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Exploring Collaborative Mobile Storage Units in the Humanitarian Supply Chain

A Master Thesis in Humanitarian Logistics with the
United Nations World Food Programme Logistics Cluster
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by

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Preface

This thesis does not only conclude five years of studies for the both of us (to be honest, it's seven years…), it concludes a large part of our lives to this day. We both threw ourselves into Lund without any hesitations or seat belts, and it has formed us to what we are: Two students that won't let a wall stop us. Because, as our provider of contacts and examiner Joakim Kembro, firmly and honestly pointed out to us when we asked for his initial help in getting into the field of humanitarian logistics: You will run into a wall, and if you pass it, you will run into another.

Writing a thesis within humanitarian logistics is borderline stupid. It's a subject that is characterized by chaos and uncertainties, two of the things that a thesis certainly does not need more of. Getting ahold of people all over the far ends of the globe and watching cyclone news in live feed from Bangladesh has become everyday business as usual. But the borders of every comfort zone was quickly breached when with seven days notice we were able to catch flights to places, which of their name we had never heard before.

However, we, as a TV-host would put it, have a result. 1 200 hours and over 14 000 km later, this 100 page thesis has been finished. For that, we are greatly relieved, happy, nostalgic, but foremost, grateful. There are some people without whom we would not be able to write this thesis and to whom we would like to extend our most sincere thanks.

To our supervisor Lina Nord, for patient support and tireless coaching.
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To Otávio Costa, Logistics Sector Coordinator in Bangladesh, and team for their time and warm hospitality.
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To Ziaur Rahman and the faculty and students of Metropolitan University in Sylhet, Bangladesh, for hosting us and participating in engaging discussions on humanitarian operations in Bangladesh.
To the ÅForsk foundation, for supporting us with funding of the field study.
To Teknologkåren vid LTH and the fulltimers, for providing us with a makeshift office and the occasional possibility for a relieving laugh.
Finally, to Sofia, for unconditional coffee and love.

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Jacob Karlsson & Björn Sanders

Abstract

This thesis is an explorative single case study on the United Nations Logistics Cluster with the purpose to *explore the usage of collaborative Mobile Storage Unit (MSU) warehouses* in terms of determining their activities' and decisions' connection to the disaster management cycle, as well as their challenges' connection to the contextual factors of the humanitarian supply chain (HSC). It attempts to answer questions (1) *What are the collaborative MSU activities and decisions throughout the phases of the disaster management cycle?* and (2) *How do humanitarian contextual factors influence challenges to collaborative MSU activities and decisions in humanitarian logistics?*.

Data was collected mainly through semi-structured interviews with practitioners from two different Logistics Cluster operations, and field observations at the Logistics Sector operations in the Kutupalong refugee camp, Cox's Bazar, Bangladesh. This was compared to literature on warehousing, the humanitarian context and the disaster management life cycle.

General collaborative MSU activities and decisions were presented, along with descriptions for the first and parameters for the second. Activities were categorized to cycle-stages and decisions were, through using the disaster management life cycle, categorized in decision points, which both were visualised with the proposal of the collaborative MSU cycle. Challenges connected to these activities and decisions are found and presented, and their influence from humanitarian contextual factors was investigated.

The thesis concludes that the collaborative MSU is a public warehouse with a distribution purpose and activities similar to a conventional commercial low tech warehouse, except in erection, dismantling and foundation, as well as those when the MSU is in stock. It distinguishes five unique features of the MSU warehouse: *flexibility*, *temporarity*, *moveability*, *modularity* and *reusability*. Furthermore, concluding that some contextual factors influence challenges a lot more than others. Together internal factors, poor operating conditions and high uncertainties influence the vast majority of challenges; values and principles, and stakeholder complexity very few.

This thesis opens up for several interesting discussions on how the MSU is used in the HSC and during the phases of the disaster management cycle, both concerning practice and research.

Keywords: *Humanitarian Logistics*, *Humanitarian Supply Chain Management*, *Logistics*, *Warehouse*, *Mobile Storage Units, Disaster Management Cycle, Public Warehouse, Bangladesh, Syria*

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List of abbreviations

BD	Bangladesh
ConOp	Concept of Operations
DMC	Disaster Management Cycle
ER	Emergency Response
HL	Humanitarian Logistics
HSC	Humanitarian Supply Chain
MSU	Mobile Storage Unit
NGO	Non-Governmental organisation
OO	Ongoing Operations
OSC	Operation Specific Condition
RQ	Research Question
SC	Supply Chain
SOP	Standard Operating Procedures
SY	Syria
UN	United Nations
WFP	World Food Programme

Chapter 1 - Introduction

The first Chapter of the thesis gives an introduction to the background of the problem. Next, the purpose and research questions are presented. Finally, the structure of the report is presented.

1.1 Background and problem discussion

The world is constantly struck with humanitarian crises, ranging from natural disasters like floods, earthquakes and storms to man-made disasters like refugee crises and terrorist attacks (Van Wassenhove, 2006). During 2007-2016 an average of 354 reported natural disasters struck each year, affecting over 210 million people and resulting in costs of $141 billion and the death of 68 000 people annually (Below & Wallemacq, 2018). Being able to respond fast, efficiently and effectively to these situations is important for the affected communities and for the organisations providing relief aid. This can be achieved through improved humanitarian logistics (HL) (Van Wassenhove, 2006).

HL can be defined as "*the process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from point of origin to point of consumption for the purpose of meeting the end beneficiary's requirements.*" (Tomas & Mizushima, 2005, p.60), and covers everything from disaster relief to continuous support operations (Kovács & Spens, 2007). HL is widely accepted to be important for the overall humanitarian operations (Van Wassenhove, 2006; Kovács & Spens, 2011; Bardhan & Dangi, 2016). However, only ten years ago, pioneer researchers in the field said that humanitarian actors were about 15 years behind their commercial sector counterparts and that the humanitarian sector was trapped in a circle of low understanding of logistics (Van Wassenhove, 2006). But from 2006, the attention and research field of HL has grown, manifested for instance by the launch of the *Journal of Humanitarian Logistics and Supply Chain Management* (Behl & Dutta, 2018) and an increase of publications, seen for instance through that a search for "humanitarian logistics" on Google Scholar has increased from 118 results in 2007 to 929 results in 2018.

Following the increased amount of publications, the field of HL has developed from exploring broad concepts to answering more specific questions in many different logistics areas (e.g. Jahre, 2017; Vahdani et al., 2018; Pazirandeh, 2016), including warehousing (Mora-Ochomogo, Mora-Vargas & Serrato, 2016). Warehousing in the humanitarian sector is in many aspects similar to warehousing in the commercial sector. The Logistics Bureau (2019) definition of *"a planned space for the efficient storage and handling of goods and materials"* is certainly true even in the HL context. In a commercial setting, warehousing has substantially grown in attention from both researchers and practitioners and is often viewed as a vital logistics process rather than just a supporting unit (Faber, de Koster & Smidts, 2013). However, in the humanitarian context, the field of warehousing is still young (Behl & Dutta, 2018).

The low accessibility of adequate or non-damaged infrastructure and high uncertainty in capacity assessment that characterize HL (Van Wassenhove, 2006; Holguín-Veras et al., 2012), makes it interesting to focus on the warehouse itself and the implications of how that infrastructure is used. Furthermore, due to the high uncertainties in demand (Beamon & Kotleba, 2006a) and incomprehensive assessments (Tatham & Spens, 2011) the HSC has to be dynamic (Van Wassenhove, 2006; Holguín-Veras et al., 2012). This makes the potential to use temporary and mobile infrastructure specifically interesting. Warehouses with a temporary structure is mainly either tents or containers (Şahin, Ertem & Emür, 2014). The temporary structure tent warehouse are called Mobile Storage Unit (MSU), and is a manually set up and mobile low tech infrastructural resource employed by humanitarian organisations in relief operations with the main purpose of storing relief items for humanitarian actors (UNHRD, 2019a; UNHRD, 2019b). To the extent of our knowledge there is no research on this area.

We have identified two distinctive purposes of using an MSU: (1) the owner of the MSU stores items *solely for themselves*, and (2) the owner of the MSU stores relief related items on *behalf of several other actors*. We call the second area of usage a *collaborative Mobile Storage Unit*. The collaborative MSU is a part of the general collaboration trend within humanitarian operations (Balcik et al., 2010) and can be operated either by a Non-Governmental Organisation (NGO) consortium (Building a Better Response, 2014) or by the Logistics Cluster, a coordinating mechanism headed by the World Food Programme (WFP) (IASC, 2006). When operational, the Logistics Cluster act in sudden-onset emergencies, conflicts, and complex and protracted crises, facilitating access to common logistics services, such as transportation and warehousing (Logistics Cluster, 2019a).

One important characteristic of the MSU is mobility (i.e. the possibility to deploy, dismantle and redeploy the storage facility), which makes it interesting to view the MSU in the context of its entire cycle: understanding what activities and decisions are performed when and where, and the connection between them. Disaster management can be viewed in a cyclic manner through the disaster management cycle (Kovács & Spens, 2007), in the context of which we seek to explain the MSU to understand its place in HL.

In an interview, a field expert of the Logistics Cluster states the importance of MSUs, but also that they are a part of the operations that has gotten little attention in practice (Costa, 2019). Enhancing operational capacity has been a strategic prioritization for the Logistics Cluster 2016-2018 (Logistics Cluster, 2016), and this includes the MSUs (Logistics Cluster, 2019a). Combining this low practical knowledge and the previously discussed low theoretical understanding of the collaborative MSU with its practical importance, makes it an especially interesting subject to explore.

1.2 Purpose and research questions

The purpose of this thesis is to *explore the usage of collaborative MSU warehouses* in terms of determining their activities' and decisions' connection to the disaster management cycle (DMC), as well as their challenges' connection to the contextual factors of the humanitarian supply chain (HSC).

To be able to address the purpose, and due to the limited amount of research in the area, we set out to explore the area with the two research questions (RQs) below.

RQ1: What are the collaborative MSU activities and decisions throughout the phases of the disaster management cycle?
We aim to understand collaborative MSU usage in HL through empirically identifying activities performed with and within it, as well as the decisions concerning MSU usage, including when in relation to the activities and by what parameters, they are made. Through existing literature we aim to connect the MSU usage to the DMC.

RQ2: How do humanitarian contextual factors influence challenges to collaborative MSU activities and decisions in humanitarian logistics?
We aim to empirically identify challenges to collaborative MSUs in HL and connect these to the activities and decisions identified in RQ1. Through existing literature we aim to understand the contextual factors, and then explain their causational relationship to the challenges.

Through our answers to the RQs, the Logistics Cluster gain an overview of their collaborative MSU usage. The usage is broken down to provide a full understanding of activities and decisions, as well as challenges. The RQs are linked to the DMC and contextual factors of the HSC in order to better understand the position of activities and decisions in the relief timeline and influences on the challenges. This information is used to identify interesting areas of improvement and discussion for the Logistics Cluster, and to highlight topics for further research.

1.3 Delimitations

As discussed in the background, MSUs can either be self-owned or collaborative warehouses. This thesis only considers collaborative MSUs owned by the Logistics Cluster, excluding all other organisations owning MSUs.

To fully understand how the MSU is used, one needs to explore activities and decisions on operational, tactical and strategic level (as defined in Chapter 2). However, due to time constraints we have not been able to study activities and decisions on strategic level, as we would have needed to follow the operation under a longer time to understand these comprehensively. Due to access constraints we have mainly been able to gather data from interviews, which means that we have not been able to closely study decisions on operational level, as longer first hand observations would have been needed. Thus, this thesis is delimited to

focus on activities on operational and tactical level, and decisions on tactical level. Challenges found are correspondently limited by these delimitations. As we review the MSU as an asset, we do not consider decisions concerning operational processes of the warehouse.

Warehousing tents come in many sizes, however, models larger than 10 m wide are excluded since they would not be able to be set up manually, and thus fall outside our definition of an MSU. We also limit ourselves to tents with a warehousing purpose, so even though tents used for other purposes (such as registration) may be called MSUs in practice, these are not included in the thesis.

1.4 Disposition of the report

This thesis is divided into six chapters. *Chapter two* provides a theoretical frame of reference by reviewing relevant literature within the subject field. *Chapter three* explains the method with which the research will be conducted. *Chapter four* introduces the reader to the case organisation and the studied operations. *Chapter five* presents the data and analysis, generalizing it through mapping the MSU cycle and identifying the challenges, and connecting them to the DMC and the contextual factors. Finally, *Chapter six* concludes the thesis, answers the research questions, discusses results and proposes areas of further research.

Chapter 2 - Frame of reference

This Chapter describes the frame of reference for the thesis. The reader is introduced to the fundamentals of warehousing, followed by a warehousing framework in the HL. Thereafter, a summary of research on the context in which the HSC is operated is presented. Finally, the DMC in HL is explained.

The theoretical foundation on which this thesis is built is comprised of three areas: warehousing, humanitarian context and the DMC (see Figure 1). Warehousing is the most significant part for the thesis through providing a fundamental understanding of warehousing, including its purposes, types, activities and resources. The humanitarian context is relevant through providing the external operating conditions for MSU usage and helping us to answer RQ2. To understand the MSU usage in its cyclic disaster management context, we need to describe the DMC and what these disaster phases means to HL.

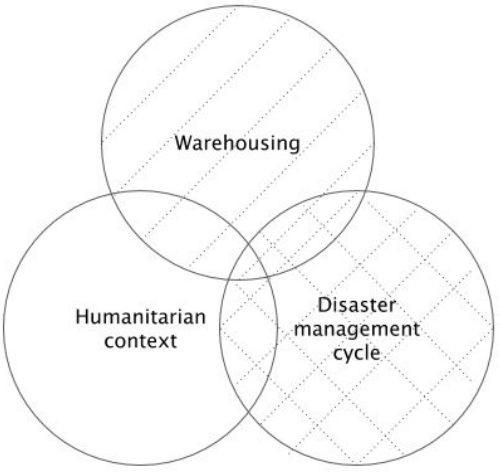

Figure 1: Areas subject to the literature review.

2.1 Warehousing

A warehouse is *"a planned space for the efficient storage and handling of goods and materials"* (Logistics Bureau, 2019). The goal of a warehouse is dependant on the goal of the organisation operating it (Mora-Ochomogo et al., 2016), and purposes for having one could for instance be the matching of supply and demand or the consolidation of products (Bartholdi & Hackman, 2017; Van den Berg & Zijm, 1999). Matching of supply and demand relates to them having different rates of change; the warehouse can for instance handle demand surge or serve as a buffer in times of supply deficit. For product consolidation, the warehouse can function as a means to reduce costs by merging flows and enabling larger and more cost-efficient shipments, but also through offering a possibility for product differentiation at a late parts in the supply chain (SC) (Bartholdi & Hackman, 2017). This is also the case in the humanitarian context (Blecken, 2010).

The field of warehousing in the humanitarian context has been addressed by previous research, mainly focusing on warehouse location (e.g. Balcik & Beamon, 2008; Chen et al, 2016), and of how (Jahre et al., 2016), why (McLachlin & Larson, 2009) and where (Richardson et al., 2016) to preposition goods for disaster preparedness. However, the general area is far from comprehensive (Behl & Dutta, 2018). Mora-Ochomogo et al. (2016) conduct a qualitative analysis on inventory management strategies and also highlight some important specifics that the humanitarian context imposes. These will be included and described when reviewing the humanitarian context (see Section 2.2).

When reviewing current literature on warehousing, we start with presenting the different warehouse types, whereafter we aim to create a framework describing the theoretical activities performed in a warehouse, as well as what resources are needed and what types of items are commonly stored in humanitarian relief operations. We investigate current research on mobile warehouses and collaborative warehouses in the humanitarian context. For decisions in humanitarian warehouses, we only find literature on the localization decision. Finally, we present research on the time based terms operational, tactical and strategic level in the warehousing context.

2.1.1 Warehouse types

Rouwenhorst et al. (2000) distinguish between two types of warehouses: production warehouses and distribution warehouses. Production warehouses store raw material, semi-finished or finished products at a production facility; distribution warehouses store goods from multiple suppliers before delivery to end customer. This division is founded in the operations the warehouse perform. Different operations generally mean different characteristics of stored goods. Production warehouses generally require larger amounts of goods in store during extended periods of time, whereas distribution warehouses more commonly has a larger total product range (ibid.).

It is also possible to make division based on who operates the warehouse. Stock & Lambert (2001) do this by categorizing warehouses as private or public warehouses. Private warehouses are operated by the actor owning the goods, and public warehouses are run by independent actors who provide storage services to multiple actors, often on first-come-first-serve basis. The actor running the public warehouse does not own the goods that are stored (Burger, 2003). In general, if a company utilizes a public warehouse rather than having their own, they will trade their control and possibility to customize operations for their needs and in turn gain greater flexibility and less risk of obsolete facilities (idib.). Drawbacks of this decision may include communication difficulties and space availability during periods of peak demand (Stock & Lambert, 2001). The public warehouse is often found in industrial parks, where it can be defined as: "*a logistics management and service platform that takes charge of all raw materials and products which belong to the manufacturing factories in the entire industrial park, providing professional and unified services such as purchasing, storage,*

logistics scheduling, distribution, and even material delivery to a single production line of each enterprise." (Cao & Pingyu, 2013, p. 1898).

A combination of private and the public warehouse approaches result in contract warehouses, which are more long-term agreements of outsourcing, where space is guaranteed (Burger, 2003). If these warehouses function well, they will enjoy benefits from both approaches (Stock & Lambert, 2001). The contract warehouses can also be called third-party logistics (3PL) services (Lieb et al., 1993).

2.1.2 Warehousing activities

Warehouses commonly have four processes: (1) receiving, (2) put-away, (3) order-picking and sorting and (4) packing and shipping (Van den Berg & Zijn, 1999). Firstly, receiving refers to the arrival of goods where they are unloaded from the transportation vessel. Secondly, goods are put away and assigned a location in the warehouse (Bartholdi & Hackman, 2017). The actual storing period occurs after these first two steps. Thirdly, goods are picked, as triggered by a request for retrieval. Lastly, goods are prepared for shipment and sent out of the warehouse (Van den Berg & Zijn, 1999). We call these handling activities.

In addition to this, a warehouse may also perform value-adding and supporting activities. Value-adding activities can be labeling, kitting or repacking (Bartholdi & Hackman, 2017) and supporting activities could be cleaning, maintenance and stock taking. To the extent of our knowledge, there exists only one explorative study on supporting and value-adding activities in the humanitarian warehouse, addressing packing (Sohrabpour, Hellström & Jahre, 2012), which will be addressed in the next paragraph. Blecken (2010) identifies protection from deterioration, damage and theft as important supporting activities, but does not elaborate on it further. From humanitarian warehousing in practice, some supporting activities addressed through policies and procedures in the Logistics Cluster Operational Guide for Warehousing and Inventory Management include health and safety, security, pest control, maintenance and cleaning, quality control, disposal of obsolete or damaged goods and reverse logistics (Logistics Cluster, 2019b). Reverse logistics refers to controlling the flow of goods "*[...] from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal"* (Rogers & Tibben-Lembke, 1999, p.2).

Sohrabpour et al. (2012) research packaging and the implication of a holistic view on goods' secondary packaging. Since the humanitarian warehouse usually does not have basic tools (such as forklifts, pallets and racks) (see Subsection 2.1.3), which links to the humanitarian contextual factors of supply of tech (which will be described in Section 2.2), it is important that the packages themselves are stackable, and can endure rough and manual handling (ibid.).

Combining all activities in this Section, it is possible to map the humanitarian warehouse, as shown in Figure 2. We group activities into the three categories handling activities, supporting activities and

value-adding activities. We have also seen activities related to management and administration (Logistics Cluster, 2019b), but find that they are not a natural part of any of the areas.

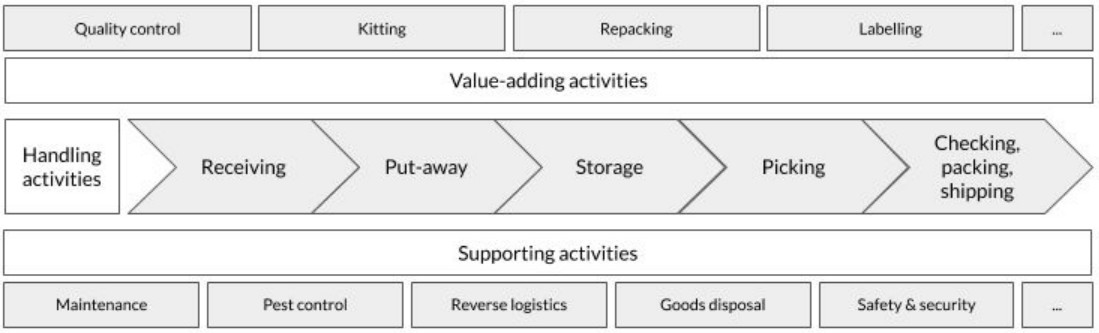

Figure 2: The activities of a humanitarian warehouse
(adapted from Bartholdi & Hackman, 2017; Van den Berg & Zijn, 1999; Logistics Cluster, 2019b).

2.1.3 Warehousing resources

Warehousing resources can be categorized into three areas: labour, equipment and information systems (Bartholdi & Hackman, 2017; ten Hompel & Schmidt 2007). Firstly, labour resources relates to the people operating the warehouse, ensuing that all its activities are performed. Palšaitis et al. (2017) identify knowledge of warehousing processes, ensuring compliance to internal policies, demand assessment and inventory classification among important competencies for warehouse managers. For scheduling, there are two important tasks: predicting daily workforce requirements and accommodating peak requirements (Sheenan, 1989).

Equipment resources relate to storage and handling of goods in the warehouse, enabling or simplifying operations (ten Hompel & Schmidt, 2007). As will be mentioned in Subsection 2.1.4, handling equipment can be customized to the SKUs moved in the warehouse. For palletized goods, basic handling equipment such as trucks ranging from pallet jacks to forklifts of various sizes may be used to ease movement of goods. We chose to also count technical resources towards equipment resources, in which we in turn include barcodes and RFID tags. Both may be used for reading and entering information, increasing efficiency or eliminating manual intensive tasks. RFID tags are more expensive than barcodes, but are reusable and not as sensitive to external factors such as heat or dirt (Delen et al., 2007).

Two main information system resources to support warehouse operations are Warehouse Management Systems (WMS) and Enterprise Resource Planning (ERP) systems (Bartholdi & Hackman, 2017). A WMS has the purpose of providing, storing and reporting information regarding the warehouse, which can be used to manage material handling inside it (Faber, de Koster & Smidts, 2013). Benefits include increased productivity, reduced inventory levels, better utilized space, reduced number of errors and support of value-adding activities (ibid.), as it makes for better decision making. A WMS may be categorized by

sophistication level; there are basic, advanced and complex systems with gradually increasing functionality, for instance regarding planning and optimization of resources and activities (Dusseldorp, 1996). In general, public warehouses are shown to have a higher need for a specific information system compared to private warehouses (Faber, 2015). Although WMS systems may communicate with other systems, such as for instance procurement or transportation (Faber et al., 2013), ERP systems are integrated for a larger range of other business functions (Olhager & Selldin, 2002). Further, ERP systems are often more long-term and handle more than the resources and activities of the warehouse (Faber et al., 2013), facilitating information access across the entire organisation (Olhager & Selldin, 2002).

2.1.4 Relief items

A warehouse may handle products of varying unit size. In general, products are kept in larger units upstream in the SC, to be gradually broken down before arriving at the end customers, who may very well consume single units (Bartholdi & Hackman, 2017). A stock keeping unit (SKU) is the smallest product unit tracked and handled by the organisation (ibid.) and does not necessarily refer to single units, should it for instance only handle cartons with a certain amount of units. In order to understand the warehouse, one has to understand the what is handled in it, as this may impact for instance equipment choices or placement of goods. In many instances of HL the secondary package is the SKU (Sohrabpour et al., 2012), so also in the case of this thesis (see the discussion on this in Subsection 2.1.2).

Products in humanitarian warehouses vary greatly as actors have different focus areas (see Subsection 2.2.2). John et al. (2012) classify relief items as consumables and non-consumables (operational and non-operational), as summarized and exemplified in Figure 3, and highlight that having a large product mix is a challenge particular to humanitarian actors. In practice these items are referred to as Food Items and Non-Food-Items (NFI) and are recommended to be stored apart from each other (Sphere Association, 2018).

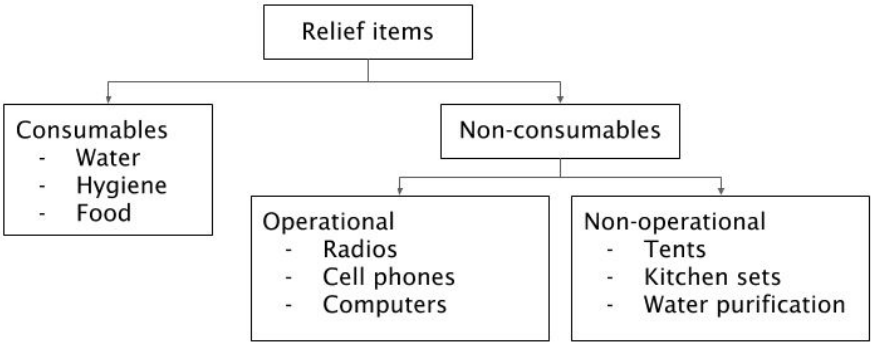

Figure 3: Classification of relief items (adapted from John, et al. (2012))

2.1.5 Mobile warehouses

As stated in Chapter 1, to the extent of our knowledge, very few studies address mobile warehouses. We find no studies in the commercial context and only two in the humanitarian context. Şahin, Ertem & Emür (2014) investigate in what way containers can be used as mobile storage units, but even here the main focus is on where to pre-position mobile warehouses as an asset if an emergency should strike, which is a strategic approach to MSU usage. Mbohwa (2010) shows that whether or not to erect a temporary storage facility or build a new warehouse is one of the decisions that are important to make when providing relief (in the case of WFP in Zimbabwe), but doesn't explore the subject further.

