 %	26 %
2B	2 000	865	2 865	70 %	30 %
3	1 420	380	1 800	79 %	21 %
4	1 060	490	1 550	68 %	32 %
5	1 215	360	1 575	77 %	23 %
6A	1 820		1 820	100 %	0 %
6B	1 756		1 756	100 %	0 %
7	670	235	905	74 %	26 %
8	1 165		1 165	100 %	0 %
9	1 725		1 725	100 %	0 %
10A	665		665	100 %	0 %
10B		385	385	0 %	100 %
11A	855		855	100 %	0 %
11B	715		715	100 %	0 %
12	480		480	100 %	0 %

Share of orders delivered by respective supplier

ERH-Kit	Total Amount of Orders	Amount of Orders Supplier 1	Amount of Orders Supplier 2	Share Supplier 1	Share Supplier 2
0	4		4	100%	0%
1A	4		4	100%	0%
1B	5		5	100%	0%
2A	27	9	36	75%	25%
2B	11	7	18	61%	39%
3	20	4	24	83%	17%
4	17	8	25	68%	32%
5	14	5	19	74%	26%
6A	18	6	24	75%	25%
6B	17	13	30	57%	43%
7	12	6	18	67%	33%
8	13		13	100%	0%
9	16		16	100%	0%
10A	10		10	100%	0%
10B		13	13	0%	100%
11A	15		15	100%	0%
11B	31		31	100%	0%
12	16		16	100%	0%