2.1.6 Collaborative warehouses

By collaborative warehousing we refer to warehousing in the collaborative sense that we define in Subsection 2.2.2. The collaborative warehouse in the commercial context is covered when discussing the warehousing types of contracted warehouse and public warehouse (see Subsection 2.1.1). To the extent of our knowledge there exists only one study specifically addressing collaborative humanitarian warehousing: Davis et al. (2013) discuss collaborative pre-positioning of goods. But, similar to mobile warehousing literature, this relates to pre-positioning and is therefore of limited relevance to this thesis. When reviewing collaborative warehousing in terms of more general humanitarian collaboration research (see also Subsection 2.2.2), we find some results related to performance and advantages of collaborative warehousing. Huang et al. (2011) state that there always will be an overall higher inventory level in a system with competition, meaning that collaboration can help improve the overall response. Schulz & Blecken (2010) conclude the following benefits for collaborative storage: Reduced facility and administration cost through consolidation of equipment, personnel and facilities; time and cost saving through expansion of warehouse network; as well as increased flexibility and availability through stock and risk pooling.

2.1.7 Location decision

The location decision for a warehouse in the humanitarian context is studied by several authors, but mainly through the means of quantitative models not including decision descriptions, points or parameter. However, Mora-Ochomogo et al. (2016) identify some important variables when deciding location: Access routes, equipment availability and from where incoming goods is expected. Additional aspects to consider for location decisions include security, capacity, ease of access, structural solidity and absence of any threat of flooding (Sphere Association, 2018).

Furthermore, due to the humanitarian contextual factors related to the temporary and dynamic SC and human resources, which will be developed on in the Section 2.2, Beamon & Kotleba (2006b) state the necessity of having warehouse solutions that are easy to implement, flexible to change and in low need of maintaining efforts.

2.1.8 Level of operations

When discussing decisions it is common to differentiate between the times based terms of operational, tactical and strategic level. This is also done in the humanitarian context (Leiras et al., 2014). Leiras et al. (2014) conclude in their literature study that the majority of studies (up until 2014) have been made on strategic level decisions, but, as discussed in Chapter 1, this thesis is delimited to mainly tactical level decisions, and operational and tactical level activities.

For the humanitarian context, Apte (2009) defines the different levels' goals and Abidi, De Leeuw & Klump (2013) show key success factors of the different levels. These key success factors include collaboration, qualified and experienced staff, and proper assessment on tactical level; and speed, flexibility and cost efficiency on operational level. In terms of commercial warehousing, these could for instance determine where incoming products should be stored and what resources, in terms of personnel and equipment, are needed to execute this decision (Faber et al., 2013). Faber et al. (2013) argue that what is usually seen as time horizon of 1-3 months of tactical planning, can be shortened to days or weeks in the warehousing case.

2.2 The humanitarian context

To be able to study the MSU, and specifically the challenges connected to it, it is important to understand what affects the entirety of the HSC. This Section creates a theoretical framework for contextual factors that affects the HL to later be able to understand how these influence the MSU challenges, and provides a basic understanding for collaboration in the humanitarian context setting the stage for the choice of collaborative implementation of storage.

2.2.1 Contextual factors

Articles concerning humanitarian operations commonly have their own way of describing the humanitarian context. We present a summary of contextual factors that are applicable when reviewing the context of the MSU. Findings are categorized inspired by the contextual factors laid out by Van Wassenhove (2006). The entire list of contextual factors can be viewed in Appendix A.

We categorize the contextual factors in eight different topics. *Poor operating conditions*, *high uncertainties* and the *temporary and dynamic* nature of the HSC are factors caused by hard to control externalities, whereas the *internal factors* are caused and controlled by the humanitarian actors themselves. In addition to this, the actors are affected by *stakeholders* through donation-based revenue streams, and through *principles and values*. We made a distinction between internal factors and *actor complexity*. Even though both are internally controllable, the actor complexity refers to the context and challenges of a scenario with a great amount of different actors in-field, where internal factors has one focal actor. The last identified topic is the *goal* of the HSC. It is debatable whether or not the goal can be seen as a contextual factor, but as it

influences the operations and as the goal of the HSC is very distinguishable from the goals of other SCs, we view it as such.

2.2.1.1 Poor operating condition

We use the phrase poor operating conditions to describe the physical, geographical and political environment (Van Wassenhove, 2006) of the HSC. By physical environment we refer to the condition of the physical infrastructure, which usually is damaged, hard to access, or even destroyed(e.g. Holguín-Veras et al., 2012; Tatham & Spens, 2011; Yu et al., 2015). By geographical environment we refer to the effect of weather and geography, ranging from draughts to floods, and from mountains to sea (Kunz & Reiner, 2012). The political environment environment is the way the local authorities affect the HSC, e.g. through getting supplies and assets to the affected area (Mora-Ochomogo et al., 2016) or even entry permissions for the organisation (Oloruntoba, 2005). The political environment is discussed extensively by several authors with regards to man-made disasters (e.g. van Wassenhove, 2006; Mora-Ochomogo et al., 2016; Oloruntoba, 2005)), but interestingly Seekins (2009) show that disregarding the political aspects can prove disastrous even in the case of natural disasters. Within this we also include safety and security issues that have been proven to be highly important when operating the HSC (Oloruntoba, 2005; Van Wassenhove, 2006; Holguín-Veras et al., 2012).

Extending the poor operating conditions further, we also choose to include the often damaged virtual infrastructure, by which we mean what Holguín-Veras et al. (2012) describe as the local social network between both people and local companies. Finally, it is also important to understand that when operating the downstream parts of the SC, supplies are usually distributed in an area influenced by a local culture and/or religion that might vary from the ones of the relief actor (Mora-Ochomogo et al., 2016).

2.2.1.2 High uncertainties

We combine the high uncertainties or supply, demand, assessment and logistics to one factor of high uncertainties. By supply uncertainties we mean what Kovács & Spens (2007) address as the supplier structure, where the amount of suitable suppliers is limited and tends to lead to need of using unwanted suppliers. The supply uncertainty is particularly prevalent in the response (see Section 2.3), where a large portion of in-kind supplies and unsolicited donations (Mora-Ochomogo et al., 2016) creates an urgent need of prioritizing goods (Holguín-Veras et al., 2012). Demand uncertainty is discussed at length in literature (e.g. Van Wassenhove, 2006; Holguín-Veras et al., 2012; Beamon & Kotleba, 2006a) with the most significant problem of unpredictable or unforecastable demand in terms of timing, location, type and size (Balcik & Beamon, 2008; Beamon & Kotleba, 2006a; Yu et al., 2015). That can result in sudden surges in demand (Balcik & Beamon. 2008), often affecting the weakest points of the HSC (Holguín-Veras et al., 2012). This demand uncertainty naturally affects the possibility to do correct assessment, but the assessment itself can also be an uncertainty. This is e.g. discussed by Tatham & Spens (2011), where slow compilation

and lack of comprehensive coverage is highlighted as a key issue in the 2004 Asia tsunami response. Finally, the logistics uncertainty is related to a general lack of operational control (Kovács & Spens, 2007), which is highlighted by Holguin et al. (2012), proposing that even as demand and supply might be relatively known while in recovery, capacity of transport corridors still can be an uncertainty.

2.2.1.3 Temporary and dynamic

Van Wassenhove (2006) states that the HSC is temporary and dynamic. On a more general level, temporary refers to the fact that every operation is different, making it hard to take practice, standards and lessons learned from one setting and simply applying it in the next (Chandes & Paché, 2010). In a more specific term, temporary is manifested through the uncertainty in demand (as previously discussed in Subsection 2.2.1.2), making it hard to create periodicity and economically satisfying scale of logistics activities (Holguín-Veras et al., 2012). Mora-Ochomogo et al. (2016) state that the latter is specifically difficult when handling inventories. When taking all uncertainty into account, it becomes intuitive that the HSC has to be dynamic. Holguín-Veras et al. (2012) take it further and calls the response HSC improvised.

2.2.1.4 Internal factors

We choose to categorize contextual factors conjured within the humanitarian organisations themselves as internal factors. Many of these factors can be explained by "the vicious circle of logistics", highlighting the low strategic mindset and maturity of HL in both practice and research (Van Wassenhove, 2006). Even though, as previously discussed, much has happened during the last ten years, standardization of logistics processes is still an issue for many humanitarian actors (Mora-Ochomogo et al., 2016). Van Wassenhove (2006) also states that humanitarian actors operate in a low tech environment, extended by Balcik & Beamon (2008) to include also lacking human resource management. Several other studies also discuss human resources as a constraint, identifying a high staff turnover rate (Van Wassenhove, 2006; Tatham & Spens, 2011) and difficulty in keeping the right labour pool size (John et al., 2012) and experience (Mora-Ochomogo et al., 2016) in humanitarian operations.

2.2.1.5 Stakeholder complexity

Van Wassenhove (2006) describes stakeholder complexity as "*large numbers of uncoordinated and disparate donors, the media, governments, the military [and] the final beneficiaries.*" (p. 477), we choose to focus our stakeholder complexity on the donors, the media and the beneficiaries. The role of the government and the military is included in the poor operating conditions.

Since humanitarian actors themselves do not generate revenue to support their activities, they are dependant on donors (Holguín-Veras et al., 2012). This dependency is arguably one of the most prevalent constraints to the HSC, influencing all its parts (Holguín-Veras et al., 2012). Operating revenue is generated this way, and in kind donations might not match the need (Oloruntoba, 2005), resulting in unsolicited donations (Mora-Ochomogo et al., 2016) and material convergence (Holguín-Veras et al., 2012). Due to the fact that

revenue is created through donations and not through customers, the end customer (the beneficiaries) does not possess the same power as they would in a commercial setting (Holguín-Veras et al., 2012). Oloruntoba & Gray (2006) argue that this creates a shift where "customer service" is directed towards donors, rather than to beneficiaries.

The important role of media in the HSC is often discussed in literature (e.g. Kovács & Spens, 2009; Mora-Ochomogo et al., 2016), and Kovács & Spens (2009) describe HL as torn between prioritizing between exposure and efficiency. When analysing the aftermath of the 2004 Asia tsunami, Oloruntoba (2005) discusses the need of having a strong media strategy, where the media should be seen as a partner for communicating to potential donors, but also to the affected population.

2.2.1.6 Values and principles

The values and principles guiding the humanitarian organisation are created by actors and based on stakeholder interests (Van Wassenhove, 2006). The "humanitarian principles", adopted by the United Nations (UN) General Assembly in 2004 (OCHA, 2012) of humanity, neutrality, independence and impartiality are the key manifestation of this (Van Wassenhove, 2006). Humanity in the meaning that suffering must be addressed, neutrality that actors do not take sides in a conflict, impartiality that prioritizing must be conducted on base of need alone, and independence that actors must be autonomous from objectives held by others (OCHA, 2012).

2.2.1.7 Actor complexity

As literature specifically points toward the challenge of having myriads of uncoordinated actors with different mandates, ideologies or religious beliefs (e.g. Van Wassenhove, 2006; Kovács & Spens, 2007; Kovács & Spens, 2009), and due to the specific implications of this cases' collaborative context, we choose to isolate actor complexity as a factor. This complexity differs over the phases of the HSC, from the response where *"thousands of independent supply chains may overlap, compete, interfere, cooperate, and even battle for the scarce resources available"* (Holguín-Veras et al., 2012, p. 500), which creates a need to prioritize in converging material flows (idib.), to recovery where lack of inter-agency standards might be the largest issue (Tatham & Spens, 2011). These stages will be developed on further in Section 2.3. Oloruntoba (2005) called for a better clarity in organisational roles, and since then authors have discussed the importance and challenges of collaboration in HL (Holguín-Veras et al., 2012). Especially worth highlighting is the asymmetrical power relationship between actors (McLachlin & Larson, 2011) that can lead to small organisations being hesitant to cooperate with big bureaucratic UN agencies and Big International Non-Governmental Organisations, which isn't eased by their mutual dependence on shared donors (Seybolt, 2009).

2.2.1.8 Goals

It is important to understand how the humanitarian goal of relieving suffering (Kovács & Spens, 2007) affects the SC operations. Beamon & Balcik (2008) call it a double bottom line with both financial stability and mission effectiveness. To achieve the second, time is by many researchers considered the most important factor (e.g. Kovács & Spens, 2007; Balcik & Beamon, 2008; Holguín-Veras et al., 2012; Mora-Ochomogo et al., 2016) along with the availability of the right quality of goods (Abidi et al., 2013). The transaction from this effectiveness to efficiency within the disaster phases will be described in Section 2.3.

2.2.2 Collaboration in the humanitarian context

In this thesis we will use collaboration to describe relationships, interactions and cooperation between different actors operating within humanitarian operations. Coordination is sometimes used to describe the same phenomenon, and even though these two are not always considered the same by literature in the commercial context, they are commonly used interchangeably in the humanitarian context (Balcik et al., 2010).

Collaboration can be performed both vertically and horizontally in the HSC (Jahre & Jensen, 2010). Horizontal cooperation occurs between humanitarian actors at the same level in the HSC and is for instance performed within fundraising, procurement, transportation and storage (Toyasaki et al., 2017). There are different forms of horizontal collaboration, ranging from two-actor partnerships to collaboration measures including hundreds of humanitarian organisations (Logistics Cluster, 2018). In larger operations, collaboration usually occurs between a limited amount of organisations (commonly referred to as NGO consortia) or UN-driven clusters (Building a Better Response, 2014; Balcik et al., 2010). NGO consortia, as previously discussed, will not be addressed further.

The Logistics Cluster is a coordination mechanism under the UN. The UN cluster approach was adopted in 2005 to address consistent gaps and weaknesses in, and to improve, international response to humanitarian crises (Logistics Cluster, 2019a). The cluster concept is driven through eleven functional areas of activity, all of which have an appointed cluster lead agency (IASC, 2006), see Figure 4. The Logistics Cluster, which is one of these coordination mechanisms, is lead by the World Food Programme (WFP) (ibid.). Logistics Cluster as an entity does not own any assets. When, further on in this document, we refer to Logistic Cluster owned or operated, it is formally WFP assets and personnel, working on behalf of the Logistics Cluster.

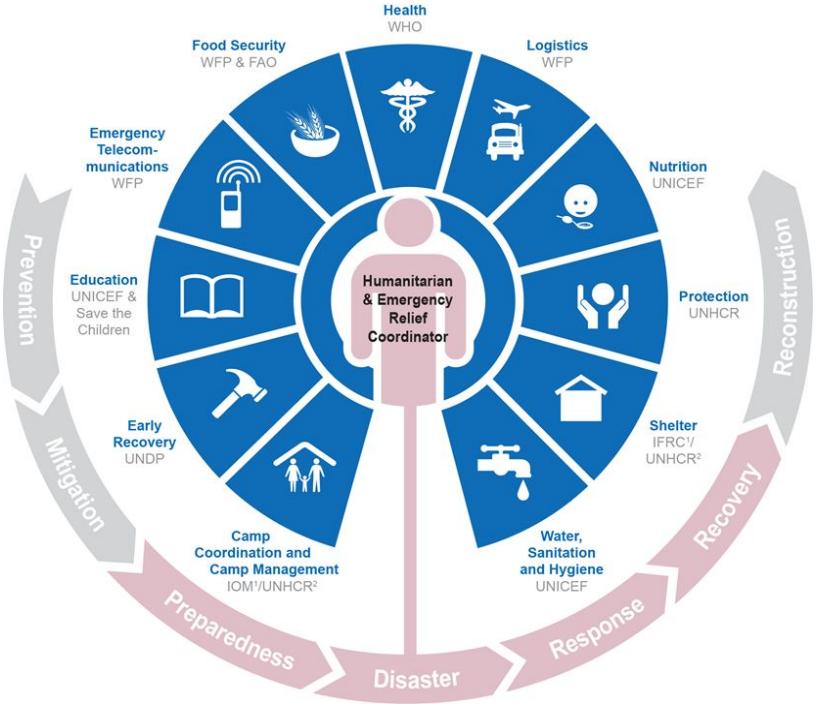

Figure 4: The cluster approach (Humanitarian Response, 2019).

Collaboration has proven beneficial in a number of different areas, including procurement, transportation and warehousing (Balcik et al., 2010;), and several researchers describe collaboration as crucial for the success of humanitarian operations (Bardhan & Dangi, 2016; Chandes & Paché, 2010). The activities in which collaboration is performed can for instance be resource and information sharing, centralized decision-making or joint projects (Balcik et al., 2010). In the Inter Agency Standing Committee (IASC) Cluster Approach Evaluation by Streets et al. (2010), future key challenges of the cluster approach are discussed. This includes the specific recommendations to address clarification of criteria and processes for cluster implementation and discontinuing, as well as the development and distribution of a standard, basic cluster management handbook or tool kit for cluster coordinators (Streets et al., 2010).

2.3 The disaster management cycle

HL is commonly defined as "*the process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from point of origin to point of consumption for the purpose of meeting the end beneficiary's requirements.*" (Tomas & Mizushima, 2005, p.60). Kóvacs & Spens (2007) launched a three step model of the phases in HL, building on DMC models within the field of disaster management, where it had been discussed since the 1930s (Neal, 1997). The model was later refined by Apte (2009) to: *Preparedness*, *Response* and *Recovery*. These phases are present in all parts of the HSC (Kovács & Spens, 2007) and are visualized in Figure 5.

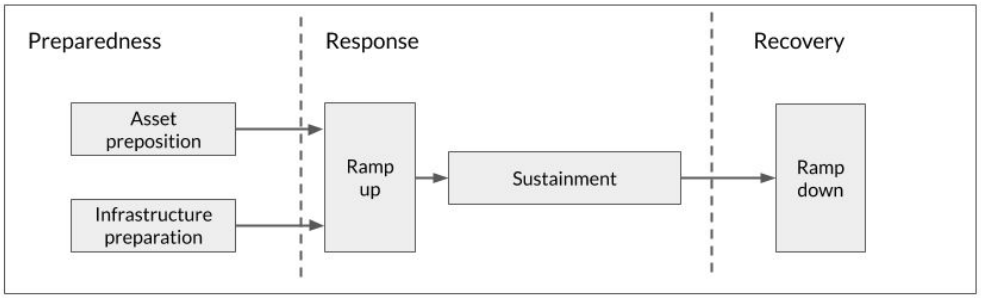

Figure 5: The phases of the DMC.
Adapted from Kovács & Spens (2007) and Apte (2009).

Even though there are distinct definitions of these phases, Holguín-Veras et al. (2012) argue that the importance of the specific characteristics of the HSC needs to be viewed as a flow through the phases. This gradient starts commercial logistics and goes through regular HL (recovery) to post-disaster HL (response). The further into the recovery phase an operation is, the more similar it is to commercial logistics (ibid.), thus making the contextual factors (as described in Section 2.2) less prevalent. This scale is most obvious when reviewing the difference between emergency response and ongoing operations (as will be discussed in Subsection 2.3.2). This needs to be kept in mind when we continue to discuss the phases and when we use the context to generalize decisions and challenges.

2.3.1 Preparedness

Preparedness within HL deals with the strategy put in place for implementation of successful response in the event of a disaster (Tomasini & Van Wassenhove, 2009). The preparedness phase includes pre-positioning of assets and preparation of infrastructure before disaster strikes (Apte, 2009). Prepositioning research mainly focus on optimization models determining whether or not to position resources in predetermined locations (e.g. Balcik & Beamon, 2008; & Verma & Gaukler, 2005), with the goal of for instance maximizing total expected demand coverage or minimizing average response time (Apte, 2009). Other disaster management capabilities include research and building virtual infrastructure (Kovács & Spens, 2007), for instance through training of staff, developing best practices and pre-negotiating agreements, which can be valuable complementary actions in the preparedness phase (Kunz et al., 2014). When defining logistics preparedness in HL, Jahre et al. (2016) highlight an increasing focus on capacities of the local community and also propose that aspects related to waste should be taken into account.

2.3.2 Response

The response phase is initiated the moment a disaster strikes. Donations, in money and in kind, are requested from potential donors, supplies are obtained from pre-arranged contracts or pre-positioned goods (Apte, 2009) and prepared plans from the previous phase are executed together with regional actors (Kovács & Spens, 2007). Inventory management and distribution are identified as important logistics operations in

the response phase (Apte, 2009). For inventory management, high staff turnover and limited funding call for low-effort, flexible and easily implementable inventory management policies (ibid.). Distribution addresses transportation from the source to the affected population within a given time frame, for instance for instance through last-mile distribution, i.e. from domestic warehouses to the beneficiaries (ibid). During the ramp up, coordination is often characterized by a centralized approach with one actionable coordinator; , which is often referred to as *coordination by command* (Tomasini & Van Wassenhove, 2009). Following the initial ramp up, there is a sustainment that attempts stabilization of the operation (Apte, 2009). For sustainment, coordination is often called *collaboration by consensus* as intensity has declined and individual agencies sign off on conditions for coordination, for instance regarding division of responsibilities or sharing of resources (Tomasini & Van Wassenhove, 2009).

2.3.2.1 Emergency Response

The first part of the response is a rapid ramping up of resources, sometimes referred to as emergency response (ER), responding to a disaster as soon as it strikes (Holguín-Veras et al., 2012). ER is commonly related to sudden-onset disasters, where it is important to reach beneficiaries as fast as possible (Jahre et al., 2016). Sudden onset disasters may both be natural, such as earthquakes or hurricanes, and man-made, such as terrorist attacks or chemical leaks (Van Wassenhove, 2006). Activities in ER are for instance transportation of supplies to deliver life-saving aid and repair of damaged infrastructure (Holguín-Veras et al., 2012).

2.3.2.2 Ongoing Operations

In contrast to ER, ongoing operations (OO) are described as sustainment, with the purpose of supporting affected people to restore the capacities of their own community and becoming self-sustaining (Jahre et al., 2016; Holguín-Veras et al., 2012). Activities in OO are for instance providing food and medical supplies on a routine basis (Holguín-Veras et al., 2012). As the time horizons are longer than in ER, there is time to perform planning and efficiency-building activities throughout the HSC in order to reduce cost (Jahre et al., 2016). OO may occur as a response to slow-onset disasters by natural causes as droughts or famine, or in case of man-made such as political crisis (Van Wassenhove, 2006).

2.3.3 Recovery

The recovery is an ongoing phase which occurs in the post-disaster period (Apte, 2009) and its importance is based in that a disaster may have long-term effects on a region (Kovács & Spens, 2007). As the need for humanitarian aid diminishes in the emergency struck area, the humanitarian operations are also gradually ramped down (Apte, 2009). Examples of activities in the recovery phase are reconstruction of infrastructure (Kovács & Spens, 2007). Coordination during the ramp down is often referred to as *coordination by default*, as individual actors focus on their own handover and exit strategies, rather than joint efforts, meaning collaboration efforts mainly occur through short and routine efforts (Tomasini & Van Wassenhove, 2009).

2.4 Combined frame of reference

When summarizing our literature search to a combined frame of reference, we initially conclude that there is almost no research on MSUs in the humanitarian context, and that the studies that exist primarily focus on strategic pre-positioning, inventory management or the localization decision. The qualitative research on the localization decision will be of interest when analysing decision parameters. Neither do we find any research on mobile storage warehouses in general in any other context. However, since the MSU in essence is a warehouse, we have been able to use research on warehousing from the commercial context to create a framework for analysis of RQ1.

To understand what makes the humanitarian context unique, we have presented eight contextual factors that aim to mutually exclusively explain the general context of the HSC. These are: poor operating conditions, temporary and dynamic, high uncertainties, internal factors, actor complexity, stakeholder complexity, values and principles, and the goal of relieving human suffering. These contextual factors will be used to generalize data and aggregate it to activities, decisions and challenges that are applicable in the general MSU usage case. This is a prerequisite to be able to answer both of our RQs. The contextual factors presented in this Chapter will also be used to answer RQ2 of their influence on the MSU challenges. Implications of the collaborative aspect of the MSU is presented, however, the contextual factor of the collaborative environment is included in the actor complexity contextual factor.

When reviewing the literature on DMC we create an overview of the change of characteristics, activities and focus areas during its phases. We note that collaboration efforts decrease in intensity as the disaster progresses, putting different expectations and requirements on how it is performed throughout the different phases of the disaster. Finally, the literature on the DMC will be used to answer RQ1 through analysing how the activities and decisions connect to different phases of a disaster.

Chapter 3 - Method

This Chapter describes how the research was conducted. It explains the selection of research strategy as well as how it was designed to fit the scope of the thesis. After this, activities of data collection and data analysis are described and justified. Finally, the Chapter discusses the quality of the research.

3.1 Research strategy

A research strategy can be described as a general plan of how researchers go about answering the RQs (Saunders et al., 2005). Our research strategy is chosen based on four arguments. Firstly, due to its exploratory nature, this thesis needs data that is non-numerical or non-quantified, i.e. of a qualitative nature. This should be supported through selection of a research strategy that enables collection and analysis of qualitative data for answering the research questions (ibid.). Secondly, the research questions aim to understand causality and its effect, as seen through the "how" framing of RQ2, which inquires an in-depth understanding of the subject field (Yin, 2003). Thirdly, the research field of MSU warehousing in HL is limited, supporting the need for an explorative research approach. Lastly, the explorative research required should address operations as they are today, providing a need for a contemporary focus for the thesis. These arguments led to the selection of case methodology.

A case study is an empirical inquiry that investigates a contemporary phenomenon in-depth and within its real-life context, especially suitable when boundaries between phenomenon and context are not clearly evident (Yin, 2003). As this is the case for collaborative MSU usage in the HSC, the selection of case methodology is further strengthened. The in-depth understanding required for the thesis leads to the conclusion that a single case rationale should be used (ibid.), investigating collaborative MSU usage within one organisation. Depending on the purpose of the research, case studies can be designed and conducted in different ways (ibid.), as is discussed in the following Section.

3.2 Research design

The research design deals with at least four topics: (1) what questions to study, (2) what data is relevant, (3) what data to collect and (4) how to analyse the results (Yin, 2003). What questions to study has been addressed in Chapter 1. The following Subsections give an overview of the research design, describe the case selection and determine relevant data, as well as the plan for collecting and analysing it. The research design is visualized in Figure 6.

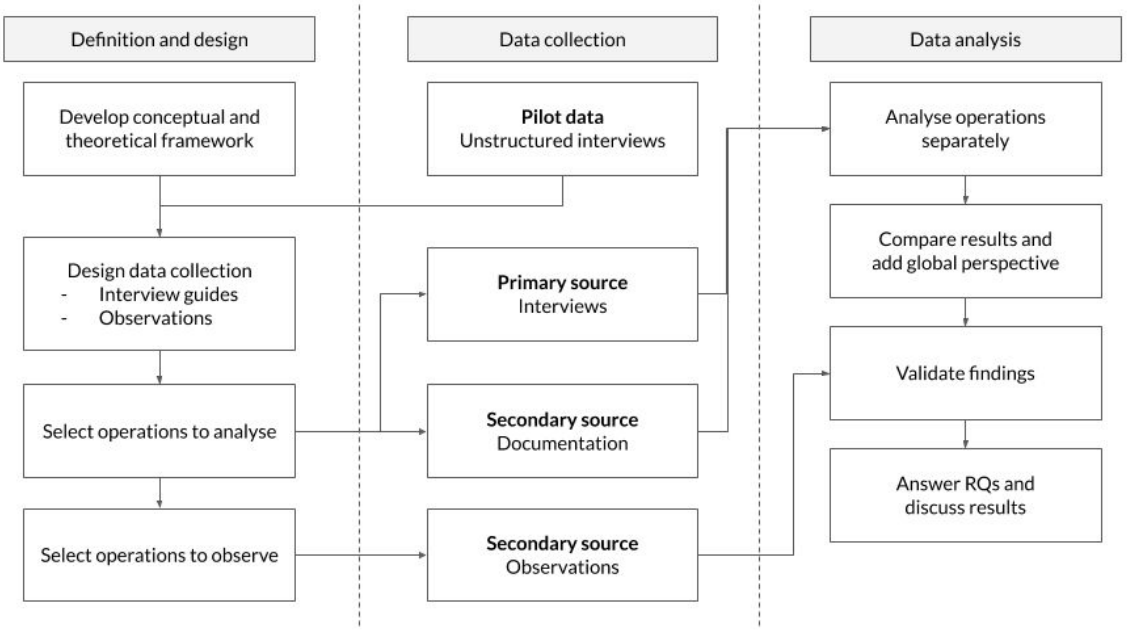

Figure 6: Research design.

3.2.1 Definition and design

A literature review was conducted to gain a theoretical understanding of the subject area and to be able to compare data collected to existing literature. Three fields were chosen for this literature review: warehousing, the humanitarian context, and the DMC (see Chapter 2). Based on this, data collection methods were designed, including creation of interview guides, selection of appropriate documentation to review, as well as designing an overall structure for the observations. For this, insights from unstructured pilot interviews with practitioners provided guidance.

The unit of analysis in a case study can be a person, group of people, company, decision or event (Yin, 2003). The Logistics Cluster is one of the few actors employing collaborative MSUs and is a part of the UN-driven cluster function. The Logistics Cluster is operational on a worldwide level, making it possible to compare different operations in the same organisational context. Furthermore, since the Logistics Cluster is the single organisation that gathers the most actors in HL (Logistics Cluster, 2018), they are a suitable organisation to perform a single case study on. The Logistics Cluster operations in Bangladesh (BD) and Syria (SY) were selected for examination, and to this a global perspective, through Logistics Cluster personnel with previous experience from multiple operations, was added. The two operations were chosen based on their major differences in terms of external conditions, such as geography, climate, political situation, as well as length and scope of operations. They are described in greater detail in Chapter 4.

3.2.3 Data collection

Three sources of data were used: interviews, documented data and observations. Through the usage of multiple data collection methods and sources, data was triangulated to strengthen the findings (Voss et al., 2002). This means that data collection methods and sources with different properties describe the same thing, avoiding biases and weaknesses related to only having one data collection method or source.

Initially, pilot interviews identified certain activities and decisions of the MSU. To provide a more comprehensible overview, activities were grouped into cycle-stages, based on their characteristics. We define a cycle-stage as *a group of activities performed when the MSU is in the same physical location, used for the same purpose or with the same responsible partner*. This provided a draft MSU cycle, which in combination with literature findings, could serve as a foundation for the interview guide for the following interviews.

Interviews can provide rigorous targeted insight into a research area, but may be subject to misleading answers, interviewees changing their response to reflect a perceived desired answer or inaccuracies due to poor recall (Saunders et al., 2005). We aimed to mitigate interview weaknesses through reviewing Logistics Cluster documentation, performing observations of their MSUs in field and triangulating data from several operations. In a similar way, more operational routines described in interviews can be reviewed in practice through observations, to see if operations are performed accordingly. The methods are explained more in-depth in the following Subsections.

3.2.3.1 Interviews

Interviews were used as the primary source of data. It is an appropriate method when information accuracy is important (Forza, 2002) and is therefore found suitable as the study is of a qualitative nature, aiming to create literature and understand MSU usage through its activities, decisions and challenges.

Desirable respondents were identified based on their roles in the respective operations. To create a better initial understanding and scoping of the thesis, an unstructured (Saunders, 2003) pilot interview round was conducted through discussions based on the draft MSU cycle and the draft interview guide. Specifically, the pilot interview with the Global Coordinator in Copenhagen was used for selection of respondents in the main interview round, using their insights into current Logistics Cluster operations and MSU usage within these. Four key roles were identified as relevant for the purposes of this thesis.

Firstly, the Global Coordinator is the global focal point of a Logistics Cluster operation and provides insight into MSU usage before and after it has been deployed. The Global Coordinator is also suitable for providing data to compare operations and create one general MSU cycle. Secondly, the Cluster Coordinator is the on-site head responsible for the Logistics Cluster operation and is identified as relevant for MSU cycle-stages linking to the operations. Thirdly, the Information Management Officer aids in assessment activities used to support decision making for deployment and dismantling and is therefore of relevance for these areas.

Lastly, the Warehouse Manager is responsible for the daily MSU operations and is therefore relevant for the operations. The respective roles link to different areas of insight. These are presented together with a summarized role description in Table 1.

Table 1: Roles of interviewed Logistics Cluster personnel

Position	**Role**	**Insight areas**
Global Coordinator	- Global focal point of operation - Working from HQ	- Deployment - Dismantling - Post dismantling
Cluster Coordinator	- Head responsible of operation - Working in-field	- Storage - Deployment - Operations - Dismantling - Post dismantling
Information Management Officer	- Responsible for assessment - Providing data for decision making - Working in-field	- Deployment - Dismantling
Warehouse Manager	- Responsible for daily operations - Working in-field	- Storage - Operations

Since we interviewed people with different roles approaching different insights areas, we used a semi-structured interview approach with open-ended questions (Saunders, 2003). The interviews were conducted with the interview guide in Appendix C, posing different questions to the different respondents based on their role, as can be seen together with interview lengths in Appendix B. The interview guides were sent to the respondents in advance, in order to give them time to prepare themselves. The respondents were asked follow up questions based on their answers on previous questions, to elaborate and clarify their answers. As interviewees were spread across the world, interviews were conducted through Voice over IP calls. The full list of interviewees is found in Appendix B.

Table 2: List of reviewed documents for each operation (for reference see Logistics Cluster, 2017).

Document	**Document content**	**Document purpose**	**Purpose for thesis**
Standard Operating Procedures (SOPs)	Instructions for routine operations	Improve efficiency, quality and uniformity	Understand routines involving partners and compare to interview data
Concept of Operations (ConOps)	Context, identified gaps, assets, collaboration mechanisms, roles and responsibilities	Improve collaboration, specify agreed on set-up including roles, responsibilities and procedures and make best use of assets	Understand overall response strategy to contextualize MSU usage

3.2.3.2 Documentation

Documentation includes information material describing the Logistics Cluster, and could for instance be correspondence, instructions, reports, pictures and video recordings (Saunders et al., 2005). Information

communicated from the Logistics Cluster to their partner organisations through the Logistics Cluster website was examined. The documents reviewed for the respective operations are presented in Table 2.

3.2.3.3 Observations

Observations refer to data collection performed directly from Logistics Cluster operations in BD. These observations were performed at the Cox's Bazar WFP office, the Madhu Chara Logistics and Engineering Hub and the Balukhali Logistics Hub over the course of five days. In this thesis, observations were used as a complementary method to validate findings from interviews and documentation. These findings included insights not only from the operation which was subject to the observations, but also other operations, including the global perspective. The findings were compared to practice through direct observation of operations, on-site interviews and a two hour workshop session with the Logistics Hub Manager, three Warehouse Managers and three Warehouse Assistants.

Prior to the observations, findings from interviews and documentation were proposed. The proposal consisted of an MSU cycle with cycle-stages and decision points, broken down into activities and decisions, as well as identified challenges. All information was structured in tables, as to ensure a structure for confirmation or rejection of their existence in practice. The direct observations of the daily warehouse operations in the MSUs and on-site interviews with the Logistics Hub Manager and Operational Support Official filled this purpose. The workshop session with the Warehouse Managers and Warehouse Assistants addressed warehousing concepts from Chapter 2 to be able to complement direct observations of the warehousing operations with competence of decision making personnel before comparing it to the literature.

3.2.4 Data analysis

When analysing data collected through interviews and documentation, pattern-matching (Saunders et al., 2003) and visualization of sequences of events (Voss et al., 2002) were used. The mapping provided an overview of the cycle-stages and decision points of the MSU cycle, as well as the activities and decisions that the cycle-stages and decision points can be broken down into respectively. To do so, collected data relevant to a certain activity or decision was grouped together.

After the data was structured, a description of the two operations, with MSU activities, decisions and challenges that relate to them, could be produced for the two operations respectively. This was done as lists for identified activities, decisions and challenges. Pattern-matching and comparison were used to highlight both similarities and differences found in the different operations. Next, the MSU activities, decisions and challenges were generalized in order to be more universally applicable for describing collaborative MSU usage. At this point, also data from the global perspective interviews were added.

For activities, data was structured through combining similar activities and using the theoretical warehousing framework from Chapter 2. Generalization was achieved through eliminating activities linking only to operational specific conditions (OSC). For decisions, data was once again structured through combining similar decisions and parameters. Generalization was achieved if decisions and parameters appeared in both operations or appeared in one operation and global insight. Parameters were also compared to the relatively small current literature to include previous research. Finally, parameters that were only found in one of the three, was included if they were caused by a contextual factor or if it does not create problems to use the parameter in other OSC (i.e. it would be negligible in OSCs where it is not relevant). In both decisions and activities, input from analysing the type and characteristics of the MSU was used. Thereafter activities and decisions were analysed to be put in relation to the DMC, to connect them to existing literature, answering RQ1.

For determining which challenges to generalize, a heuristic with four scenarios in which to include a challenge was used. These scenarios were: A challenge (1) appeared in both operations, (2) appeared in one operation and global insights, (3) appeared in either an operation or the global insight, and can be linked to the contextual factors, (4) appeared in either an operation or the global insight, and can be linked to the characteristics of the MSU. At this point, challenges could be linked to the humanitarian contextual factors identified in Chapter 2, answering RQ2. This process of generalizing, structuring and analysing to be able to answer the RQs is visualised in Figure 7.

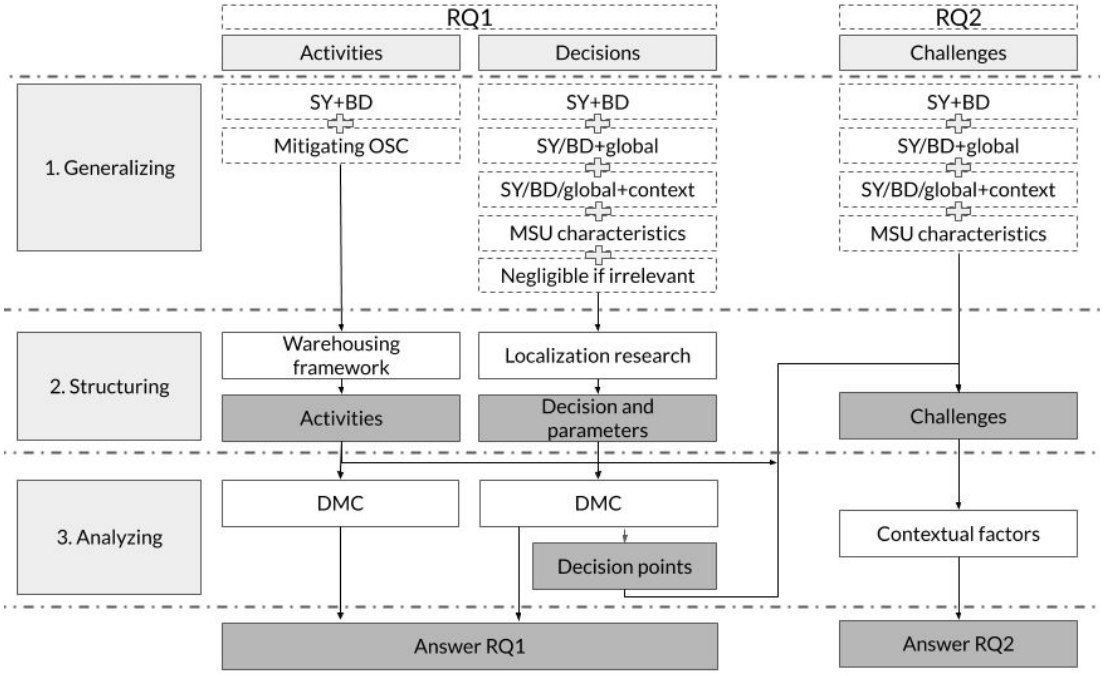

Figure 7: Visualizing the data analysis. Dotted border boxes means heuristic, white boxes theoretical frameworks, dark grey boxes output.

3.3 Research quality

In order to judge the quality of case research, tests that review the logic with which the research is designed can be performed. For this thesis, the four most common tests is addressed. Construct validity refers to using the correct measures for what is being studied, ensuring measurement of what is intended to be measured. External validity refers to the generalizability of the findings, hence being able to apply findings to other occurrences of the phenomenon. Reliability relates to whether or not the research can be repeated with the same results, relating to the minimizing of errors and biases in the research design. There is also a test for internal validity, which aims to establish causal relationships which show that certain conditions lead to other conditions, but as it is not regarded as necessary for descriptive or exploratory studies, we disregard of it. The research quality tests and their applications for the research design presented is shown in Table 3. (Yin, 2003)

Table 3: Review on the quality of the research (adapted from Yin, 2003).

Test	**Overall**	**Case selection**	**Data collection**	**Data analysis**
Construct validity	Continuous improvements of RQs, scope and method in collaboration with field experts in Logistics Cluster.	Case selected with possibility to view different operations in the same organisational context.	Multiple sources of data.	Analysing results with a stringent method.
External validity	N/A	Transparent and truthful explanation and argument for the choice of the case.	Data collected from different Logistics Cluster operations, validated globally.	N/A
Reliability	Well-documented research strategy and method.	N/A	Interviewees and interview guide is published in the Appendix.	-

Chapter 4 - Findings

This Chapter describes the empirical findings from the interviews, documents and observations. It includes a description of the collaborative MSU, Logistics Cluster and their connection. The Logistics Cluster Standards Operating Procedures (SOP) are described and the different operations are introduced using their Concepts of Operations (ConOps) to give a context to the operation specifics. The data is then structured as description of the MSU usage (activities and decisions) and challenges in the different operations.

Throughout this Chapter, unless stated otherwise the facts presented are empirical findings from interviews, documents and observations.

4.1 The MSU

We define an MSU as *a manually set up, temporary and mobile low tech infrastructural resource employed by humanitarian organisations in relief operations with the main purpose of storing relief related items for humanitarian actors*. The main supplier can supply tents with width from 4,5m to 50m (OB Wiik, 2019a), but the most common sizes employed by the Logistics Cluster are of size 10x24m and 10x32m and are modular in 10x4m modules. We have only observed tents with the width of 10m.

We define the collaborative MSU as *an MSU where the owner has the purpose of offering storage to partner organisations*. This includes situations were the owner (i.e. Logistics Cluster) is not operating the MSU themselves, since their purpose still is collaborative.

Figure 8: A picture of an O.B. Wiikhall NEX (OB Wiik, 2019b).

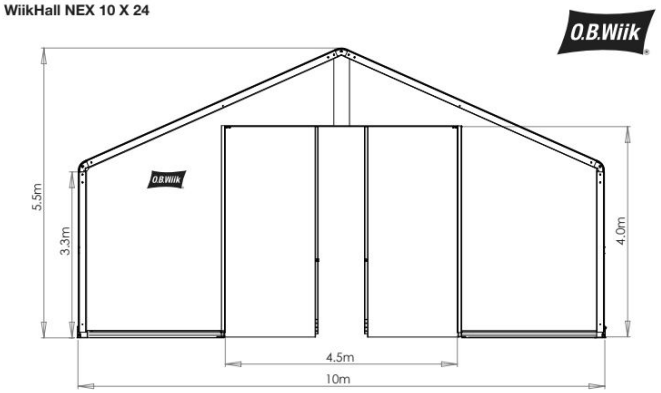

Figure 9: A drawing of an O.B. WiikHall NEX 10x24 (OB Wiik, 2019b).

The MSU consists of (1) a steel or aluminum frame, (2) tarpaulin segments (tarps), (3) side segments, doors and tension wires and (4) nuts, bolts and stakes. The MSU is shown in Figure 8 and Figure 9. Due to the size of the frame, MSUs cannot be fully palletized and are therefore partially transported in special large boxes. Tools and manuals necessary for assembly are included when purchasing an MSU. No single piece is too heavy to be loaded or offloaded from a truck with manual labour. In addition to the MSU itself, it is also possible to purchase a repair kit to tend to tears in the tarp.

When further on discussing, location will refer to the place to where the MSU is deployed, and position to the exact spot within that location the MSU is erected.

4.2 The Logistics Cluster

The Logistics Cluster aims to ensure an efficient and effective response to emergencies. This is achieved through coordination and information management to support operational decision-making and improve predictability, timeliness and efficiency. The cluster activities range from proactive preparedness activities to operational measures in relief aid operations. When operational the Logistics Cluster act in sudden-onset emergencies, conflicts, and complex and protracted crises, facilitating access to common logistics services, such as transportation and warehousing. (Logistics Cluster, 2019)

The Logistics Cluster does not work directly with or for beneficiaries, but rather with their partner organisations through facilitating logistics services for these organisations. The partner organisations are all the humanitarian actors that are involved in responding to the crisis in question. This includes e.g. UN agencies, NGOs, International NGOs and in some instances even the military, as long as their purpose is of a humanitarian nature. Logistics Cluster services are generally free of charge, and all partner organisations are eligible to make use of them, but there are also instances of cost-sharing when it is not feasible to cover the total requested need of the partner or if the service is outside the SOP.

The Logistics Cluster may be operational in responses where there are no cluster activations. In these instances, the government maintains the decision maker role, but there might still be need for collaboration and common logistics services for the partners. The operations are then run as the Logistics Sector, as to stress that there is no cluster activation. For this thesis, there are no differences to the collaborative MSU usage and Logistics Cluster will therefore be used as a term that includes Logistics Sector operations. In a similar way, collaboration, cluster prioritization and decision making for the response as a whole is commonly provided by the UN Office for the Coordination of Humanitarian Affairs (OCHA) when the government is unable to enter into this role. For responses when there is no cluster activation and the government maintains mandate, the Inter Sector Coordination Group (ISCG) fills the coordination and prioritization mandate.

We have found that every identified decision in every instance ultimately has been made by the Logistics Cluster Coordinator, who has an autonomous role in the cluster structure. Therefore, we choose not to study the decision makers further.

4.3 Standard Operating Procedures

The objective of the common warehousing services provided by the Logistics Cluster are specified in the Standard Operating Procedures (SOP) for the respective operations. In general, the services aim to *"enable responding organisations to establish an uninterrupted supply chain that supports the delivery of humanitarian relief items to the affected population"* (Logistics Cluster 2018a; Logistics Cluster 2018b). It is not intended to replace logistics capacities of other organisations or compete with local commercial service providers, but only serve as a last resort solution for enabling operations. The services offered are planned for a specific period of time, with the option of further extension. The SOPs state that services may be discontinued for three reasons: Changes in the disaster situation on ground, no more identified need, and funding constraints.

Partner organisations who wish to utilize the common storage has to submit a Service Request Form (SRF) to the Logistics Cluster a set period of time before goods are expected to be ready for delivery. This varies with the operation, and is 48 hours for SY and 72 hours for BD. The Logistics Cluster will approve or deny the SRF within 24 hours of its receipt. If accepted, storage is offered for a maximum of 30 days, but this may be subject to revision, depending on the demand of services. When the partner wishes to pick up their goods they have to sign and send a Release Order Form (ROF/RLO) to the Logistics Cluster. For the SY response, transport to and from the warehouse is included in the common storage service.

4.4 Bangladesh response

The Rohingya crisis is among the fastest growing and densest humanitarian crises in the world and has forced hundreds of thousands of people from Myanmar into BD (OCHA, 2019e). Approximately two hundred thousand people arrived in BD from 2015 up until August 2017, after which there was a large influx of an additional seven hundred thousand people, due to escalating violence in Myanmar. The total amount of people in need in BD is depicted in Figure 10, a vast majority of which are living in the Kutupalong refugee camp.

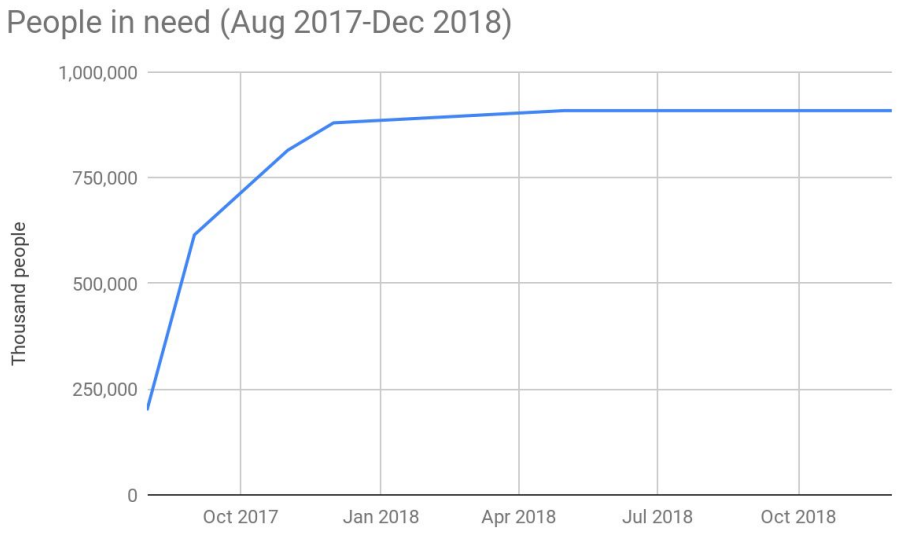

Figure 10: The number of people in need in BD over time (adapted from OCHA, 2019d).

The complex setting of the response poses constraints for the relief operations. The hilly landscape makes access to beneficiaries difficult and complex legislation regarding land permits might change access to space on short notice. The issue of access is worsened by the low number of road connections to the camp. As for climate, the cyclone seasons and the monsoon season threaten both people and infrastructure with short notice and lead to a great threat of floods (OCHA, 2017).

The Logistics Cluster has activated a sector response to address the lack of available storage capacity and availability of logistics facilities, assets and infrastructure capable of withstanding weather conditions during peak seasons (OCHA, 2018; Logistics Cluster, 2019f). In total, logistical aid has been targeted for 60 organisation (OCHA, 2019d). For collaborative warehouse services, shelter and WASH (water, sanitation and hygiene) products currently make up approximately 90% of stored goods (Logistics Cluster, 2019d). The total funding for the operation for 2018 amounted to $4,4 Million (Logistics Cluster, 2018).

The response has three logistics hubs with a total of 14 MSUs. The Madhu Chara Logistics & Engineering Hub is the main hub with 9 MSUs, located close to the northwestern border of the Kutupalong refugee camp. Its little brother hub, The Balukhali Logistics Hub, is a newly opened hub that is located on the east side of the Kutupalong refugee camp and has a total of three MSUs. The last hub is the Teknaf Logistics Hub with two MSUs, which is operated by the partner organisation Handicap International, tending to warehousing need in the smaller refugee camps in the south. The setup is shown in Figure 11.

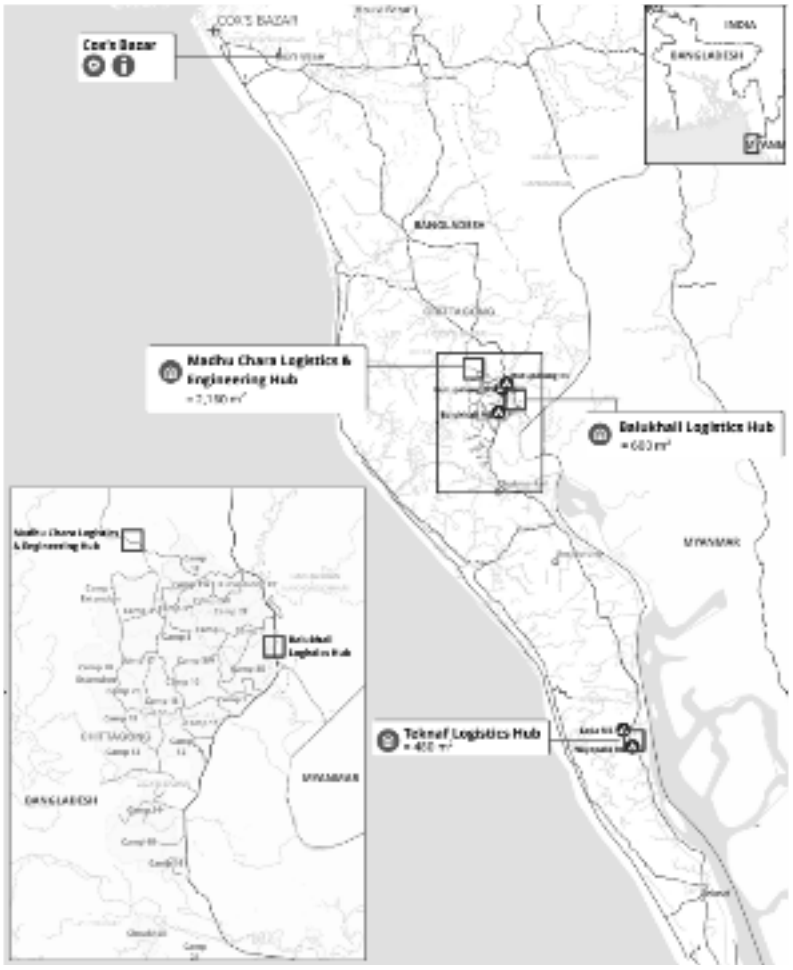

Figure 11: The Logistics Cluster Concept of Operations as of April 2019, Bangladesh (Logistics Cluster, 2019g).

4.4.1 Activities

MSUs are stored in Madhu Chara, or in Balukhali in case of that site being inaccessible due to flooding. When MSUs are in stock they are used for erection training for Logistics Cluster personnel as well as partner organisation. The sessions are also combined with cyclone preparedness drills. The MSU is always dispatched from the Madhu Chara warehouse and before it is deployed its parts are counted according to the packing list. If there are no MSUs in Madhu Chara, the MSUs are procured from the United Nations Humanitarian Resource Depot (UNHRD). MSUs can also be loaned to a single partner to operate non-collaboratively if there is a specific need during a short period of time, and the organisation is capable of running the MSU themselves. Examples of loaning partners are other WFP operations, humanitarian organisations in BD and the BD army.

The aim is to always erect at least two MSUs in the same location. At least three meters between the MSUs are kept for safety reasons and to be able to have a drainage system that is built around the entire MSU. However, this standard was observed to not be kept. If the erection location is on lowland it is required to fill the ground with sand to raise the MSU and prevent flooding damage to the stored goods. Pallets are also

usually used for this purpose and to elevate the goods from the ground. Concrete can be used to create a floor or anchor the frames of the MSU in case of cyclones. The first erection of the program was supervised by an experienced WFP staff from the operation in Pakistan. This person taught the local Logistics Cluster personnel how to erect an MSU. All erections are made by local daily workers and supervised by a technically experienced person within the Logistics Cluster.

When on site, the operations are dictated by the SOP process where partners apply to get storage space. The amount of space is then decided by the warehouse manager. The daily operations are run with workers that are contracted on a daily basis with respect to the planned operations of that day. In general, goods are not delivered on pallets. When it arrives to the MSU it is preferred that the partner that owns the goods is on site to control the quality of the incoming goods before storage; which, however, is not always the case. The most common problem with quality is that items are incorrectly kitted. Logistics Cluster hesitates to perform these kittings, but have done so in several instances. When the goods are in stock, they are tracked with the WFP program Relief Item Tracking Application (RITA), in which partners can track their goods, and through physical stock cards. RITA is a manually operated information software with the purpose of consolidating and visualizing consignment data to partner organisations and for internal use. Availability of storage in the MSUs is tracked through a whiteboard dashboard on site.

At the end of every day, the MSU is cleaned, weed is removed and goods is covered with tarpaulins. The inventory is checked by comparing RITA and stock movement documents, once a month during a day without planned operations. However, actual inventory checking observed was only twice during the last year, and the daily covering with tarps was not conducted. Security is ensured with guards hired from the local community as well as a continuous dialogue with the border police. Barbed wire fences, fire fighting equipment and video surveillance is also in place. The operation had no security issues yet. To prepare for potential cyclones, daily workers are trained to remove the tarpaulins from the MSU as quickly as possible.

MSU dismantling is supervised by the same person that erected the MSU and performed by the daily workers. Before dismantling an MSU, the tarps are cleaned, parts are counted and the quality is controlled. At this point some repairing of tarps or exchange of damaged parts could take place. They are then shipped back to the Madhu Chara hub. When at the warehouse, MSUs that are marked as in really bad condition have good parts salvaged for other MSUs. If needed counting of parts and quality control can be done at the warehouse as well. The MSU is then either redeployed directly, as a loan to a partner or in collaborative operation, or kept as contingency stock. If Logistics Cluster would discontinue the operation in BD, the MSU could be donated to local NGOs or to the government. If the MSU is loaned, and the loan period is expired, the MSU can be donated to that organisation or the loan can be renewed.

4.4.2 Decisions

The decision to deploy an MSU is based on partner organisation need, commonly caused by permanent structures being too hard or too time consuming to find. The location is determined relatively precisely in the initial decision to deploy and is based on accessibility, type of land, space to erect and cost. The deployment location needs to be near, but outside, the Kutupalong camp, as well as directly accessible from roads that are resilient to floods (i.e. main roads). The Logistics Cluster hesitates to deploy on agricultural land since it might destroy it for future use, and is also looking for high ground to minimize the risk of flooding. There also needs to be enough space to deploy at least two MSUs and space for trucks maneuver safely. The exact size could, but rarely is, possible to adjust when on site. The MSUs are commonly erected in the two standard sizes. The exact erection position of the MSU is decided when on site. Laying out sand/gravel or not, depends on the type of soil and how uneven the ground is. The decision whether or not to cement or brick the floor of the MSU can be made both at deployment and continuously, and is based on if there is a large need of efficiency and the time horizon of the operations is long. Who is implementing the MSU was observed to be depending on current presence in the location of deployment.

A decision to dismantle can be done based on either of these four reasons: No more activity in the MSU, permanent structures have been found to replace the MSU, the partner organisations have found and established their own storage, or direct requests from the partners. It is preferred to dismantle the MSU if there is no or low current usage, since the MSU is more prone to wear down when erected.

After dismantling and transport back to Madhu Chara, the decision on whether to replace broken parts or use the MSU as spare parts is made, based on the condition of the MSU and the amount of damaged parts. An entire MSU is never thrown away. Only if the entire operation is discontinued, the MSU can be donated. Then it is donated to the local authorities or a local NGO that is capable to run it, based on what organisation wants it. The reasons behind loaning would be that the time horizon is sufficiently long and that the partner that it is loaned to either have a large enough need to fully utilize the MSU alone, or it could be conditioned to be used by collaboratively by a set amount of partners.

4.4.3 Challenges

The main challenge when the MSU is in stock is to keep track of what pieces belong to which MSU, since the parts are interchangeable and old incomplete sets of MSUs are kept for spare part. It's also a challenge to keep the right competence to erect in the organisation if no new MSUs are erected in a while.

In BD it is specifically hard to find suitable, non agricultural land for MSU erection. Most potential locations are owned by the government and thus the Logistics Cluster needs to be granted permission to erect an MSU, which is challenging. When erecting the MSU it's still a challenge to find a good exact position that is flat enough to safely operate the MSUs. The competence to erect MSUs is also crucial and a

challenge. If you don't have the right competence, wrongdoings in the erection can create leakage in the MSU. Additionally, manually offloading the MSU from trucks is difficult.

There are several challenges connected to the operations of the collaborative MSU. Due to uncertainties, transportation will often be delayed and arrive on different days than planned, which makes it hard to plan the work force. This, together with the already tight space around the MSUs, can create truck congestions, which creates a need to prioritize between incoming and outgoing cargo. Prioritizing is also needed when to decide which storage requests to accept and which to deny.

As previously mentioned, quality of incoming goods is not always acceptable. It is a challenge to get the owning partner to be present to do the quality control. Quality of secondary packaging cartons limit stackability and can even endanger the quality of the goods inside, as they lose their integrity and stability due to humidity. The partners don't always see the issues with storage of low quality cartons and don't understand the benefits of more expensive packages. The daily workers come from the local population and do not have any training in warehousing and are often even illiterate, making it challenging to keep track of all items and poses a risk of sending the wrong items or wrong amount of items to a partner.

When deciding to dismantle it is a challenge to predict future flow of goods and partner gaps to ensure that there is no further MSU need. When actually dismantling it is difficult to make sure that all parts are in the right boxes and in the right condition.

4.5 Syria response

The raging wars and continued hostilities of SY have created an evolving humanitarian crisis over the past nine years and the increasing need of humanitarian aid have been striking (OCHA, 2019a; OCHA, 2019c). As can be viewed in Figure 12, there is currently a stable and even declining trend of total amount of people in need. According to the latest humanitarian update from SY currently 13 million people are in need of humanitarian assistance, whereof 5.2 million are in acute need (OCHA, 2019b). This can be compared to the total SY population of 18.4 million people (Worldometers, 2019). The volatile political situation demands a complex and dynamic response even as the crisis has matured into sustainability; OCHA predicts that hostilities and insecurities will continue throughout 2019 (OCHA, 2019a).

Even though the majority of people in need live around the large cities in the west side of the country, the entirety of the disaster is spread over large parts of the waste deserts of SY (OCHA, 2019c). The main challenges facing humanitarian actors in SY are: The landscape and climate of SY makes it specifically prone and vulnerable to drought as well as floods, safety for humanitarian work force and facilities, and sporadic closure of key border crossings and key access routes (ibid.). The SY commercial sector, however, has been operating relatively smoothly during the entire crisis.

The Logistics Cluster has been active in SY since January 2013 and has during that time supported 64 organisations (Logistics Cluster, 2018). It currently offers common storage in four locations throughout SY (Logistics Cluster, 2019d) and has 22 MSUs in-country. For collaborative warehouse services, WASH and food products currently make up approximately 80% of stored goods (Logistics Cluster, 2019d). The total funding for the operation for 2018 amounted to $8 Million (Logistics Cluster, 2018).

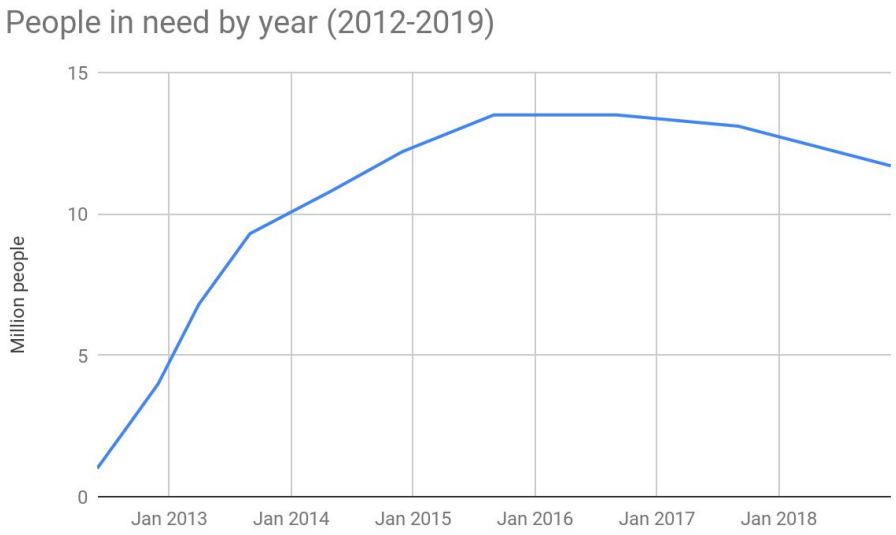

Figure 12: The number of people in need in SY over time (adapted from OCHA, 2019c).

4.5.1 Activities

MSUs for deployment are stocked domestically by Logistics Cluster. While in storage, MSUs might be used for trainings with partners. For transport, MSUs are deployed from the in-country warehouse or hub closest to the final destination.

Once on site, the MSUs are built by on-site personnel (internal or contracted company) which Logistics Cluster is responsible for, regardless of MSU purpose. Technical competence regarding the MSU is needed to lead the work. Given the nature of the land, drilling is a required skill to be able to properly mount the stakes in the ground. Moreover, a drainage is always dug around the MSU, and sometimes the floor is cemented. If not cemented, pallets will be sent out with the MSU as floor. During the erection it is common to invite partner organisations to partake, facilitating competence building. In addition to this, MSUs are used for training during specific sessions such as firefighting and other security and safety matters.

As for daily warehouse operations, MSUs are treated as any other storage facility. Physical inventory is performed daily by the storekeeper. A more thorough inventory is performed monthly. Commodities are checked as part of the daily routine, but also with random checks. Given the risk of theft, which is common in humanitarian crises, guards need to be contracted. In addition to high concrete walls, the premises also

has video surveillance. In addition to this, fire alarms are installed. Daily cleaning is performed by a special cleaning team. The maintenance is foremost based on regular checks of the stakes, to ensure their stability, and the tarps, to look for tears in the fabric. In addition to this, an external company performs a quarterly repair of the MSU.

More than operating MSUs as collaborative warehouses, they might also be loaned or donated to partner organisations, depending on the length of need for warehousing capacities. If an operation is longer than one year, the MSU is commonly donated. In these instances, the partner organisation is responsible for the management of the MSU, but Logistics Cluster might deploy technical experts to aid in the erection. Further, long-term loans might transition into donations if the need is longer than first expected or if the conditions of the operation changes the loaning partner can be changed.

The dismantling procedure requires the same amount of workers and technical expertise as the erection. Parts are counted as they are dismantled, as well as when they are in storage. When in storage, quality is controlled, tears in the tarps are fixed and the MSU is cleaned. A final physical inspection is performed in order to make a recommendation of the MSU for the future. If MSUs are returned from field with damaged or worn-out pieces, they might be subject to smaller maintenance, such as rust removal. MSU parts might be salvaged to provide complete sets if pieces are missing. It is uncommon to throw away full sets of MSUs.

4.5.2 Decisions

The decision to deploy an MSU is based on a partner need of additional warehousing capacity. The lack of warehousing capabilities can in turn be due to low warehouse capacities in the region or gaps in commercial sector. Given the emergency nature, capacity caps might also occur, as there is no time to contract location or facilities through a third party. The initial deployment decision commonly includes the number and sizes of the MSUs, which are commonly multiples of the standard sizes, and depends on the estimated need and variety of commodities (i.e. NFI and food can't be stored in the same MSU), as well as available space. The location from where the MSU is deployed is also part of the decision. Logistics Cluster MSUs are the first hand and most common choice, and after that partners might be consulted, to find the nearest warehouse. Sometimes access to the deployment area is limited, creating the need to deploy from a partner with access. MSUs are always procured through UNHRD. When deciding to contract a company to erect or not, the cost or erection and travel (see challenges), and whether the internal competence is needed elsewhere, are considered.

The decision to loan an MSU to a partner is only made if there is no or not enough existing collaborative storage, otherwise all partners are eligible for a loan. The purpose and need, as well as the insurance of a feasible location to erect, are examined when making the decision to grant a loan.

The setup decision relates to more detailed aspects of MSU deployment and the implications these might have on the activities to be performed thereafter. In general, MSUs are located as close to the beneficiaries as possible. Additionally, some aspects restrict the storage of food, such as proximity to sewages or plantations. MSUs are commonly built in parallel to each other and, to ensure proper ventilation and stability, restricted to 14 four meter modules, giving them a maximum total length of 56 meters. The space between MSUs is dimensioned to be able to facilitate drainage, but not so much that trucks can access the area. Other than this, truck maneuvering space has to available. Another aspect taken into consideration is the ground, as it needs to be level, have soil appropriate for mounting stakes and cannot be prone to flooding in case of large amounts of rain. Also, the nature influences the position of the MSU. For instance, strong winds might damage the MSU and loose soil might call for cementing the floor to ensure handling efficiency and proper mounting.

The decision to dismantle an MSU is linked to that there is no longer a need for logistics services with the partner organisations, which may be indicated by a declining utilization of the warehousing services provided. Some indicators of this might be that other partners discontinue their operations or that commercial services in the area is once more up and running. Preferably, the request to dismantle should come directly from the partners. Another reason to dismantle is that the MSU is no longer in good enough condition to use, but in these cases the MSU is simply replaced.

When determining the use of an MSU after dismantling, the previously mentioned physical assessment serves as decision support for determining its future. MSUs deteriorate over time, meaning they might not be suitable for another deployment after prolonged use. The decision is taken by a local property survey board, which is comprised by representatives from different parts of the WFP organisation, i.e. finance and procurement. Disposal of full MSU do not occur. Most common is that it is reverted to its previous storage and that a decision is made from there. Other places with warehouse capacity gaps are searched for straight away. The MSU could also be sold through an auction or, if it was loaned from an external partner, be reverted to there.

4.5.3 Challenges

The main challenges in MSU deployment are found to be related to its storage location. It is difficult to ensure a suitable and secure location in the proximity of a hub ahead of time. MSUs are preferably deployed from domestic Logistics Cluster stock. It is challenging to get the right goods and people to the right location within SY. Both due to the conflict itself, but also since supplies and personnel need to have a proper governmental approval both for entering the country and moving within it.

As previously mentioned, it's a challenge to get the right erecting expertise to the MSU location, but it can also be challenging to get workers for erection at a reasonable price in remote areas in SY. Even with the

right expertise, the erection is difficult and requires the team to follow a very precise manual. The ground on which to erect the MSU poses challenges. It's hard to find level ground or, if needed, leveling the ground. The ground soil in most locations in SY are very sandy, which makes it difficult to erect the MSU and keep it standing. There is often no time or possibility to cement the floor.

The main challenge in MSU operations in SY is related to the weather condition. Heat, cold and humidity creates a poor working condition in the MSU. This tires the workers and reduces operation efficiency. It also makes it difficult to maintain the quality of commodities, increasing the risk of infestation and making infestation isolation difficult. The humidity also reduces stackability of goods. Handling in an MSU is perceived to take a long time, due to the amount of manual labour and low-tech setup. The temporary and informal setting of the warehouse makes it hard to motivate workers to apply the same standards as in a permanent building warehouse. In addition to this, the relatively unstable structure of an MSU makes it vulnerable to damages due to truck accidents.

The decision to dismantle can be challenging as the Logistics Cluster doesn't want to leave partner organisations without sufficient warehousing capacities, together with the difficulty of assessing future need of warehousing. In general they tend to stay on the safe side and only dismantle as soon as all partner organisations have secured storage capacities. The dismantling itself can be challenging as materials can be damaged or lost. Rusty or damaged parts are harder to remove and might break further during the dismantling process.

4.6 Global findings

Global findings refer to data collected through interviews with practitioners not directly connected to one single operation. These interviewees generally have a longer experience of MSU usage and have experience from several different operations. The main focus of these interviews was decisions and challenges.

4.6.1 Activities and decisions

The collaborative MSUs are described as intended to help partner organisations address gaps in warehousing capacities and to understand if they have long or short term needs. Long term needs might be better addressed by helping the partners themselves fill the need, whereas short term needs might be more suitable to address by providing the collaborative services. They provide higher effectiveness and efficiency of space as single organisations might not have neither need nor resources to deploy an MSU by themselves. In general, there is a strive towards pre-agreeing on usage of local governmental or commercial resources, but MSUs excel in rapid deployment situations, where there might not be time to establish such contracts.

Global insights for MSUs in stock relate to keeping inventory and doing training exercises. The first relates to ensuring complete sets of MSU so that smooth deployment is possible. This may include scraping parts from incomplete or damaged MSUs to create complete sets ready to deploy. It also includes inventory

checks and counting. In general, there is an ambition to keep MSUs in the country stock, spread out in strategic locations. Training exercises, mainly for erection but also for security, safety or contingency actions are also common.

The decisions to deploy MSUs are commonly made based on partner needs assessments. This relates to available warehousing resources within the affected community and those of the partners themselves. The need also dictates the size and amount of MSUs to deploy. Aside from the collaborative warehouses, whether they are run by the Logistics Cluster or operated by an implementing partner, MSUs might be loaned out to partner organisations with needs large enough to sufficiently utilize a full MSU by themselves. This is especially relevant when there is great urgency in the situation. UN agencies and NGOs of the humanitarian community are all eligible to request an MSU as a loan. Some operations avoid this type of cooperation with the military, but this is not always the case. Before approving the request, some operations confirm that the feasibility of the location, for instance through ensuring that there is enough flat space.

In these situations it is common that Logistics Cluster is involved in the MSU erection. Either through providing a competent in-house personnel or through local contracted specialized teams. This is decided depending on if the in-house personnel is needed elsewhere, and the cost of the local team. MSUs are commonly firstly dispatched from hubs within the country and secondarily as a purchase from the UNHRD. The latter can either be dispatched directly to the field or first to the hub and then to the affected area. It is also possible to have MSUs deployed from MSUs loaned to partner organisations with the agreement that they can be rapidly requested in case there is an urgent need elsewhere. In some cases, pallets for flooring are dispatched with the MSU in order to ensure proper flooring.

The precision of the initial deployment decision is a product of how well-prepared the cluster is, as well as on the assessment made by partners. Given the modularity of the MSUs, they are most commonly deployed in their previously mentioned standard sizes, even though there are no obstacles to customize the size.

The decision of an exact position to erect the MSU is based on a number of factors. Commonly, (1) proximity to aid recipients, (2) truck accessibility, (3) flooding resistance, (4) erection permits, (5) flooding resistance and (6) scaling possibilities are highlighted as factors of interest.

The decision to dismantle an MSU links to that there is no longer a partner need for the service, preferably manifested in a request for operation discontinuing This might have multiple causes, including an operations coming to an end, the MSU being in unoperational condition, or other warehousing capabilities being secured. The dismantling process itself is commonly led by a competent associate and involves parts being cleaned, counted and put back into their boxes. In some operations, dismantling is the least preferred option and is actively tried to be avoided through donations.

The future of the MSU after its dismantling depends on its condition and the need of the humanitarian community. In general, options are divided as reuse, salvage for spare parts, donate, loan and sell. Donation is preferred when a single partner has a long term need and if condition isn't sufficient for redeployment with collaborative purposes. These donation tend to be to organisations whose presence in disaster situations are more long term, staying in the area when other organisations discontinue their operations and release common resources. The donation decision is made by the entity which owns the specific MSU. For WFP, which is the largest owner of Logistics Cluster utilized assets that would mean the Local Property Survey The disposal process for MSUs is not commonly clear or structured. If they are not reused or donated they will be salvaged for spare parts, which end up in the warehouses.

An ambiguous aspect of deciding on the future of MSUs are the possibility to sell MSUs. Some operators claim that this is an unthinkable scenario, as it is a complicated matter with regards to funds received from donations. Others claim that they would absolutely consider selling if there are other NGOs or Logistics Cluster operations that would be prepared to pay for them.

4.6.2 Challenges

The challenges commonly faced for MSUs in stock relate to keeping track of parts, especially if it is not newly procured. Losing parts render MSUs out of use. Bolts and nuts can be bought at local markets, whereas tarpaulins and frames have to be purchased through UNHRD. As MSUs might be challenging to handle, picking out of storage and transportation can be simplified by utilization of a crane on the delivering truck. Keeping track of parts also extends to the transportation of the MSU into field. For this, it is also important to achieve efficiency in the transportation.

For both erection and dismantling, competence of the MSU is crucial to ensure both efficiency and precaution when operating the MSU. MSU parts are susceptible to damage if they are erected incorrectly. The challenges for decisions to erect or dismantle the MSU mainly concern being able to determine the partner need, ensuring their capability to handle their own goods after dismantling. Similar to when MSUs are kept in stock, it is crucial to keep track of all parts during the dismantling process. For inbound quality control it is difficult to find time and space for counting and quality control, which tends to leave the MSU parts in an unstructured way.

Chapter 5 - Analysis

This Chapter describes the process of analysing the empirically found data. First the ER/OO connection to BD and SY, as well as the MSUs connection to warehousing types, are described. Thereafter the MSU cycle is presented, followed by an analysis of activities and decision, and their respective connection to the DMC. Finally the challenges and their connection to the contextual factors are presented.

The aim of this Chapter is to be able to answer the RQs: (1) "What are the collaborative MSU activities and decisions throughout the phases of the disaster management cycle?" and (2) "How do humanitarian contextual factors influence challenges to collaborative MSU activities and decisions in humanitarian logistics?". To do so, a prerequisite is that we can present the general MSU usage, through presenting activities, decisions and challenges that are applicable regardless of what operation the MSU is implemented. As we currently have findings from three different instances, we need to generalize by mitigate for what could be caused by operation specific conditions (OSC), that is not applicable in general MSU usage, or even caused by faulty data. When these are presented we are able to use the theoretical framework to analyse the data to (1) structure and connect the activities and decisions to the DMC, and (2) see how the contextual factors (as described in Chapter 2) influence the challenges.

The generalization is conducted through using the theoretical context framework with the following heuristic (for more details see Chapter 3): The activities, decisions (including parameters) or challenges that are found in both SY and BD, or either of them but can be verified globally, are considered generalizable. Descriptions of activities are adapted to be generally applicable through mitigating for OSCs. Decision parameters and challenges that are only found in one instance, are included if they are caused by the contextual factor framework presented in Chapter 2, since we argue that if a challenge is caused by the humanitarian context it should (in different extents) influence all operations in this context, or directly caused by the MSU characteristics. A decision parameter is also included if it would be negligible in OSCs where it is not relevant.

Differences between what activities, decisions and challenges that we have observed can depend on where, or how frequent, the different operations are in relation to scale between ER and OO. Thus, to be able to understand what to generalize we start with revisiting the literature and analyse the BD and SY operations. Thereafter, we discuss how the findings relate to the warehouse types described in the literature, to create a theoretical frame for the MSU. With this understanding and based on the empirical findings, we are able to present the first version of the MSU cycle, which helps us to structure and categorize activities.

We choose to present, generalize and analyse activities, decisions and challenges in this order, to be able to present the challenges as connected to the concluded activities and decision points. Activities are analysed using the warehousing framework and the DMC, analysing gaps between literature and practice as well as in

which DMC phase they occur. The DMC will be used to understand what decision points occur in the MSU cycle. Finally, we analyse the challenges by using the contextual factors, through presenting how challenges are influenced by the context.

5.1 ER and OO

To get an initial understanding of and explain why some findings appear in one operation and not another, we will revisit the ER and OO discussion from Chapter 2. When viewing the operations of BD and SY in terms of ER and OO, we can conclude two similarities. Both operations have started out as ER in reaction to quickly escalating man-made disasters and thereafter transitioned into OO, with a longer time horizon, performing activities of providing continuous aid in the form of food and medical supplies and other goods on a routine basis. This is for instance manifested through the time aspect of MSU deployment not being as time crucial in Bangladesh at this point, which instead mainly captures the cost aspect of these decisions.

It is however, also important for both operations to maintain some instance of preparedness in regards to potential forthcoming instances of ER while performing their operations. For BD, the cyclone season poses a great threat to the refugee camps, where severe cyclones would have devastating consequences. This is manifested through training and pre-positioning of the MSUs. For SY, this is represented through the risk of development in the hostilities in the country, but also through natural disasters, such as flooding.

A big difference found is that SY actually has experienced instances where they have transitioned into ER, to respond to newly developed crises in different parts of the country, and operated according to those characteristics and activities during limited periods of time. Another is that the situation in BD in many aspects is further progressed into OO, even though the operation is a lot younger, e.g. the amount of beneficiaries is stable and the prerequisites for operating in BD are stable.

5.2 Warehouse types

When understanding the MSU it becomes important to understand what type of theoretically described warehouse it is the most similar to. As there is no current theory of warehouse types specifically in the humanitarian context, we observe similarities to the commercial context. It is fairly intuitive that the MSU is a distribution warehouse, rather than a production warehouse, as it stores goods from multiple "suppliers" (i.e. actors) before delivery to "end customer" (i.e. beneficiaries) – which would imply that the Logistics Cluster collaborative MSUs would have a relatively large total product range.

The other division of types of warehouses is between private and public warehouses, as well as the potential combination: contracted warehouses. As the collaborative MSU is defined as having the purpose of offering storage to partner organisations, we can quickly exclude the private warehouse. However, when looking at the differences between contract warehouses and public warehouse, the distinction is less obvious. The most distinguishing property of the contract warehouse compared to the public warehouse, is that in the

contract type the customer would be guaranteed a certain space for a given amount of time (often long-term). As the outspoken purpose of the collaborative MSU is to store goods for a shorter time period of time, and often with a first-come-first-serve policy without guarantees of continuous storage space, it appears that the best commercial approximation of the MSU would be the public warehouse.

However, we have observed that the Logistics Cluster does not always follow its SOPs regarding storage length, as well as that a few actors fill up the majority of space in the warehouses. This creates a reality where the collaborative MSU rather mimics the contract warehouse, also known as the 3PL warehouse.

5.3 The MSU cycle

Through the empirical data presented in Chapter 4 we are able to visualize how the MSU is used in the HSC. We present the identified cycle-stages, entry and exist stages, and visualize it in what we call the MSU cycle in Figure 13.

5.4.1 Cycle-stages

We use cycle-stages as a denotation for *a group of activities performed when the MSU is in the same physical location, used for the same purpose or with the same responsible partner*. This definition gives us the two main cycle-stages. The "In stock"-stage contains activities of the MSU when it is being stored domestically. This means that it is at the Logistics Clusters' disposal for deployment. The "In operations"-stage contains activities of the MSU when it has been deployed on site for collaborative usage. This means that storage is available for the partner organisations and that the Logistics Cluster assumes responsibility, for goods of the partner organisations. This also includes instances when an implementing partner is managing MSUs on behalf of the Logistics Cluster to offer common storage for the partner organisations.

In complementary to this, we require two additional cycle-stages to describe the MSU. The third cycle-stage is the "Partner stock"-stage, which is a variation of the "In stock"-stage. This represents the instances when partner organisations willingly offer their own MSUs to be operated collaboratively within the Logistics Cluster. The fourth cycle-stage is the "Loan"-stage, which relates to the "In operations"-stage. It represents instances when the MSU is being loaned to a partner organisation for them to use. The MSU will then be operated by partner personnel and store goods for the purpose of that one actor (or a given set of actors). The "Partner stock"-stage and the "Loan"-stage will not be examined into greater detail in this thesis, as they fall outside the collaborative MSU definition from Chapter 4 and are therefore regarded as out of scope. They are however included at the cycle-stage level as MSUs in these stages may return to the two main cycle-stages.

5.4.2 Entry and exit stages

The entry and exit stages mark the instances where the MSU starts and stops being used with collaborative purpose by the Logistics Cluster. As we have found that all Logistics Cluster MSUs are originally acquired from the UNHRD, this is the main entry stage. In the case of partner-owned MSUs being deployed as collaborative MSUs within the Logistics Cluster, the "Partner stock"-stage is the entry stage. The two exit stages mark the end of the usage of an MSU. The first is "Spare parts", where damaged MSU parts are discarded and their functional parts salvaged for repair and future use. The second exit stage is "Donation", where the MSU is given to another actor for future usage within their organisation. This also includes situations where the MSU is donated to another Logistics Cluster operation. It is interesting to note that we have found no waste-stage, where the entire MSU would be discarded.

5.4.3 Transportation

Transportation of the MSU is in essence the same as for any given commodity or asset and follows existing transport arrangements for goods. No difference between transporting before and after operations is found. Even though transportation is per definition a cycle-stage, it is not included as a cycle-stage in the MSU cycle. Mainly since the transportation is found to be uninteresting for the specific case of the MSU (with the exception of within challenges), but also since it would greatly complicate the visualization of the cycle, as the MSU can move between cycle-stage both with or without transport.

5.4.4 Combining the MSU cycle

When combining cycle-stages, entry and exit stages we get the collaborative MSU cycle, as shown in Figure 13. MSUs enter the cycle through the entry stage. From the two stock stages, or directly from UNHRD, the MSUs move to the "In operations"-stage or "Loan"-stage. When a decision to pull the MSU out of field is made, it either returns to its origin stock (i.e. Logistics Cluster or partner) or leaves the cycle through either being donated or salvaged as spare parts. The MSU may also exit the cycle directly from the Logistics Cluster stock both as a donation or as becoming spare parts.

As transport is not included in the MSU cycle, arrows should not be confused with geographical movement of the MSU. The MSU can move between several cycle-stage without necessarily being transported and/or re-erected, as the responsibility and/or purpose of the MSU can be transferred between actors.

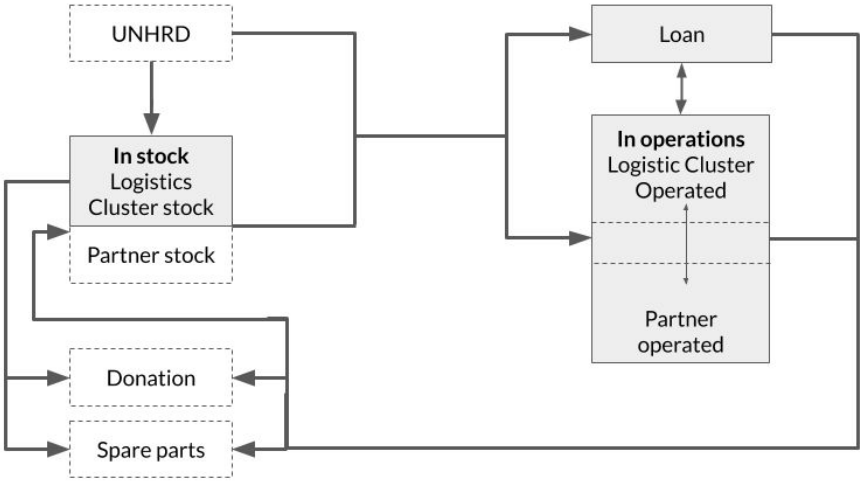

Figure 13: The collaborative MSU cycle isolated for a set operations without decision points. Grey boxes are main cycle-stage and dotted boxes are entry and exit stages.

5.4 Activities

This Section generalizes data regarding activities through comparing and structuring the empirical findings, and analyses using the warehousing framework and the DMC. The findings can be viewed in text in Chapter 4 and are summarized in tables, highlighting the differences between the two operations, in Appendix D. We use the "In stock"- and "In operations"-stage presented in Section 5.3 to categorize found activities.

5.4.1 Discussing differences between operations

Activities performed in the "In stock"-stage are to a large extent similar. In maintenance, the only difference we have found is that SY does cleaning and repairing of MSUs while in stock and not when it is outbound. This could be due to the fact that the SY operation is older, and therefore has had a larger need for repairing old MSUs for redeployment. In BD we have found that *preparedness* through disaster training is combined with erection training, probably due to the OSC of cyclone risk and in SY we have identified trainings for erection and fire safety. The only activity that we have only found in one operation (BD) is the outbound quality control of counting the parts before shipping the MSU. The reason why this is done could relate to the *internal factor* of low strategic mindset, where poor storage and maintenance procedures in BD creates the need of controlling quality before dispatching. As discussed in Section 5.1, the BD operation is more characterized as OO, and time is not as crucial when dispatching MSUs, whereas dispatching MSUs in SY could still be done as ER and thus there might be no time for an outbound quality control.

Advancing to the activities performed with and within MSUs while in the "In operations"-stage, we once more see that the operations are similar in many aspects. The erection is very similarly described, where the only difference is that SY sometimes need to drill holes for the stakes due to the type of soil. The only difference in the foundation activity is that BD sometimes uses concrete blocks to anchor the frame

(whereas SY only would anchor the frame in the ground), in cyclone preparedness purpose. This OSC is also the reason we only find tarps removal training in BD. In SY, we have found fire fighting and first aid training, which we have not seen in BD. This is probably due to the hostilities in SY. Regardless of this, the security activity is described similarly in both operations, showing that safety and security is also important in BD. BD also has a continuous dialogue with the local police, which is difficult in the unstable SY.

Quality control of goods in BD is performed together with the owner of the consignment when goods arrive, while the SY operation has a more continuous approach (including random inspections). The first may be explained by the long distances and restricted accessibility in SY, which are not regarded as issues in BD. However, we find no reason that we would not find the same continuous approach in BD. BD has, more or less voluntary, performed kitting/packing for partners, caused by the *high uncertainties* in supply, where partners have shipped goods that require kitting/packing without themselves having the means to perform it at a later part of the SC. We found daily cleaning activities in both operations, but the continuous approach of controlling the MSU condition was only found in SY. We find nothing in literature nor in OSC to explain this difference.

Both operations say that they do monthly inventory checks, but when observing BD we found that it has only been done twice during the last year. This discrepancy could be due to *internal factors* of labour pool size and supply of people, and it is not unlikely that one would see something similar if performing observations in SY. Covering the goods with tarp in the end of the day was only found in BD, which probably is due to the high humidity in BD. We also observed that this routine was not always followed, probably due to the same reasons as mentioned above. The daily control of goods stability was only found in SY and the observations confirmed poor secondary packages in BD, implying that the stability control was not performed even though it would be beneficial to do it, especially in the moist weather in BD.

Finally, the dismantling is done very similar in both operations. The only observed difference is that BD does replacements and repairs of the MSUs on site, which could be explained by the geographical span of the different operations. In SY, the long distances might make it hard to get the right competence to the dismantling site to do proper quality control and repairs. In BD, MSU locations are always comparably very close to the stock where the MSUs are stored, which makes it easy to do repairs and replacements already on site.

5.4.2 Generalizing and analysing activities

The differences in activities in the "In stock"-stage between the operations are very few, and there is no literature to base the analysis on. Removal of rust from stakes, and cleaning and repairing tarp is considered generalizable, and not only an OSC, since it is connected to how the length of the operation. The two training activities are combined to one more general activity of erection and preparedness. The outbound

quality control activity is included, but should be seen in the light of the current phase of the disaster. When applying the DMC phases to the activities in the "In stock"-stage, we find that all are connected to the preparedness phase, except the outbound quality control, that we argue to be a part of the response phase. The result can be seen in Table 4.

Table 4: Activities performed with the MSU while in stock.

DMC phase	**Activity**	**Description**
Preparedness	Preparedness training	Erecting and dismantling the MSUs to create know-how/experience in erection and dismantling within Logistics Cluster and its partner organisations. Training to execute various drills in preparedness purpose.
	Maintenance	Change damaged parts using spare parts from old MSUs or spare parts from supplier, or salvage damaged MSUs for non-damaged parts to become spare parts for new MSUs. Remove rust from stakes. Clean and repair tears in the tarp.
	Inbound quality control	Counting the parts and inspecting quality.
	Storage	The MSUs are stored in domestic Logistics Cluster stock for contingency and preparedness purpose.
Response	Outbound quality control	Counting the parts before sending out on site.

For "In operations"-stage, there is more to discuss. In both the erection and dismantling activities we removed descriptions of who does it, since it appears to be varying on OSC, as seen in the discussion about decisions (see Section 5.5). In this cycle-stage, activities of the MSU can be compared to the warehouse activities identified in the theoretical humanitarian warehousing framework (Figure 2). We revisit the categories of handling activities, supporting activities and value-adding activities from the activities in a humanitarian warehouse from Chapter 2. The result of applying the framework on our empirical data, is visualized as found activities, including overall categories (white) and their respective activities (grey), and presented in Figure 14. A more detailed result can be seen in Table 5.

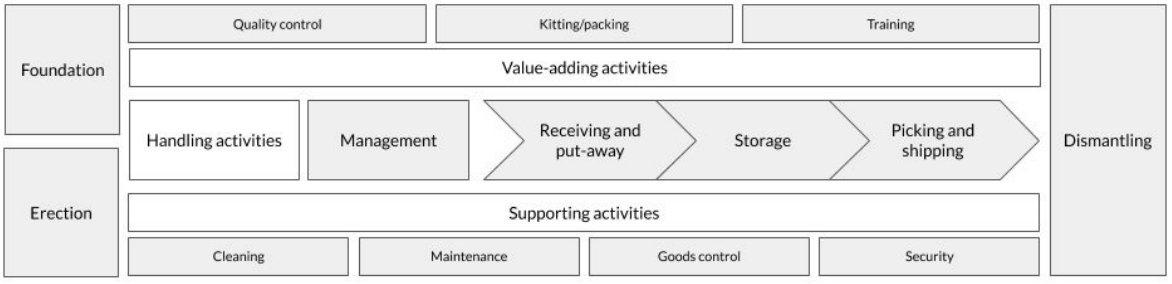

Figure 14: Visualization of the identified "In operations"-stage activities in the theoretical warehousing framework.

Table 5: Activities performed with and within the MSU while in operations.

DMC phase	Area of activities	Activity	Description
Response	-	Erection	Erecting the MSU supervised by a person with technical competence and erection experience. Inviting partners to participate to build erection competence. Depending on the soil, drilling expertise is needed.
	-	Foundation	Creating a solid foundation for the MSU. Digging drainage, filling with sand/gravel/shingle if there is a risk of flooding. The floor can be cemented or bricked, and/or pallets can be used to raise the floor from the ground. Concrete blocks to anchor the frame.
	Handling activities	Management	Receiving requests for storage and deciding to accept or deny storage. Receiving and handling requests for dispatching goods. Tracking goods in RITA and through stock cards.
		Receiving	Goods are received, handled and put away manually by daily workers, supervised by a managing person.
		Storage	Goods are stored for partners.
		Shipping	Goods are picked and moved onto trucks (or similar) manually by daily workers, supervised by a managing person.
	Supporting activities	Security	Security guards, fences/walls, continuous dialogue with local law enforcement if possible, fire fighting system and video surveillance.
		Goods control	Inventory checking. Control goods stability.
		Maintenance	Control of MSU conditions and potential external general repairs.
		Cleaning	Daily cleaning (including weed control).
	Value-adding activities	Training	Training, such as removing tarps quickly, fire fighting and first aid training.
		Quality control	Performing quality checks preferably together with the partner that owns the goods if possible. Continuous quality check on goods and random goods inspection.
		Kitting/packing	Kitting/packing goods.
Recovery	-	Dismantling	Dismantle the MSU supervised by a person with technical competence and erection experience. Cleaning of tarps and control the quality of MSU. Replace or repair damaged parts. Mark and separate part or whole MSU if bad condition, and counting parts.

For handling activities, we identify three activities. Contrary to literature, there is no clear distinction between receiving and put-away, as this is performed in one action. Goods are manually picked directly from the incoming vehicle and placed at the storage location. Similarly, when dispatching, goods are manually picked from the storage location and placed onto the outgoing vehicle. This can be explained by the absence of handling equipment, meaning there will be no transfer from manual picking onto pallets or trucks. It may also be due to the small distances traveled, meaning it is feasible to carry goods to and from

the storage location in one action, or due to the limited space, making it difficult to find spaces for offloaded goods that are not their final storage position. In relation to the disaster management cycle, all these activities are performed in the response phase, when the MSU is operational. We choose to include management within handling activities as it has tightest connection to the daily operations.

For supporting activities, we identify cleaning, maintenance, goods control and security. Pest control may be regarded cleaning or security, depending on the kind of pests. In security, the part about dialogue with the local police is generalized to local law enforcement and "if possible" is included to mitigate for OSCs. Even though goods control activities were found not to always be performed in reality, we choose to use their routines as description. Since we found that goods stability controls would be beneficial in BD as well, we do not consider it an OSC and include it. Covering with tarp, however, is caused by an OSC in BD and is not generalizable. To generalize and mitigate for differences in how continuously activities are performed, we have chosen to remove *when* several activities are done in the description. As all supporting activities are performed continuously, similar to the handling activities, we conclude that these also belong to the response phase.

For value adding activities, we identify quality control, kitting/packing and training. The former two are aligned with reviewed literature, but training is not. We chose to include it since it creates value (in the form of knowledge) for the Logistics Cluster. Exactly what the training consists of differs with OSCs, but we keep the examples for clarity. Packing is similar to kitting in the context of this thesis and we therefore combined them to one activity that we call kitting/packing. The kitting/packing activity is included since it is specifically empirically found. Discrepancies to literature are found for labelling, reverse logistics and goods disposal. These aspects relate to the MSU being managed collaboratively by the Logistics Cluster. Common logistics services offered by the Logistics Cluster only include storage and transportation, meaning there is a reluctance to perform other activities, such as the value-adding activities described in literature. We exclude labelling for this reason, but nonetheless we include kitting/packing despite them being regarded as value-adding activities, as they has been found in the operations. The topic of value-adding activities will be discussed in Chapter 6, and in the future, labelling could be included in that discussion. The absence of reverse logistics in the MSU is created by partner ownership of stored goods; the goods will seldom be routed through collaborative storage facilities if returned. Goods disposal is not found, both due to partner ownership of goods and there being less time for perishable goods to deteriorate as a result of the limited storage time given from SOPs. Similar to handling and supporting activities, we regard these as belonging to the response phase.

Erection, dismantling and foundation are activities found that not captured within the handling, supporting or value adding activities, as they naturally would not be performed in a regular warehouse, being unique to MSUs. As they represent the beginning and end of the "In operations"-stage, they are

placed first or last in the visualization in Figure 14. Foundation can be also be performed during the time the MSU is operational, but is primarily done in the beginning. We regard the dismantling as part of the recovery phase, as it relates to ramping down the current operations.

5.5 Decisions

This Section generalizes and analyses data regarding decisions through comparing and structuring the empirical findings, and analyses using the literature found on specific decisions and the DMC. This Section concludes by using the decisions' connection to the DMC to categorize them into decision points that are visualised in the MSU cycle. The findings can be viewed in text in Chapter 4 and are summarized in tables, highlighting the differences between the two operations, in Appendix D.

5.5.1 Discussing differences between operations

All decisions are found in both operations, except 'Laying out sand/gravel?' (BD), 'Throw away?' (SY), 'Internal or partner implemented?' (BD) and 'Who erects?' (SY). The first of the four is a consequence of *poor operating condition* in the geographical environment, and is in essence similar to the decision to cement or brick the floor. Regarding throwing away entire MSUs, this has never been done in neither SY nor BD, but interviewees in SY named it as an option. Due to the *stakeholder complexity* of dependency to donors and *high uncertainty* in supply, both operations generally hesitate to throw away more than absolutely needed, and would rather discard broken parts and save the rest as spare parts. The third difference is seen since SY does not use partners to implement the MSU operations. In the fourth, BD would always have internal expertise present, but due to long distances this is not always possible in SY. 'Cost' of both the erection company and the travel of expertise is found to be parameters in SY as well.

In 'To deploy MSUs?', the reason why we do not find 'commercial storage availability' as a parameter in BD could be since there are practically no commercial storage available. When deciding on 'Location of deployment?', the 'type of land', 'space available' and 'cost of land' are all only found in BD. These are caused by space being a rare resource in BD, compared to SY. As discussed in Chapter 5.1, 'cost of land' can also be related to that BD is more characterized as OO, making cost generally more important. 'Distance to possible contaminations', such as plantations and sewers, are only seen in SY, possibly caused by the above mentioned space constraints in BD. When observing, the distance to possible contaminations in BD was indeed very small.'From where to deploy?' is mainly found in SY, but 'access to deployment location' can be a parameter in BD in case of ER to a cyclone hit. The reason why 'proximity of deployment location' is only found in SY can be explained by the large distances. 'Position within location?', 'distance to fences' and 'wind direction' are only found in SY. The former is previously discussed under 'proximity to contamination', and the latter is directly linked to the *MSU characteristics* being specifically prone to heavy winds. Regarding 'Erected size?', we found 'space available' in BD (see discussion on space constraint above) and a length constraint of 14 modules for 'ventilation' and 'stability' in SY, caused by the *MSU*

characteristics. We combine cementing and bricking the floor since they are decisions with the same purpose of making the flooring more permanent to mitigate the *poor operating conditions*. For this decision, BD includes the 'need of efficiency' and 'time horizon of operations', where in SY we have only found 'type of soil'. The two found in BD relates to the need of mitigating the *poor operating conditions* as well as how *temporary and dynamic* the operation is. 'Type of soil' also relates to the *poor operating condition* of geographical environment. The parameters behind 'Anchor the frame?' has the same reasons as previously discussed about wind and soil.

When deciding 'To discontinue current MSU operations?', both operations have the ideal discontinuation initiated through an active request from the partner organisations, but this is a rare scenario in practice. In BD we found 'permanent structure availability' as a parameter, which shadows the decision to deploy an MSU, where 'permanent structure availability' is found in SY as well. In SY we found three more parameters not found in BD: 'commercial service availability', 'other partners in area discontinuing' and the MSU no longer being operational (i.e. 'condition of MSU'). The first has the same discussion as 'permanent structure availability' above, and the second is probably a sign of 'diminishing warehousing need'. The third is directly connected to the *MSU characteristics* and the *poor operating conditions.* We believe it is not found in BD since the operation is younger than SY. Regarding 'Replace/repair or salvage as spare parts?', we only find 'condition of parts' in BD.

'Loan MSU?' in BD is connected to the 'time horizon' of the need of the MSU; the longer the horizon, the more likely to loan an MSU. The two other parameters only found in BD are 'specific single partner need' and 'amount of potential users'. These might appear contradicting, but they reflect the two different reasons why the BD operation would loan an MSU. The first is if the single partner has a need so that they alone would utilize an entire MSU, or if there is a set number of partners that together can utilize an entire MSU. In SY, we found similar parameters to the general deployment decision: 'no existing collaborative storage' and 'feasible location'. The second is connected to the *high uncertainties* of assessment, and the *actor complexity* of high fragmentation creating the need for Logistics Cluster to themselves assess the feasibility of deployment. Donation of an MSU in BD is only made if the operation is completely discontinued in the area (i.e. it has never been done), whereas SY could donate as a part of their operation. Thus, it is intuitive that we only find the parameter of 'time horizon' (over 1 year) in SY. In 'Whom to loan to?', the parameters found in both operation also differs. In BD, the only parameter is 'capability to run the MSU' and in SY a loan can only be made to 'Logistics Cluster partner'. Only loaning to partners relates both to *collaboration challenges* of maintaining trust to the cluster lead and to *stakeholder complexity* in terms of accountability for the assets even as it is loaned out. However, loaning to whoever is capable of running it appeals to the humanitarian principles under *values and principles.* Finally, the same parameters are found in 'Whom to donate to?'. BD also includes 'partner need'. SY broadens it to 'organisation type' and do

especially avoid donating to the government or the military, which, interestingly, we have found that BD has no problem with. This could be due to the unstable situation in SY, were the government and/or the military would probably not use it for the *goal of relieving suffering*.

5.5.1.1 Global perspective

All parameters in 'To deploy MSUs?' are verified globally, as well as the 'Internal or partner implemented?' decision. In 'Who erects?', both parameters can be verified globally. In "Location of deployment?', it is surprising that we only found 'erection permits' globally and not in BD, since we have found it a challenge to get permission related to the political environment of the *poor operation conditions* of the country, where complex land legislation makes land access uncertain. 'Space to scale up' is also only found globally, and is connected to the *high uncertainties* in demand and being able to respond to sudden changes. We believe that we did not find this in BD since space is such a scarce resource that this would not be a possibility (i.e. you would use all the land you have available) and in SY of the opposite reason, since land is so freely available this has never been an issue.

In 'From where to deploy?', the only global insight is 'urgency of need of warehousing'. This correlates to whether or not the best choice is to optimize on cost or on speed, i.e. whether the operation is more in OO or in ER – higher urgency of need would create need for faster deployment, which can be related to from where the MSU is deployed. Within the parameters behind 'To discontinue current MSU operations?' we confirm 'permanent structure availability'. Surprisingly, we do not find 'commercial service availability' or 'condition of MSU' globally. However, the latter is found in the donation decision, which here overlaps with discontinuation. The 'condition of parts' in 'Replace/repair or salvage decision?' is verified globally.

In "Loan MSU?", we confirm 'specific partner need' but not 'amount of potential users', indicating the second way BD is using loans is uncommon. We also find 'urgency of need of warehousing' as a parameter, where the discussion from 'From where to deploy?' can be applied. In 'Donate MSU?' we confirm 'time horizon', but 'specific single partner need' is only found globally (however, see "Loan MSU?'-version). 'Condition of MSU' is a parameter here since some operations would donate MSUs that are below the quality standards of Logistics Cluster, which in essence is a decision to discontinue rather than to specifically donate. Finally, in 'Whom to donate to?' we have found the more general parameter of 'humanitarian purpose', which appears to be applicable in both observed operations.

5.5.2 Generalizing and analysing decisions

As described in Chapter 2, the literature on tactical decision regarding MSU usage is very limited. However, one connection that can be made is to the parameters of 'Location of deployment?'. Equipment availability and structural solidity are not applicable in the MSU case, since there is no pre-established equipment or structure when erecting an MSU. Ease of access ('access to good roads'), threat of flooding ('topography') and capacity ('space available') are all found to be general in our case. However, neither 'from where

incoming goods is expected' nor 'security' are found. The former can, however, be connected to access to good roads, and/or be considered impossible to assess due to the collaborative context. We also include 'type of land' since this parameter is considered negligible if space constraint is not an OSC. This can also be said for the 'cost of land', which also should be seen in the light of the current phase of the disaster. 'Distance to possible contaminations' is included of the same space constraint reason. 'Erection permits' is included from the global findings since it is connected to contextual factors and that we find a challenge directly connected to this parameter in BD. It also appears obvious to us that one generally needs erection permission to erect in a location. 'Space for scaling' up is included since it is so tightly linked to the contextual factors.

Another connection to literature can be made with the 'variety of commodities' in 'Amount and size?', where the literature recommendation of storing NFIs and food separately will have consequences on the amount of MSUs to deploy. In 'From where to deploy?' we generalize all the parameters we have found: 'Proximity of deployment location' since it is negligible in operations where it is inapplicable; 'urgency of need of warehousing' since is connected to OSCs of geographical distances phases, and is also negligible in other OSCs. However, both should be seen in the light of the current phase of the disaster. We also choose to generalize the entire 'Internal or partner implemented?' since it appears to be depending on how the MSUs are used and that the BD usage is not uncommon. If the MSU is not implemented by a partner in an operation, the decision can be interpreted as always result in internal implementation. From our observations we also add the parameter of 'presence in location of deployment' for both internal and partner. In 'Position within location?', all found parameters are generalized: 'Distance to fences' is included of the same reasons as 'distance to possible contaminations' discussed above, and 'wind direction' is included since it is caused by context. Regarding 'Erected size?', we choose to include 'space available' of the same reasons discussed with the 'Location of deployment?' above, as well as 'ventilation' and 'stability' due to their relation to the MSU characteristics. Since 'Laying out sand or gravel?' and 'Cementing/bricking the floor?' and all their respective parameters are linked directly to the context, we generalize them. This is also the case for 'Anchor the frame?' and its parameters.

'Discontinue current MSU operations?' has quite a few differences between the operations. 'Commercial service availability' is only found globally, but since it is connected to the decision to deploy (where it is found in all three instances), it should also be included here. 'Condition of MSU' is surprisingly only found in SY, however, it is directly linked to both the context and the MSU characteristics, and, as discussed in Subsection 5.5.1, we found the parameter in 'Donate MSU?' globally, we are including it in the general case. Finally, we do not include 'other partners in area discontinuing', since it is only a way of assessing other parameters.

Table 6: The decisions and parameters of the general MSU usage case.

DMC phase	Decision	Parameters
Response	To deploy MSUs?	1. Urgency of need of warehousing 2. Permanent structure availability.. 3. Commercial storage availability. 4. Need of warehousing.
Preparedness Response	Amount and size?	1. Size of need of warehousing. 2. Space available. 3. Variety of commodities.
Response	Location of deployment?	1. Erection permits. 2. Space available. 3. Space for scaling up. 4. Distance to possible contamination. 5. Access to good roads. 6. Proximity to beneficiaries. 7. Topography. 8. Cost of land. 9. Type of land. 10. Security.
Preparedness Response	Procure new MSU?	1. Amount of MSUs in country stock.
Response	From where to deploy?	1. Proximity of deployment location 2. Access to deployment location. 3. Urgency of need of warehousing
Response	Internal or partner implemented?	1. Presence in location of deployment
Preparedness Response	Who erects?	1. Need of internal competence elsewhere. 2. Cost.
Response	Position within location?	1. Truck maneuver space. 2. Distance between MSUs. 3. Distance to fences 4. Wind direction.
Response	Erected size?	1. Space available. 2. Standardized length. 3. Ventilation. 4. Stability.
Response	Laying out sand/gravel?	1. Topography. 2. Type of soil.
Response	Cementing/bricking the floor?	1. Need of efficiency. 2. Type of soil 3. Time horizon of operations.
Preparedness Response	Anchor the frame?	1. Type of soil. 2. Area prone to heavy winds.
Recovery	To discontinue current MSU operations?	1. Requested by partners. 2. Declining activity in the MSU. 3. Permanent structure availability. 4. No more need of warehousing. 5. Commercial service availability. 6. Condition of MSU.
Preparedness Recovery	Replace/repair or salvage as spare parts?	1. Amount of damaged or missing parts. 2. Condition of parts/MSU.
Response Recovery	Loan MSU?	1. Specific single partner need or amount of potential users 2. Feasible location 3. Urgency of need of warehousing
Response Recovery	Whom to loan to?	1. Capability to run the MSU. 2. Organisation type. 3. Humanitarian purpose.
Response Recovery	Donate MSU?	1. Specific single partner need or no more operations in the area. 2. Time horizon.
Response Recovery	Whom to donate to?	1. Capability to run the MSU. 2. Organisation type. 3. Humanitarian purpose.

In ‘Loan MSU?’, ‘feasible location’ is connected to the contextual factors and should be included. We also include ‘urgency of need of warehousing’ in the same way as in ‘From where to deploy?’, and here should it be seen in the light of the current phase of the disaster. We choose to combine ‘specific single partner need’ and ‘amount of potential user’ to one parameter to be able to encompass both types of loans. Depending on what type of loan is implemented in a given operation, either or both parts can be used as parameter. ‘Time horizon’ is only found in BD, and as it is not connected to context or MSU characterics and is not negligible if not used, it is not included. The same applies for ‘no existing collaborative storage’, which is not included. In ‘Donate MSU?’, ‘specific partner need’ and ‘no more operations’, are, in the same way as in the discussion on ‘Loan MSU?’ above, also merely two ways of using donation. They are therefore combined, and either or both parts can be used as a parameter depending on what type is implemented in a given operation. The ‘condition of the MSU’ is, as previously discussed, seen a part of the discontinuation decision. Within both ‘Whom to donate to?’ and ‘Whom to loan to?’, we include ‘capability to run the MSU’. We also choose to generalize ‘Logistics Cluster partner’ to ‘organisation type’ and ‘humanitarian purpose’, which also both are included in ‘Whom to donate to?’. ‘Partner need’ is included in the decision to donate in the first place, and is thus not included here either

When having concluded what decisions and parameters to include in the general case, we are able to understand them in relation to the DMC. The majority of the decisions are connected to the response phase. The decisions concerning ramping down and discontinuing MSU operations, are positioned in the recovery phase. ‘Amount and size?’, ‘Procure new MSU?’ and ‘Who erects?’, are decisions that may be made before the disaster strikes to quicker be able to respond. ‘Anchor the frame?’ is a decision that would be made during the response phase, but it can also be viewed as preparedness for a potential new emergency (i.e. see the discussion in Section 5.1). ‘Replace/repair or salvage as spare parts?’ can be seen either as a part of ramping down in recovery, or as a decision made in preparedness for the next disaster. Finally, loan and donation related decisions are seen as response or recovery, depending on the purpose of the loan (as discussed in e.g. Section 5.3). These discussions are summarized as generally applicable decisions and decision parameters, connected to the DMC in Table 6.

5.5.3 Decision points

In order to create an overview of the decisions, we chose to categorize them in decision points, based on when they may be made. The decision points are identified from the empirical data. We identify eight decision points, in which the decisions are positioned, and to which DMC phases are linked. As we have not found many instances before disaster strikes in which decisions are made, we include only one decision point in the preparedness phase including all of these decisions. It is worth noting that this decision point could be several decision points combined. We place multiple MSU decision points inside the response phase, i.e. from the moment a disaster strikes until ramp down commences, and we categorize these in four different decision points depending on their purpose and relative time to each other. The 'Improvements' point contains the 'Anchor the frame in concrete?', which we have identified to be partly preparedness, however, we still position it in response since that is the emphasis of the decision (for further discussions on this see Section 5.6). Lastly, decisions relating to ramp down and post ramp down are categorised in the recovery phase and these are divided into three different decision points depending on their scope and the physical location of the MSU. 'Replace/repair or salvage as spare parts?' is included in this decision point, even though it could be made in preparedness for the next disaster, as it is mainly seen as a recovery decision. This is presented in Table 7 and Table 8.

Table 7: Decisions grouped by the decision point in which they may be made

DMC phase	**#**	**Decision point**	**Decisions**	
Preparedness	0	Pre-deployment	Amount and size? Who's erecting?	Procure new MSU?
Response	1	Deployment	To deploy MSUs? Amount and size? Location of deployment?	From where to deploy? Who's erecting? Procure new MSU?
	2	Purpose	Internal or partner implemented? Donate MSU? Whom to donate to?	Loan MSU? Whom to loan to?
	3	Set up	Location of deployment? MSU position within location? Erected size?	Laying out sand/gravel? Cementing/bricking the floor? Anchor the frame in concrete?
	4	Improvements	Cementing/bricking the floor?	Anchor the frame in concrete?
Recovery	5	Discontinuing	To discontinue current MSU operations? Donate MSU? Whom to donate to?	Loan MSU? Whom to loan to?
	6	After dismantling on site	Replace/repair or salvage as spare parts? Donate MSU? Whom to donate to?	Loan MSU? Whom to loan to?
	7	After dismantling off site	Donate MSU? Whom to donate to?	Replace/repair or salvage as spare parts?

Table 8: Visualization of which decisions are made in what decision points, as empirically found.

	0. Pre-deployment	1. Deployment	2. Purpose	3. Set up	4. Improvements	5. Discontinuing	6. After dismanting on site	7. After dimantling off site
To deploy MSU?		x						
Amount and size?	x	x						
Location of deployment?		x		x				
Procure new MSU?	x	x						
From where to deploy?		x						
Internal or partner implemented?			x					
Who errects?	x	x						
Position within location?				x				
Erected size?				x				
Laying out sand/gravel?				x				
Cementing/bricking the floor?				x	x			
Anchor the frame?				x	x			
To discontinue current MSU operations?						x		
Replace/repair or salvage spare parts?							x	x
Loan the MSU?			x			x	x	
Whom to loan to?			x			x	x	
Donate MSU?			x			x	x	x
Whom to donate to?			x			x	x	x

As indicated by Table 8, some decisions may be taken at more than one decision point in the same operation. For instance, the exact location of an MSU can be determined both at the point of the deployment and the setup decision. In SY, the decision of location is present both at deployment, as a more general decision of direction, and then more exactly when it is to be erected. In BD, the location is determined immediately. Moreover, the decision to cement the floor can be made either as a part of setup or as a continuous improvement decision.

Finally, these decision points are positioned in the MSU cycle from Section 5.3 (see Figure 15). The relative positioning of the decision points is not to be confused with the time between them (e.g. (1) and (2), or (3) and (4) could be made simultaneously), but merely the order from which they are made in relation to each other and to the different stages of the cycle.

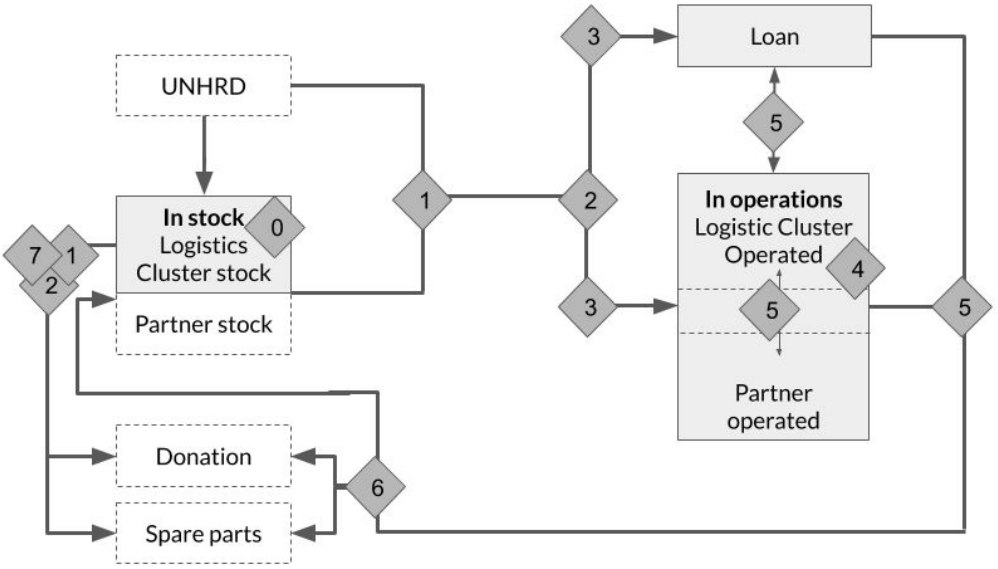

Figure 15: The collaborative MSU cycle isolated for a set operations including decision points. Grey boxes are main cycle-stage and dotted boxes are entry and exit stages.

5.6 Summarizing the connection to the disaster management cycle

With the entire collaborative MSU cycle presented, we can summarize the activities' and decisions' connection to the different phases in the DMC as presented in Table 9.

Table 9: Positioning activities and decision points by their occurrence in the DMC.

Disaster phase	**"In stock"**	**"In operations"**	**Decision point**
Preparedness	Preparedness training Maintenance Inbound quality control Storage	Training	Pre-deployment
Response	Outbound quality control	Erection Management Receiving Storage Shipping Maintenance Cleaning Kitting/packing Goods control Security Quality control Foundation	Deployment Purpose Set up Improvements
Recovery		Dismantling	Discontinuing After dismantling on site After dismantling off site

With regards to preparedness, we see that the MSU can serve as a contingency resource, being positioned in the domestic stock in anticipation of emerging disasters that may increase warehousing need of humanitarian organisations on short notice. We also identify similarities to literature in the competence building, through training of staff with instances of preparedness trainings, as well as best practices through

the routines, experiences and global perspectives that the Logistics Cluster takes with them from previous operations. Through the global insights we have also heard of the possibility of pre-negotiating contracts for the erection, warehouse personnel and transportation. We have not found any indications that waste implications are evaluated with regards to MSUs or MSU operations during the preparedness phase. This may link to the previously discussed reluctance of throwing away MSUs or MSU parts.

There is only one decision point regarding MSUs that we position in the preparedness phase. This could be an indication of the low strategic mindset of the humanitarian sector and that the MSUs currently may not be viewed as a strategic resource. However, given the cyclic nature of the MSU and the DMC, decision points regarding recovery (namely those made after dismantling on site and after dismantling off site) are of interest also in that they are in preparation of another deployment. We can draw similar conclusions regarding the dismantling activity in the recovery phase.

MSU activity in the response phase begins with getting MSUs into the appropriate locations and erecting them. Related to inventory management, we have discussed low-effort, flexible and easily implemented inventory management policies, which are found to be used for the activities in the MSUs in both studied operations. The response decisions' position span the time from the disaster strikes until the ramp down during which the MSUs are deployed, and they all relate to the warehousing operations of the MSU. The improvement decision and the related foundation activity might be the hardest to position in only one phase. As part of the response they relate to increasing the operational efficiency and how permanent the MSU is. This in turn is related to the previous discussion of ER and OO, where focus may have been shifted from time to cost, and it therefore may be more feasible to invest in improving working conditions. Indications that the MSU operation is going to span over an extended period of time might also foreshadow these discussions. However, if seen as a preparation for the risk of a new emergency, it is arguably a part of the preparedness phase for that potential disaster.

For recovery, we conclude comparatively little connection to the MSU. We have seen that MSUs may be donated to the local government or local NGOs as the Logistics Cluster discontinues their operations. The actual MSU usage of the partners receiving donations are out of scope. It is clear that recovery activities and decisions occur during the ramp down phase of a disaster, relating to a diminishing need of warehousing capacity with the partner organisations.

5.7 Challenges

This Section generalizes data regarding challenges through comparing and structuring the empirical findings, and analyses using the contextual factors. The findings can be viewed in text in Chapter 4 and summarized in tables, highlighting the differences between the two operations, in Appendix E. The

challenges are sorted based on activities and decision points concluded from Section 5.4 and Section 5.5. We choose also to include transport, since we have found challenges in this area

5.7.1 Discussing differences between operations

In the "In stock"-stage, maintaining erection competence in the organisation is found to be challenging in both operations, while making sure no parts are lost during storage is only found in BD. The transport challenges are only found in SY, probably caused by the large distances and the fact that transport is specifically hard in the unstable environment.

Regarding challenges in erection and foundation, both "having erection competence on site" and "erecting correctly" are found in both operations. "Unloading from trucks" is found in BD only, but is linked to the *internal factor* of supply of people, tech and capacity, since unloading equipment is rarely available. Finding construction labour and finding it at the right price are both only found in SY. This is connected to the fact that the BD operation never outsources erection (see Section 5.5). In foundation, "finding time to cement" is only found in SY, and is possibly connected to the potential of more ER scenarios in SY. In handling activities, the following four are only found in BD: "Prioritizing what storage requests to accept and deny" is strongly connected to the *actor complexity*; "transportation arriving on wrong dates" to the *poor operating conditions* and *high uncertainties*; "prioritizing what truck to serve first in case of congestion" to *actor complexity* and *high uncertainties*; and "operating with untrained staff" to the *temporary and dynamic* nature of the HSC and the *internal factors*. Concerning supporting activities, the last five challenges are only found in SY. "Finding secure location and position" is connected to the security situation in SY previously discussed, and the *poor operating condition* of safety and security. "Keeping the MSU stable if the ground is loose" is related to the *poor operating condition* geographical environment. "Maintaining quality of food" and the high risk of "cross contamination" is caused by the MSU characteristics of being operated outdoors and in a congested area. The value adding activity of kitting/packing is only observed in BD, which explains why the challenges of "kitting/packing wrongly kitted/packed items" is only found there; the challenge is both connected to *high uncertainty* in supply and and to the space constraint discussed in previous Sections.

In the decision points we see differences in three challenges, all of which solely found in BD: "Getting government permission to erect", "finding suitable position within the location" and "assessing future supply of warehousing". The first relates to the political environment in *poor operating conditions* and the third to the *high uncertainties*. The second, however, connects to the space constraints in BD.

5.7.1.1 Global perspective

When in stock, "making sure no parts are lost during storage" is confirmed, and two more challenges are found: "Frames and tarps need to be sourced globally" caused by the *high uncertainty* in supply of the usual local market; and "finding time and space to do inbound quality control" probably caused by *internal*

factor of small labour pool size. One reason why we might only find the latter in the global data is because it is connected with the phase of the disaster, being more prominent when more into ER, where time is more crucial. In transport we find "making sure no parts are lost in transport", which is in essence very similar to the same challenge in stock.

During erection and foundation we confirm "unloading from trucks". During dismantling we confirm "removing damaged parts without damaging other parts" and "returning responsibility to partners". We also find "having dismantling competence on site", which is very similar to "having erection competence on site". As the latter is found in all operations, also the former is included. Finally, in the decision points, we can confirm "assessing future supply of warehousing".

Table 10: General tactical challenges in collaborative MSU usage.

Area of challenges	**Challenges**	
"In stock"	1. Frames and tarps need to be sourced globally. 2. Finding time and space to do inbound quality control.	3. Making sure no parts are lost during storage. 4. Maintaining erection competence in the organisation
Transport	1. Getting government travel approval. 2. Finding secure transport corridor.	3. Making sure no parts are lost in transport.
"In operations" Erecion/ foundation	1. Having erection competence on site. 2. Unloading from trucks. 3. Erecting correctly.	
"In operations" Handling	1. Prioritizing what storage requests to accept and deny. 2. Transportation arriving on wrong dates. 3. Prioritizing what truck to serve first in case of congestion.	4. Operating with untrained staff. 5. Maintaining efficiency in poor operating conditions. 6. Maintaining warehousing procedures/standards.
"In operations" Supporting	1. Finding secure location and position. 2. Leakage due to wrongly erected MSU. 3. Keeping the MSU stable if the ground is loose.	4. Humidity affecting secondary packages. 5. Humidity affecting goods. 6. Maintaining quality of food. 7. Cross contamination.
"In operations" Value adding	1. Getting owners of goods to perform quality checks.	2. Kitting/packing wrongly kitted items.
"In operations" Dismantling	1. Getting the right parts into the right boxes. 2. Correctly assessing the condition of parts. 3. Removing damaged parts without damaging other parts.	4. Returning warehousing responsibility to partners. 5. Having dismantling competence on site.
Decision points	1. Finding suitable land. 2. Getting government permission to erect. 3. Getting government approval to import MSUs to country stock.	4. Finding suitable position within the location. 5. Assessing future need of warehousing. 6. Assessing future supply of warehousing.

5.7.3 Generalizing and analysing challenges

Initially we note that several challenges to the MSU usage relates to its condition. MSUs that are new, or in new condition, are not going to experience these challenges to the same extent as used ones. This does not change the challenges, but rather makes them easier to overcome or mitigate.

Since the challenge of frames and tarps sourcing is created by a contextual factor, it can be generalized. Making sure no parts are lost in storage and in transport are very similar, and probably have the same causes. This leads us to conclude that if BD would have served for transport, that challenge would have been found there as well, and thus make it generalizable for such operations. Since we can not verify "finding time to cement" globally, and we can not connect it directly to the context, we conclude that it is caused by an OSC and do not include it. The same goes for finding construction labour and finding it at the right price.

The first three challenges in handling activities are, although only found in BD, connected to the context and should be included. In supporting activities, "vulnerability to vehicle accident" is not confirmed nor connected to the context, and is thus not included in the general case. The other four, all of which are only found in SY, are all connected the context or the direct MSU characteristics.

In value adding, we have only observed one operation that we know performs kitting/packing, thus it is not unreasonable that we find the challenge only in the operation. The same goes from "Getting owners of goods to perform quality checks". As we have included these in the general activities, we do also include them here. However, it should be noted that these will obviously not be challenges were these activities are not performed. In dismantling, "dismantling competence on site" is only found globally. However, even though it is not strictly connected to context, we choose to include it due to its similarities to the erection competence challenge found in all instances. We believe that this merely shadows our finding that dismantling generally is not regarded as important, or hard, as erection (which will be discussed further in Chapter 6).

Finally, in the decision points we include "getting government permission to erect", due to its contextual connection. We also choose to include "finding suitable position within the location" and "finding land with the right topography", with the same space constraint reasoning as in Section 5.5.

Now that general case challenges to MSU usage are presented (as seen in Table 10), the influence of contextual factors on these challenges can be analysed. Challenges and contextual factors are mapped against each other in Table 11, and the reasoning behind it is explained below.

Table 11: The connection between the contextual factors from Chapter 2 and the general challenges to MSU usage.

		Internal factors	Poor op. cond.	High uncertainties	Actor complexity	Temporary dynamic	Values and principles	Goal	Stakeholder complexity
	Number of caused challenges	16	15	10	8	5	2	1	1
"In stock"	Frames and tarps need to be sourced globally.	x		x		x			
	Finding time and space to do inbound quality control.	x							
	Making sure no parts are lost during storage.	x				x			
	Maintaining erection competence in the organization	x							
Transport	Getting government travel approval.		x						
	Finding secure transport corridor.		x	x					
	Making sure no parts are lost in transport.	x							
"In operations" Erection/ foundation	Having erection competence on site.	x	x						
	Unloading from trucks.	x							
	Erecting correctly.								
"In operations" Handling	Prioritizing what storage requests to accept and deny.			x	x		x	x	
	Transportation arriving on wrong dates.		x	x					
	Prioritizing what truck to serve first in case of congestion.	x			x		x		
	Operating with untrained staff.	x							
	Maintaining efficiency in poor operating conditions.		x			x			
	Maintaining warehousing procedures/standards.	x				x			
"In operations" Supporting	Finding secure location and position.		x						
	Leakage due to wrongly erected MSU.	x							
	Keeping the MSU stable if the ground is loose.	x	x			x			
	Humidity affecting secondary packages.		x						
	Humidity affecting goods.		x						
	Maintaining quality of food.								
	Cross contamination.								
"In operations" Value adding	Getting owners of goods to perform quality checks.	x	x		x				
	Kitting wrongly kitted items.			x	x				
"In operations" Dismantling	Getting the right parts into the right boxes.	x							
	Correctly assessing the condition of parts.	x							
	Removing damaged parts without damaging other parts.								
	Returning warehousing responsibility to partners.			x	x				x
	Having dismantling competence on site.	x	x						
Decision points	Finding suitable land.		x	x	x				
	Getting government permission to erect.		x						
	Getting government approval to import MSUs to country stock.		x						
	Finding suitable position within the location.		x	x					
	Assessing future need of warehousing.			x	x				
	Assessing future supply of warehousing.			x	x				

Initially it can be seen that four challenges are not influenced by the context at all, rather are they challenges caused solely by the MSU characteristics and would due to that be present in any form of MSU usage (also outside the humanitarian context). It should be noted that all challenges in some part are influenced by the MSU characteristics (which will be further discussed in Chapter 6), but "erecting correctly", "maintaining quality of food", "cross contamination" and "removing damaged parts without damaging other parts" are all only influenced by it.

Several of the challenges are influenced by lack of time, which is a part of the HSC *goal of relieving human suffering*, wherein time as the most crucial factor for HSC success, is included. This is, as previously discussed, also connected to where in the ER-OO-scale the focal operation is. To not cloud the analysis with this conclusion in all challenges, we note the reader of this fact here and not in the relationship of each challenge.

"Frames and tarps need to be sourced globally" is not necessarily a challenges if the time is not constraining, however, *high uncertainties* in demand can create rapid changes which makes long lead times of global sourcing challenges. The initial need of sourcing new frames and tarps is influenced by the *internal factor* of varying human resources, and the low possibility of local sourcing might be connected to the *temporary and dynamic* nature of the HSC. "Finding time and space to do inbound quality control" is directly influenced by low labour pool size in *internal factors.* "Making sure no parts are lost during storage" is influenced by the *internal factor* of low strategic mindset, if the MSU is not seen as a strategic asset the risk of losing parts increases. It could also be influenced by the *temporary and dynamic* improvised HSC, where a warehouse might be unstructured, and storage policies for MSU parts are poorly constructed. "Maintaining erection competence in the organisation" is directly influenced by high staff turnover rate in *internal factors*.

"Getting government travel approval" is influenced by *poor operating conditions* of political environment. "Finding secure transport corridor" is influenced by *high uncertainty* in logistics, as well as the *poor operating condition* of security and physical environment in the sense of damaged physical infrastructure and roads. "Making sure no parts are lost in transport" is influenced by negligence in the transport, which in turn is caused by *internal factors.*

"Having erection competence on site" is both an issue in regards of having erection competence in the organisation, which is influenced by the *internal factor* of high staff turnover rate, but also to actually get the competence to the site, which is influenced by various parts of the *poor operating conditions* (e.g. safety/security and physical environment). "Unloading from trucks" is influenced by the *internal factor* low access to equipment.

"Prioritizing what storage requests to accept and deny" is obviously influenced by the *actor complexity* in the need of prioritizing in congesting goods. The humanitarian principle of impartiality in *values and principles*

states that prioritizing must be conducted on base of need alone, but since it is hard to assess the *high uncertainty* in future demand (i.e. future partner need of warehousing) this prioritization challenges is even more challenging.

"Prioritizing what truck to serve first in case of congestion" is in the same way influenced by *actor complexity* and complicated by *values and principles*, but also related to that the one who actually makes the rather operational decision not might be qualified, relating to the *internal factor* of labour pool size. "Transportation arriving on wrong dates" is influenced by *high uncertainties* in logistics and supply, which in turn might be influenced by the physical environment *poor operating condition*. "Operating with untrained staff" is clearly influenced by the labour related issues in *internal factors*. "Maintaining efficiency in poor operating conditions" is primarily influenced by *poor operating conditions*. However, it is also connected to the inability or unwillingness to create routines and standards caused by the *temporary and dynamic* nature of the HSC. The latter is intuitively influences "maintaining warehousing procedures/standards", which is also influenced by the labour related *internal factors* and the low tech environment.

"Finding secure location and position" is influenced by the *poor operating conditions* of safety/security and the political environment. "Leakage due to wrongly erected MSU" is influenced by lack of internal competence and low strategic mindset in *internal factors*. "Keeping the MSU stable if the ground is loose" is naturally influenced by the geographical environment in *poor operating conditions*, but could it could also be influenced by low strategic mindset *internal factor* during erection, or the *temporary and dynamic* nature of the HSC that creates an unwillingness or an inability to create anchoring improvements. "Humidity affecting secondary packages" and "humidity affecting goods" are influenced by the *poor operating condition* geographical environment of weather.

"Getting owners of goods to perform quality checks" could relate to several different contextual factors. The physical environment in *poor operating conditions* could make it hard for partners to access the MSUs and the *internal factor* of labour pool size could be an issue for the partners. However, since we have not interviewed partners it is hard for us to make a certain analysis about this. It is only poor collaboration in *actor complexity* that can be connected to the Logistics Cluster. "Kitting wrongly kitted items" is initially influenced by wrong supply connected to *high uncertainties*, but could also be caused by poor information sharing between the partners or by low clarity in roles – both in *actor complexity*.

"Getting the right parts into the right boxes" is influenced by the two *internal factors* of low strategic mindset in form of no standards of storing MSUs and poorly defined processes, and by the varying human resources in the labour pool size. The latter is also causing "correctly assessing the condition of parts". "Returning warehousing responsibility to partners" is influenced by the *high uncertainty* in supply and

demand and/or the *actor complexity* of poor collaboration. It can also be influenced by the *stakeholder complexity* factor of misaligned incentives; since Logistics Cluster services are free, partners have no incentive to retake responsibility and fill the gap themselves. "Having dismantling competence on site" is basically the same as having erection competence on site discussed above.

"Finding suitable land" can be influenced by topography in the *poor operating condition* geographical environment or by *high uncertainties* in assessment. It could also be influenced by the *actor complexity* of competing SCs, since many actors could be competing over limited land. "Getting government permission to erect" and "getting government approval to import MSUs to country stock" are influenced by the political environment *poor operating condition*. "Finding suitable position within the location" is initially influenced by the *poor operating conditions* of geographical and physical environment. But it could also be influenced by *high uncertainties* in assessments, where the initial location assessment might prove to be incorrect, making the position decision challenging. Finally, "Assessing future need of warehousing" and "Assessing future supply of warehousing" are both primarily influenced by *high uncertainties* in assessment and demand, but could also be influenced by poor information sharing and collaboration in the *actor complexity*.

Finally, we conclude that some factors influence challenges a lot more than others. Together internal factors, poor operating conditions and high uncertainties influence the vast majority of challenges; values and principles, and stakeholder complexity very few. This will be further elaborated on in Chapter 6.

Chapter 6 - Conclusion

This Chapter concludes the thesis through answering the research questions, and discussing contribution to practice and research. Finally, further research and our limitations is presented.

The purpose of this thesis has been to explore the usage of collaborative MSU warehouses in terms of determining their activities' and decisions' connection to the DMC, as well as their challenges' connection to the contextual factors of the HSC. We have performed a literature review of HL and warehousing in order to create an interview guide to serve as foundation for our main data collection of ten interviews with practitioners. In complementary to this, we also collected data from documentation and observations in field. The literature review also provided us with contextual factors, that was later used for the analysis.

The collected data was structured through identifying and generalizing activities and decisions, and reviewing these in terms of the DMC. Building on this, challenges relating to the activities and decisions were identified and their influence from humanitarian contextual factors was investigated. Through this we are now able to answer our RQs.

6.1 RQ1: What are the collaborative MSU activities and decisions throughout the phases of the disaster management cycle?

Since the area is previously unexplored, we start with concluding that the collaborative MSU is a public warehouse with a distribution purpose and activities similar to a conventional commercial low tech warehouse. Additional activities are erection, dismantling and foundation, as well as those performed when the MSU is in the "In stock"-stage. These all relate to at least one of the distinguishing MSU features: *flexible*, *temporary*, *movable*, *modular* and *reusable*. We conclude that the collaborative MSU has many similarities to a 3PL, but that it is distinguished through its restrictions in offered storage time and services. However, when routines and SOPs are not followed, which is an observed case from practice, the collaborative MSU acts more as a 3PL.

We describe collaborative MSU usage through the collaborative MSU cycle, which is shown in Figure 14 and further explained through identified activities, decisions and decision points in Table 4 and Table 5 (see also Figure 15), Table 6, and Table 7, respectively. In total we identify 19 activities when it is deployed in operations or kept in storage, and eight decision points, containing a total of 18 decisions. All identified activities and decisions are positioned in relation to the phases of the DMC cycle (see Table 9 for a summary).

By doing so we have shown that the MSU is an asset that can be used in different ways throughout the entire DMC. For the *preparedness* phase, an MSU may itself be stored in domestic warehouses as a contingency warehousing capacity resource if demand surges should occur. In this case, training activities

may be performed. During the *response* phase, MSUs may be deployed early on, during times of large uncertainties in total warehousing demand, only to later be adjusted when more accurate information is available. If the operation is continued for an extended period of time, some flexibility may be traded for efficiency and durability through foundation measures, following the shift of focus from time to cost when disasters transition from ER into OO. This means that the MSU usage can be seen and utilized in the light of the current disaster phase. Finally, during the *recovery* phase, in situations with multiple MSUs for collaborative storage, they may be gradually dismantled in order to smoothly scale down capacity of operations when a decision to discontinue has been made. These recovery decisions and activities link back to the preparedness, where the cyclic nature of the MSU lead them to the next deployment. Currently, however, we see that these decisions and activities are made more with recovery than with preparedness in mind.

The relative importance of the identified decision parameters have not been the focus of this thesis. However, we can see that operations value parameters differently. This is due to OSCs, different disaster phases, or different priorizations. The parameters should thus not be seen as equally important for all operation, but rather as the perspectives that need to be taken into consideration when making decisions. Every operation and decision maker should, strategically, choose to emphasize the parameters that helps reach the objectives of that operation. Several identified parameters are highlighted as differently important for ER and OO, due to the relative importance of time and cost, implying that using the current phase of the disaster as an indication for what parameters to use, and what weight to assign them, could be valuable.

We have found several differences between the studied instances in both activities, but foremost in decision parameter, all which have been discussed in Chapter 5. These are relatively small and the generalization process was done without big changes, except in the area of loan and donations of the MSU. We have identified that the MSU can be loaned or donated either as a means of fulfilling the responsibilities and mandate of the Logistics Cluster, or as a downscaling of Logistics Cluster activities in the area of operations. These two different ways of viewing loan and donation creates low generalizability of parameters. We have also identified that different operations have very different definitions of whom to loan or donate an MSU to, something that also decreases the generalizability.

6.2 RQ2: How do humanitarian contextual factors influence challenges to collaborative MSU activities and decisions in humanitarian logistics?

After reviewing literature regarding the humanitarian context and how it affects supply chain management in the humanitarian sector, we grouped these into eight overall factors that are presented in general in Chapter 2 and in detail in Appendix 1. With the activities and decisions for collaborative MSU usage from

RQ1 we identify 36 challenges which are presented in Table 10, and investigate the causational relationship between the factors and challenges, which is presented in Table 11.

We can conclude that the most prevalent contextual factors affecting the challenges to collaborative MSUs are *internal factors* (almost half), relating to the internal mindset and resources (people, tech, capacity, money) of the humanitarian organisations, and the *poor operating conditions* (almost half), in terms of political, geographical and physical environment. The internal factors are interesting as they are in large factors that the humanitarian actors themselves can control, implying that many of the current challenges with MSU usage could be heavily mitigated by looking into the own operation. Such challenges as "finding time and space to do inbound quality control", "maintaining erection competence in the organisation", "unloading from trucks" that are only caused by internal factors, should in theory be possible to completely avoided. The operating conditions describes the environment of the humanitarian operations, and, as it is the contextual factor that spans over the largest portion of the context, especially on non-strategic level, it should come as no surprise that many challenges are found to be influenced by this factor. These contextual factors are often well known to the humanitarian organisations and mitigating actions for these challenges are in most cases already operational.

It is interesting to note that only around a fifth of the challenges were caused by *actor complexity*, which is the contextual factors that characterize the collaborative context of the MSU, implying that the results of this thesis might be more generalizable to all MSU usage in HSC than what we set out to achieve. This conclusion is even more interesting, when seeing that none of these challenges are solely connected to the *actor complexity*. It has already been proven by previous research that collaborative storage is beneficial in many ways, but the challenges of doing storage collaboratively have not been explored. Even though this thesis does not include all forms of collaborative storages, the very few instances of challenges caused by the collaborative context, and that none of them are caused by it alone, implies that there are very few drawbacks to collaborative storage in general and to collaborative MSUs in particular.

The reason why only one of the challenges were connected to *stakeholder complexity* is presumably that this important complexity in relation to financial streams is more present at the strategic level. The *goal of relieving humanitarian suffering* is also only connected to one challenge. However, as previously discussed, the importance of time in the HSC can be partly connected to almost all of the challenges, as it is generally harder to do things the more limited your time is. It is important to understand this in relation to the discussion about different MSU purposes and usages in different disaster phases discussed in Section 6.1.

We identified that four activities were directly connected only to the MSU characteristics and was not affected by the context in any way, meaning that these challenges would be as important in e.g. a commercial context. We also found that the vast majority of other challenges are more or less connected to

the MSU characteristics, meaning that these as well probably would have an impact on MSU usage outside the HSC.

6.3 Contribution to practice

In this Section the contributions to practice will be described through a discussion of the findings that destills to 14 propositions for improved MSU usage.

6.3.1 Discussion

6.3.1.1 MSU modularity and flexibility

Modularity is a key feature of the MSU, yet it is currently commonly stored and deployed in the standard sizes in which it is bought, rather than in its 10x4m modules. When deploying in this manner, land is not fully utilized, and since the lack of good locations is seen in several challenges, this might be a bottleneck to efficient utilization. The tradeoff is the simplicity of handling only standard sizes to deploy. The benefits of viewing the MSU as a modular resource basing storage on MSU modules, rather than storage as whole MSU kits, will be elaborated in the following paragraphs. Proposition: *View MSUs as 10x4m modules and deploy, dismantle and store them in these modules.*

The temporary setting and flexibility of the MSU enables revision of decisions throughout the operation, perhaps specifically relating to its location/position and capacity. Given how crucial the time aspect is in ER, MSUs can be deployed rapidly with a roughly estimated capacity and then be subject for future revision once better assessments have been made. As seen from the literature review, uncertainty is a distinguishing factor of HL and being able to utilize this aspect of the MSU as a means of dealing with this issue can have great value. The modularity mentioned above makes this type of decision postponement easier, as long as other constraints are taken into consideration (such as ventilation and stability). Proposition: *Postpone decisions regarding deployment and purpose until the setup decisions are made.*

Reluctance to discard entire MSUs has been identified in several interviews, probably caused by a notion to use resources as efficiently as possible. However, it may be a more efficient usage of resources to know the quality, and thus, throwing away (or recycling) damaged or incomplete sets of MSUs. The incomplete sets of MSUs are shown to create storage problems in and around warehouses. They create handling inefficiencies, which lowers flexibility and speed of future deployment decisions and deployments, which is one of the more important aspects of MSUs usage. For instance, not knowing the quality of an MSU causes the need for outbound quality control, which slows down deployment, and poor quality MSUs complicate erection, which in turn can cause operational problems when deployed. Circling back to the discussion about modularity, it would be possible to increase the willingness to get rid of poor quality MSU modules, rather than whole sets. Even though scraping MSUs for spare parts is a good idea, it should be done according to a strategy for storage of these items (e.g. amount of parts to store, and to only store spare parts

that can't be sourced locally). To create a routine for recycling, or even prearrange disposal agreements with local companies, would lower the bar for deciding to dispose of MSUs.

Continuing the discussion on outbound quality control activity in the "In stock"-stage and how it slows down MSU deployment, we have found that quality control is currently made both inbound and outbound. Even though an OO characterized operation might not currently need the extra speed, the risk of an ER in these operations still exist. To make sure that no outbound quality control is needed, the inbound control needs to be systematic and correct. But this might not prove sufficient. Since we have identified the challenge of making sure that no parts are lost during storage, the outbound quality control might be needed as long as that challenge is not overcome. Following the discussions regarding modularity and recycling, this challenge might be mitigated enough so that, with a systemic inbound quality control, outbound quality control will be redundant. Within this discussion it becomes important to clarify how and when MSU maintenance is done, where both on and off site have been observed. Proposition: *Formulate a lowest acceptable quality for MSU parts and create a routine for recycling*, and *try to advance quality control from outbound to inbound in "In stock"-stage.*

At the same time as MSU decisions can be revised later, it can be concluded that they tend to be made at the latest possible point. As with HL in general, this may be caused by the low accessibility of information. Arguably, the common logistics services provided by the Logistics Cluster are meant to be a last resort type of solution when no other options exist, but given the potential of the MSUs through their unique flexibility and modularity, their deployment can be more prepared. This can mean to prepare decisions to a certain extent before they have to be made, which could also increase the tactical aspects of them. Connecting this to our conclusion, it would mean that decisions made in decision point (1) to (7) should be moved forward to (0). For instance, if the decision can be revised easily, one could in preparedness formulate a strategy of deploying a set amount of MSUs. Then in the ER situation, in response, the set amount of MSUs are deployed directly, with the possibility of revising once the situation has stabilized. Another, larger area where this mindset could be applicable is when discussing exit strategies, which has also been highlighted as important in literature. The decisions related to recovery (such as the donate or loan decisions), could probably be made in preparedness. Proposition: *Advance decisions from decision point after deployment has been made to before when possible.*

6.3.1.2 Erection, discontinuing and dismantling

As seen from literature, the DMC defines different properties and priorities for the different phases of the disaster. We argue that the MSU performs best early in a disaster, when time is the most crucial factor and the flexibility of the MSU can be best utilized. As the disaster matures, the focus shifts to cost, where operational efficiency is more important, and, as has been shown previously, this is not the strong suit of the MSU. This should be taken into consideration both when deploying and discontinuing, as well as when making improvements to the MSU.

The main reasons to deploy and to discontinue is the absence, respectively presence, of commercial and/or permanent warehouse facilities. One of the current key tellings of this is the need of the partner organisations, but this is not always true. Since partners are storing for free in the Logistics Cluster MSUs, they have no incentive to investigate commercial solutions on a strained budget, both with regard to time and money. The better the service provided by Logistics Cluster, the lesser the incentives to investigate other solutions. In other words, partner utilization of the service provided might not decline even though commercial sector has increased its capacity, if the partners are not actively looking for these types of resources. To be able to understand the need of collaborative MSUs, the Logistics Clusters could themselves conduct these kinds of investigations, and in turn help partners move their operations to a commercial and/or permanent warehouse solution. Helping partners have been identified as a challenge, and one way of not having to deal with that challenge is to avoid it. However, if integrated as a part of the Logistics Cluster's MSU operations, and made clear to partners from the beginning, acting this way might even mitigate the current challenge. Proposition: *Conduct own assessments of commercial and permanent warehouse facilities, and in turn help the partners to move their operations to a commercial and/or permanent warehouse solution.*

Situations of low storage utilization is also addressed in different ways. Some operations always dismantle as soon as possible to preserve the quality of the MSU, whereas other operations keep MSUs erected with low utilization. Erecting and dismantling are identified as activities where the MSU is especially teared. Given the challenges connected to them, we propose that MSUs should be kept up rather than dismantled even though utilization is low. Proposition: *Do not dismantle MSU unless it is needed elsewhere or the operations is discontinuing.*

The way the interviewees talk about dismantling an MSU is interesting. The process of dismantling an MSU is described as the opposite of erection and the competence and experience needed as erection dito. When training in erecting and dismantling MSUs, it is unanimously described as "erection training" with the purpose of building "erection competence". This implies that the focus of Logistics Cluster is and have been erection, rather than erection and dismantling. Even though proper erection has been proven vital, precise

dismantling can too be very important as a part of the preparedness phase for future disasters. Proposition: *Increase awareness of the importance of correct dismantling.*

How to perform the erection is also addressed differently in different operations. As was seen from global insights, cooperation with specialized external teams might ensure faster and more consistent erections, which in turn mitigates operational challenges. This could also free up competent and experienced personnel to other parts of the operations. Having these agreements in place prior to disasters may also lower the time of getting necessary competence on site for erection. It also enables the possibility of specialization of these teams, for instance by ensuring cranes on delivering trucks. Ensuring land and erection permission is also proven challenging, which suggests that pre-agreements with government and/or land owners also could reduce erection time, which is also supported in reviewed literature as a crucial part of the preparedness phase. Proposition: *Make pre-agreements for transport, erection and land usage.*

6.3.1.3 The warehouse adds value

The Logistics Cluster is clear with only offering storage and transportation services, but some partners wish that the Logistics Cluster's responsibilities extended to more than these most basic tasks. The Logistics Cluster takes responsibility for the goods while in storage, and maybe this responsibility should also include other activities that might be best suited to be performed at the warehouse. Literature shows that public warehouses often perform value-adding activities, indicating that the collaborative nature of the MSU might not impede the Logistics Cluster. Previous research has shown that collaboration has a positive effect on many activities in the HSC and that warehousing in general should be viewed as more than a supporting function. This, together with the fact that the Logistics Cluster already has resources and structures for areas and personnel in place, shows that limited extra efforts could have a positive impact on the HSC as a whole. Two distinguished areas of activities that can be performed collaboratively in warehouses, and that are done in some operations already, are kitting of goods and quality control of incoming goods. Proposition: *Consider expanding the value-adding and supporting activities offered to partners in collaborative warehousing to e.g. kitting and quality control of incoming goods.*

Another challenge that we have identified relates to the quality of secondary packages, which is mentioned as important in existing literature and is even more important due to the humid environment of the MSU. It is challenging to get partners to invest in secondary packages that would not directly benefit the partner, but the SC in general, and the handling that the Logistics Cluster does on their behalf in particular. When in field, daily controls of stackability and quality is found to be done in only one of the observed operations. This mitigating action should be standard procedure. Proposition: *Discuss and stress the importance of good quality secondary packages for warehousing operations with partners.*

6.3.1.4 Collaboration and prioritization

The collaborative context of the Logistics Cluster operated MSUs poses challenges related to prioritization of goods in the daily operations. Given the restricted amount of storage space, not all requests can be accepted. On the aggregated level, goods belonging to clusters that OCHA/ISCG have prioritized, such as shelter or nutrition, are accepted at first hand. After this, we have found no precise routine for how goods prioritization is continued. Strictly following the humanitarian principles would imply that the consignment with highest impact for beneficiaries always should be prioritized. However, the most efficient use of collaborative warehousing is not necessarily that which satisfies the most beneficiaries directly. For instance, collaborative measures should be prioritized to organisations that can not themselves fill the gap; or, since knowing the partners' future need of warehousing is challenging, accepting one large consignment might imply denying future unknown requests. Furthermore, the mistrust towards large UN agencies/NGOs as identified in the literature could be increased if a request from them would be accepted over a request from a smaller partner. There is also an instance of prioritization of goods to handle once they have arrived, for instance of multiple trucks should arrive at the same time. Proposition: *Create a standard of operations for prioritizing incoming requests for storage.*

6.3.1.5 Warehouse routines and resources

When comparing SOPs and routines to practice, multiple gaps are found. In general, SOP fulfillment, which involves partner organisations, is regarded as more important. In the instances where SOPs are not followed, often involuntarily from the Logistics Cluster, the distinguishing limitations of the MSU as a public warehouse (i.e. limitations in terms of total storage time and services provided) are blurred and the MSU becomes more and more similar to a contract warehouse, i.e. a 3PL. Which does not necessarily have to be undesirable, but then it should be done as a conscious choice. Routines linking to daily maintenance and safety (e.g. regular inventory, control of stackability and covering with tarps) in the MSUs generally have larger gaps (e.g. as discussed in Subsection 5.4.1), which in turn affect the performance of the MSU. Responsibility of compliance to routines fall on the Warehouse Managers. The identified challenge "Maintaining efficiency in poor operating conditions" pinpoints this very discussion. Linking this to the critical competencies for Warehouse Managers identified in literature, we conclude gaps, not only regarding ensuring compliance to internal policies, but through our observations we also see discrepancies for multiple other areas. Issues relating to labour resources is thoroughly described in humanitarian logistics literature and is addressed in the discussion of contextual factors in Chapter 2 (Subsection 2.2.1).

We also conclude the absence of any information management system to support the warehousing operations. Availability of storage in the MSUs is tracked through a whiteboard dashboard, but given the reluctance to follow routines, these are seldom up to date, making decision making even more difficult. The mentioned software RITA is very limited, and as it is updated manually, and does not span the entire warehouse operations, it is not regarded a full WMS. The scope of RITA only stretches as a means of

displaying and managing data of the operation internally, as well as give partners information about their respective assignments, both with the purpose of providing a better service for the partner organisations. However, linking to the difficulties in competence and contextual factors, introducing a WMS is not currently regarded feasible. Resources to aid in eliminating manual labor intensive tasks, such as entering information into RITA (i.e. as RFID tags or barcodes) are not used. Although barcodes could for instance eliminate manual information, this is not regarded as a relevant focus for improvement measures. Given the aforementioned difficulties relating to competence, we conclude that greater improvements in MSU efficiency could be gained through competence building of Warehouse Managers. Proposition: *Increase organisational focus on aligning and improving Warehouse Manager competences.*

6.3.1.6 Other considerations

One point where interviewees disagree is whether or not an MSU can be sold. Several interviewees, especially those that are more operational, stated that selling is a viable option that also has been implemented. Those who remain doubtful towards selling MSUs generally claim that it will be a complicated situation given that operations are donation-based and that donation of MSUs should be the obvious option. Those who are more open towards selling MSUs claim that the money gained can be reinvested in the operations, thus enabling further relief activities, which is the very goal of the humanitarian operations. We will not concern ourselves with discussing if selling MSUs is a good option, but merely conclude that the Logistics Cluster should have a single clear direction of this. Another area where the interviews differs is what organisations are eligible for a donate and/or a loan of an MSU, differences are for instance found relating to whether the military is a viable option or not (which can also be seen in the decision parameters). Once again, we do not concern ourselves with what is right, but conclude that the Logistics Cluster need a clear direction of this. Proposition: *Make a decision on, and give clear direction internally of whether or not an MSU can be sold, and what type of organisations are eligible for a donation and/or a loan of an MSU.*

Finally, as many of the challenges are connected to internal factors these can and should be addressed internally. Specifically interesting to discuss are the challenges connected only to internal factors. Some of these have already been addressed previously in this Section, but we encourage Logistics Cluster to internally discuss how all of these challenges in particular can be addressed. Proposition: *Discuss mitigating tactics and actions particularly for the challenges connected to internal factors.*

6.3.2 The 14 propositions

Following the discussion and conclusions from above we distill 14 proposition to Logistics Cluster for improved collaborative MSU usage. These propositions are based on our insights into MSU usage and are not yet scientifically verified. These can be considered for improving and rethinking MSU usage.

1. View MSUs as 10x4m modules and deploy, dismantle and store them in these modules.
2. *Postpone decisions from decision points regarding deployment and purpose until the setup decisions are made*.
3. Create a systemic strategy for quality control of MSUs.
    a. Formulate a lowest acceptable quality for MSU parts and create a routine for recycling.
    b. Try to advance quality control from outbound to inbound in "In stock"-stage.
4. *Advance decisions from decision points after deployment has been made to before when possible*.
5. Conduct own assessments of commercial and permanent warehouse facilities, and in turn help the partners to move their operations to a commercial and/or permanent warehouse solution.
6. Do not dismantle MSU unless it is needed elsewhere or the operations is discontinuing.
7. Increase awareness of the importance of correct dismantling.
8. Make pre-agreements for transport, erection and land usage.
9. Consider expanding the value-adding and supporting activities offered to partners in collaborative warehousing to e.g. kitting and quality control of incoming goods.
10. Discuss and stress the importance of good quality secondary packages for warehousing operations with partners.
11. Create a standard of operations for prioritizing incoming requests for storage.
12. Increase organisational focus on aligning and improving Warehouse Manager competences.
13. Make a decision on, and give clear direction internally of whether or not an MSU can be sold, and what type of organisations are eligible for a donation and/or a loan of an MSU.
14. Discuss mitigating tactics and actions particularly for the challenges connected to internal factors.

6.4 Contribution to research

This thesis has explored the usage of collaborative MSUs in the HSC through evaluating their activities, decisions and challenges, and their relation to the DMC and the humanitarian context. It contributes to research by creating a theoretical understanding of this previously unexplored area, how it is linked to the DMC and how the properties of the MSU can be utilized during its phases. Building on the activities and challenges, this thesis also explains the influence of the humanitarian contextual factors to the challenges of collaborative MSU usage. We have found that the collaborative warehousing of Logistics Cluster is very similar to the public warehouse described in commercial logistics and through this, we are able to highlight the most interesting areas for deeper and more focused studies (see Section 6.5).

Through using the DMC as a tool for analysing the MSU cycle, we have been able to understand different purposes and functions of the MSU in different phases of disasters. This contributes to research on the disaster as a cycle, as it uses the MSUs to illustrate the cyclic nature of the disaster and how the different MSU activities and decisions occur in the different phases.

Even though we can not say for sure, the results of RQ2 might, as discussed in 6.2, be more generalizable than our initial aim. A majority of challenges appears to be connected to humanitarian operations in general, and these should thus be applicable also in all MSU usage in the HSC. Furthermore, several challenges are connected solely, or in great part, to the MSU characteristics rather than the humanitarian context, and these should thus be applicable also MSU usage outside the HSC (e.g. in commercial SCs).

This conclusion is even more interesting, when seeing that none of these challenges are solely connected to the actor complexity. It has already been proven by previous research that collaborative storage is beneficial in many ways, but the challenges of storing collaboratively have not been explored. Even though this thesis does not include all forms of collaborative storages, the few instances of challenges caused by the collaborative context and that none of them are caused by it alone, implies that there are very few drawbacks to collaborative storage in general and to collaborative MSUs in particular.

The fact that very few challenges are connected to that the MSU is operated collaboratively is, as discussed in 6.2, yet another theoretical evidence to support collaboration in general and the usage of collaborative storage in particular. Research has previously proven it to beneficial but have not elaborated on the drawbacks. The concluded challenges connected to actor complexity (i.e. “prioritizing what storage requests to accept and deny”, “prioritizing what truck to serve first in case of congestion”, “getting owners of goods to perform quality checks”, “kitting wrongly kitted items”, and “returning warehousing responsibility to partners”) can be seen as the drawbacks to compare the proven advantages against.

6.5 Further research

For further research, it might be of interest to continue investigating NGO consortia operated MSUs. As cycle-stages of the MSU cycle should be similar in that context, conclusions from this thesis could be used as a starting point for such a study. It might also be relevant to investigate operations of MSUs employed by one humanitarian actor for their own storage purposes. Many activities, decisions and challenges should be applicable in both cases. As discussed in Section 6.4, it would be interesting to further investigate how the results of this thesis can be even further generalized in several directions.

This thesis has mainly focused on tactical level decisions and challenges connected to tactical and operational level activities. To get a holistic view of MSU usage, one could investigate MSU connection to

the strategic level decisions and challenges, and in what way tactical activities can be used to mitigate strategic challenges.

We have identified important decision points and relevant parameters to consider. It would be interesting to further investigate how these decisions affect the operations of the MSU, as well as other parts of the HSC. One could also investigate how this result can be integrated in a decision support system. We have concluded that the identified parameters are not equally important in all operations, but that they are connected to the current phase of the disaster. A study on how these different parameters affect different operations, partly or fully using the scale from ER and OO to understand their importance, would contribute greatly.

We have found that the collaborative warehousing of Logistics Cluster is very similar to the public warehouse type. This study has not gone into depth in this area, but the results point to it being interesting to further develop on how theories on public warehouses can be applied to collaborative warehousing in the humanitarian context. With this knowledge one could expand the general area of collaboration in the humanitarian context by using literature on the role of public warehouses in commercial SC, to understand collaborative warehousing in the HSC.

We have also summarized potential improvements and discussion points for collaborative MSU usage within the Logistics Cluster. Some of these areas might also be of interest for further discussion within academia. Understanding the relative importance, proposing solutions or merely depthen the questions and discussion. Finally, one way of enhancing our results would be to make an analysis on the relative importance of the different challenges and how these vary over the DMC and in different operations. One way of doing this could be to connect the concluded challenges with risks and assessing these.

6.6 Limitations

Data was only collected from two operations and from a global perspective. This could create a shortage of data, meaning that the thesis is missing relevant insight due to lack of data. Furthermore, since humanitarian actors are usually very busy, it was a challenge to, within the given time frame, gather a sufficient amount of data. This is reflected in the relatively small sample of interviews conducted. Thus, especially when reviewing challenges, that what is not found, presented and concluded, should not be seen as is unexisting.

For this thesis, the main data collection method was conducting interviews. Data from the interviews are in their nature biased. One gets answers based on the posed questions, and there could be many reasons why interviewees, both consciously and unconsciously, skew the answers in certain directions. This was mitigated by in field observations, but since the observations were conducted in only one operation, and only during a limited period of time, the impact of the interviews were still large. An issue with describing current usage is how to handle discrepancies in activities between what was found in interviews and what

was observed in the field. The way we framed activities takes the observed reality into consideration, but it can be argued that these discrepancies might have been local in time and/or operation or caused by something for us unknown. Since our observations were based on a short period of time and in one single operation, the found discrepancies could also be a sign of larger discrepancies which in turn could make substantial parts of our results useless.

Finally, no partner organisations were interviewed during this thesis. As owners of the goods stored in the collaborative MSUs, these organisations could have contributed to understanding how the MSUs are used. Insight into the partner perception of the Logistics Cluster services offered could have given an interesting contrast to many of the identified activities, decisions and challenges.

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Appendix A - The humanitarian context

Table 12: The studied humanitarian context summarized.

Sources: [1] Kovács & Spens (2007); [2] Oloruntoba (2005); [3] Van Wassenhove (2006); [4] Oloruntoba & Gray (2006); [5] Beamon & Balcik (2008); [6] Holguín-Veras et al. (2012); [7] Beamon & Kotleba (2006a); [8] Kovács & Spens (2009); [9] Balcik & Beamon (2008); [10] Mora-Ochomogo, Mora-Vargas & Serrato (2016); [11] John, Ramesh, & Sridharan (2012); [12] Abidi, De Leeuw, & Klump (2013); [13] Tatham & Spens (2011); [14] Yu et al. (2015); [15] Kunz & Reiner (2012); [16] Seekins (2009); [17] McLachlin & Larson (2011); [18] Seybolt (2009).

Topic	Aspect	Detailed aspect
Poor operating conditions	Political environment [3][10][2][16]	Often large scale disasters with many nationalities [2]
	Safety [3][6] and Security [2]	
	Geographical environment [3]	Different needs in different countries [2] Weather [15] Topography, vegetation etc [15]
	Physical environment [3]	Damaged physical infrastructure [6][13][14] Roads [10] Hard to access [2] Absence of communication infrastructure [13][10]
	An impacted social system and networks [6]	Damaged virtual infrastructure [6]
	Local cultural context [10]	
High uncertainties	Supply [3]	Scarcity of resources [10] Unsolicited donations [6][10] Need of prioritizing goods [6] Low ability to choose suppliers, leads to unwanted suppliers [1] Supplier development needs are high, but specifically hard [10]
	Demand [3][6][7][10]	Unpredictability of demand, in terms of timing, location, type and size [9][7][14] Suddenness of occurence [9] Surging demand at SCs weakest point [6]
	Assessments [2][3][13]	Limited transparency (tracking and tracing) [6][2]
	Logistics	Unknown capacity in transport corridors [6] Low operational control due to emergency [1]
Temporary and dynamic	Temporary SCs [3][14]	
	Dynamic [3] and sometimes improvised SCs. [6]	
	No periodicity and volume of log activities [6]	Non-repetitive [10]
Internal factors	Low strategic mindset [3]	Poorly defined manual processes [3] Little standardization [6][10] Fire fighting mentality [3]
	Supply of people, tech, capacity, money [9]	Low tech equipment [3]
	Labour pool size [11]	Varying human resources, both in size and experience. People along the SC doing different activities/multitasking. [10]
	High staff turnover rate [3][13]	
Stakeholders	Many stakeholders [3]	Accountability - transparency [3][12] Hard to coordinate stakeholders [10] Stakeholder communication and information [2]
	Media attention [3][8][10]	Need for media partnership [2]
	Incentives	No capitalistic incentives [3] Misaligned incentives [5]
	Dependency to donors [6]	Donor constraints [6] Donor uncertainties [10] Matching in kind donations to need [2] Unsolicited donations [6][10]
	Low beneficiaries power [6]	Low beneficiaries involvement. [4]
Values and principles	Humanitarian principles [3]	Ethical aspect of neutrality [12]
Actor complexity	Many different actors with different mandats and focuses [3][1][8]	Difficulty in aligning different actors without compromising mandates [3] Low clarity in roles [2]
	Interfering and competing SC [6]	Lack of inter-actor standards [13] Material convergence [6] Need of prioritizing of goods [6]
	Poor collaboration [6][2]	Asymmetrical power relationship [17] Mutual dependency to donors [18]
	High fragmentation [6]	Information sharing [2]
Goals	Relieve suffering [1]	Striving to achieve social purpose or mission [5]
	Availability of right quality goods [12]	Time is the most crucial factor [1][6][9][10]
	Double bottom line [5]	Direct measuring of deprivation cost [6]

Appendix B - Interviewees

Table 13: List of interviewees.

Role	Perspective	Questionnaire modules	Research part	Date	Length
Logistics Coordinator	Malaysia	Unstructured	Pilot interview	2019-02-12	1:00 h
Warehouse Manager	BD	Unstructured	Pilot interview	2019-02-12	1:30 h
Global Coordinator	Copenhagen	Unstructured	Pilot interview	2019-02-01	1:30 h
Information Management Officer	BD	Deployment, Dismantling	Interview	2019-04-05	0:30 h
Warehouse Manager	BD	Erection, In operations, Dismantling	Interview	2019-03-18	1:00 h
Logistics Cluster Coordinator	SY	Deployment, Transportation, Erection, Dismantling, After dismantling	Interview	2019-03-15	1:00 h
Information Management Officer	SY	Deployment, Dismantling	Interview	2019-03-18	0:20 h
Warehouse Manager	SY	Erection, In operations, Dismantling	Interview	2019-03-17	1:00 h
Logistics Cluster Coordinator	Iraq	Deployment, Transportation, Dismantling, After dismantling	Interview	2019-04-16	0:30 h
Logistics Officer	DRC	In stock, Deployment, Transportation, Operations, Dismantling, After dismantling	Interview	2019-04-15	0:45 h

Appendix C - Interview guides

In stock

1. Do you stock keep MSUs?
2. What activities do you perform with the MSU is stock?
3. Are there any challenges connected to the MSU while it is in stock? What are the main challenges while the MSU is in stock?
4. Do you control the quality of an MSU before deployment?
5. What kind of extra equipment/addons do you have and use?

Deployment

1. Why do you deploy a collaborative MSU?
2. How detailed is the initial decision to deploy an MSU?
3. Who is the next decision maker?
4. How do you decide on specifications for the MSU?
5. From where do you deploy an MSU?
6. What is the most challenging part about making an MSU deployment decision?

Transportation

1. What are the challenges of transporting the MSU?
2. Are there any different challenges when transporting before and after operations?

Erection

1. How do you determine the exact position to build an MSU?
2. How do you determine the set up for the MSUs?
3. Who builds the MSU?
4. What is the most challenging part about erecting an MSU?

In operations

1. Stock-keeping (**daily operations**)
    a. Describe a working day in the warehouse.
    b. Describe your main challenges in stock-keeping.
2. What **value adding activities** do you perform in the warehouse (outside of the daily operations)?
    a. Follow-up questions based on answer.
    b. Describe your main challenges in the value adding activities.
3. What **supporting activities** do you perform in the warehouse?
    a. Follow-up questions based on answer.
    b. Describe your main challenges in the supporting activities.
4. Inventory check
    a. When and how do you do inventory checking (/stock-taking)?
    b. What kind of problems do occur?
    c. Describe your main challenges in inventory checking.
5. Maintenance/cleaning
    a. Describe your maintenance routines.
    b. Describe your main challenges in maintenance.

6. Security
    a. What security measures do you take?
    b. Describe your main challenges in security.
7. Training
    a. What kind of training activities do you do within the MSU?
    b. Describe your main challenges in training.
8. Management
    a. Describe your relationship with the partners using the MSU.
    b. When and how are requests for storage and retrieval handled?
    c. Describe your main challenges in management.
9. Quality control
    a. Do you do any quality control of incoming or outgoing goods?
    b. What activities do you do to preserve the quality of stored items?
    c. Do you dispose of faulty goods?
    d. Describe your main challenges in quality control.

Dismantling

1. Why do you dismantle an MSU?
2. Is there any specific dismantling procedure?
3. What is the most challenging part about making a dismantling decision?
4. What is the most challenging part about dismantling an MSU?

After dismantling

1. How do you decide to keep or throw away the MSU?
2. Do you ever donate an MSU?
3. Do you ever loan an MSU?
4. If you keep it, whereto do you transport the MSU?
5. If you keep it, do you do any activities with the MSU before storing it when its off site?

Appendix D - Summary of empirical findings for activities and decisions

Table 14: The activities performed with the collaborative MSU when in stock as found in SY and BD (QC = quality control). Capital 'X' indicates that the activity is found in the operation.

Activity	Description	BD	SY
Erection training	Erecting and dismantling the MSUs to create know-how/experience in erection and dismantling within Logistics Cluster and its partner organisations.	X	X
Preparedness training	Training to quickly remove tarps for the case of cyclone.	X	
Maintenance	Change damaged parts using spare parts from old MSUs or spare parts from supplier, or salvage damaged MSUs for non-damaged parts to become spare parts for new MSUs. Remove rust from stakes. Clean and repair tears in the tarp.	X	X X
Inbound QC	Counting the parts and inspect quality after fixing the issues identified on site.	X	X
Storage	The MSUs are stored in country for contingency and preparedness purpose.	X	X
Outbound QC	Counting the parts before sending out on site.	X	

Table 15: The activities performed with the collaborative MSU when in operations as found in SY and BD. Capital 'X' indicates that the activity is found in the operation, lower case 'x' indicates that the activity was found in the interviews but disconfirmed during observations. (continued on next page)

Activity	Description	BD	SY
Erection	Local daily workers erect the MSU supervised by a person with technical competence and erection experience. Inviting partners to participate to build erection competence. Depending on the soil, drilling expertise is needed.	X X	X X X
Foundation	Creating a solid foundation for the MSU. Digging drainage, filling with sand/gravel/shingle if there is a risk of flooding. The floor can be cemented/bricked or pallets can be used to raise the floor from the ground. Concrete blocks to anchor the frame in case of cyclone.	X X X	X X
Management	Receiving requests for storage and deciding to accept or deny storage. Receiving and handling requests for dispatching goods. Tracking goods in RITA and through stock cards.	X	X
Material handling	Goods are received, handled and put away manually by daily workers, supervised by a managing person. Goods are stored for partners. Goods are picked and moved onto trucks (or similar) manually by daily workers, supervised by a managing person.	X X X	X X X
Training	Training to remove tarps quickly. Fire fighting and first aid training.	X	 X
Quality control	Performing quality checks preferably together with the partner that owns the goods. Continuous quality check on goods. Random goods inspection.	X	 X X

Kitting/ packing	Kitting/repacking wrongly kitted goods.	X	
Security	Security guards. Fences/walls. Continuous dialogue with local police. Fire fighting system. Video surveillance.	X X X X X	X X X X
Goods control	Monthly inventory checking. Cover goods with tarp in the end of working day. Daily control goods stability.	x x	X X
Maintenance and cleaning	Daily cleaning (including weed control). Continuous control of MSU conditions. External quarterly general repair of MSU.	X	X X X
Dismantling	Local daily workers dismantle the MSU supervised by a person with technical competence and erection experience. Cleaning of tarps and control the quality of MSU. Replace or repair damaged parts. Mark and separate part or whole MSU if bad condition, and counting parts.	X X X X	X X X

Table 16: Decisions and parameters identified in the different operations and from the global perspective

Gen. = Generalised?

Res. = Reason for generalising (1. SY+BD; 2. SY/BD+global; 3. Context; 4. Characteristics; 5. Negligible if irrelevant: 6. Other), see Section 3.2 for detailed method.

(continued on next page)

Decision	**Parameters**	**BD**	**SY**	**Global**	**Gen.**	**Res.**
To deploy MSUs?	Need of warehousing Urgency of need of warehousing No permanent buildings available No commercial storage available	X X X	X X X X	X X X X	X X X X	1 1 1 2
Amount and size?	Size of need of warehousing Space available Variety of commodities	X X	X X X	X	X X X	1 1 6
Location of deployment?	Type of land (e.g agricultural, government owned) Erection permits Space available (at least two MSU and maneuver space) Access to good roads Proximity to beneficiaries Topography (flooding resistance, flat) Cost of land Distance to possible contamination (plantations, sewers) Space for scaling up	X X X X X X	 X X X X	 X X X X X X	X X X X X X X X X	5 3 2 1 1 1 5 5 3
Procure new MSU?	Amount of MSUs in country stock	X	X	X	X	1
From where to deploy?	Proximity of deployment location Access to deployment location Urgency of need of warehousing	 X	X X	 X	X X X	5 1 5
Internal or		X		X	X	2

partner implemented?						
Who erects (WFP or erection company?	Cost. Need of internal competence elsewhere		X X	X X	X X	2 2
MSU position within location?	Truck maneuver space Distance to fences Distance between MSUs Leeward/wind direction	X X 	X X X X	X 	X X X X	1 3 1 3
Erected size?	Space available Standardized length Ventilation (no more than 14 modules) Stability (no more than 14 modules)	X X 	 X X X	 X 	X X X X	5 1 4 4
Laying out sand/gravel?	Topography Type of soil	X X			X X	3 3
Cementing/ bricking the floor?	Need of efficiency Time horizon of operations Type of soil	X X 	 X	 	X X X	3 3 3
Anchor the frame in concrete?	Type of soil Area prone to heavy winds	 X	X 	 	X X	3 3
To discontinue current MSU operations?	Declining activity in the MSU. Permanent structures available. No more need of warehousing. Commercial services available Other partners in area discontinuing Condition of MSU (no longer operational) Requested by partners	X X X X	X X X X X X	X X X X	X X X X X X	1 2 1 6 3/4 1
Replace/repair or salvage as spare parts?	Condition of parts/MSU Amount of damaged or missing parts	X X	 X	X 	X X	2 1
Loan MSU?	Time horizon Specific single partner need No existing collaborative storage Feasible location Urgency of need of warehousing Amount of potential users	X X X	 X X 	 X X 	 X X X X	 2 3 5 5
Whom to loan to?	Capability to run the MSU Logistics Cluster partner	X 	 X	 	X 	3
Donate MSU?	No more operations in the area Time horizon (over 1 year) Condition of MSU Specific single partner need	X 	 X 	 X X X	 X X	 2 5
Whom to donate to?	Capability to run the MSU Partner need Humanitarian purposes Organisation type (partner, military, government)	X X 	 X	 X 	X X X	3 6 6
Throw away?	Condition of MSU		X			

Appendix E - Summary of empirical findings for challenges

Table 17: Challenges identified in the different operations and from the global perspective.

Gen. = Generalised?

Area of challenges	Challenges	BD	SY	Global	Gen.
"In stock"	1. Frames and tarps need to be sourced globally.			X	X
	2. Finding time and space to do inbound quality control.			X	X
	3. Making sure no parts are lost during storage.	X		X	X
	4. Maintaining erection competence in the organisation	X	X	X	X
Transport	1. Getting government travel approval.		X		X
	2. Finding secure transport corridor.		X		X
	3. Making sure no parts are lost in transport.			X	X
"In operations" Erecion/ foundation	1. Having erection competence on site.	X	X	X	X
	2. Unloading from trucks.	X		X	X
	3. Finding construction labour.		X		
	4. Finding construction labour at the right price.		X		
	5. Erecting correctly.	X	X	X	X
	6. Finding the time to cement.		X		
"In operations" Handling	1. Prioritizing what storage requests to accept and deny.	X			X
	2. Transportation arriving on wrong dates.	X			
	3. Prioritizing what truck to serve first in case of congestion.	X			X
	4. Operating with untrained staff.	X			X
	5. Maintaining efficiency in poor operating conditions.	X	X		X
	6. Maintaining warehousing procedures/standards.	X	X		X
"In operations" Supporting	1. Vulnerability to vehicle accidents.		X		
	2. Finding secure location and position.		X		X
	3. Leakage due to wrongly erected MSU.	X	X		X
	4. Keeping the MSU stable if the ground is loose.		X		X
	5. Humidity affecting secondary packages.	X	X		X
	6. Humidity affecting goods.	X	X		X
	7. Maintaining quality of food.		X		X
	8. Cross contamination.		X		X
"In operations" Value adding	1. Getting owners of goods to perform quality checks.	X			X
	2. Kitting/packing wrongly kitted/packing items.	X			X
"In operations" Dismantling	1. Getting the right parts into the right boxes.	X	X	X	X
	2. Correctly assessing the condition of parts.	X	X		X
	3. Removing damaged parts without damaging other parts.		X	X	X
	4. Returning warehousing responsibility to partners.		X	X	X
	5. Having dismantling competence on site.			X	X
Decision points	1. Finding suitable land.	X	X		X
	2. Getting government permission to erect.	X			X
	3. Finding land with the right topography.	X	X		
	4. Getting government approval to import MSUs to country stock.	X	X		X
		X			X
	5. Finding suitable position within the location.	X	X	X	X
	6. Assessing future need of warehousing.	X		X	X
	7. Assessing future supply of warehousing.				

Table 18: Empirically found challenges in the different activities (QC = quality control).

Activity	**Challenges**	
Preparedness training	No challenges identified.	
Maintenance	1. Frames and tarps need to be sourced globally.	
Inbound QC	1. Finding time and space to do inbound quality control.	
Storage	1. Maintaining erection competence in the organisation	2. Making sure no parts are lost during storage.
Outbound QC	No challenges identified.	
Transportation	1. Getting government travel approval. 2. Finding secure transport corridors.	3. Making sure no parts are lost in transport.
Erection	1. Having erection competence on site. 2. Unloading from trucks. 3. Finding construction labour.	4. Finding construction labour at the right price. 5. Erecting correctly.
Foundation	1. Finding the time to cement.	
Management	1. Prioritizing what storage requests to accept and deny.	
Receiving	1. Transportation arriving on wrong dates. 2. Prioritizing what truck to serve first in case of congestion. 3. Operating with untrained staff.	4. Maintaining efficiency in poor operating conditions. 5. Maintaining warehousing procedures/standards.
Storage	1. Maintaining warehousing procedures/standards.	
Shipping	1. Transportation arriving on wrong dates. 2. Prioritizing what truck to serve first in case of congestion. 3. Operating with untrained staff.	4. Maintaining efficiency in poor operating conditions. 5. Maintaining warehousing procedures/standards.
Security	1. Vulnerability to vehicle accidents.	2. Finding secure location and position.
Goods control	1. Humidity affecting secondary packages. 2. Humidity affecting goods.	3. Maintaining quality of food. 4. Cross contamination.
Maintenance	1. Leakage due to wrongly erected MSU.	2. Keeping the MSU stable if the ground is loose.
Cleaning	No challenges identified.	
Training	No challenges identified.	
Quality control	1. Getting owners of goods to perform quality checks.	
Kitting/packing	1. Kitting wrongly kitted items.	
Dismantling	1. Getting the right parts into the right boxes. 2. Correctly assessing the condition of parts. 3. Removing damaged parts without damaging other parts.	4. Returning warehousing responsibility to partners 5. Having dismantling competence on site.

Table 19: Empirically found challenges in the different decision points.

Decision points	**Challenges**	
Pre-deployment	No challenges identified.	
Deployment	1. Finding suitable land. 2. Getting government approval to import MSUs to country stock.	3. Getting government permission to erect. 4. Finding land with the right topography.
Purpose	No challenges identified.	
Set up	1. Finding land with the right topography.	2. Finding suitable position within the location.
Improvements	No challenges identified.	
Discontinuing	1. Assessing future need of warehousing.	2. Assessing future supply of warehousing.
After dismantling on site	No challenges identified.	
After dismantling off site	No challenges identified.	