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Evaluating the Effectiveness of Supply Chain Simulation Exercises in Public Health: A Case Study Perspective

School of Management
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MSc
Academic Year: 2024 - 2025

Supervisor: Ismail Abushaikha
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This thesis is submitted in partial fulfilment of the requirements for the degree of MSc in Supply Chain and Logistics Management
(NB. Remove if the degree award is based solely on examination of the thesis)

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Academic integrity declaration

I declare that:

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- that all content, including primary and/or secondary data, is true to the best of my knowledge.
- that all quotations and references have been duly acknowledged according to the requirements of academic research.

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Abstract

Accompanied by a United Nations Organisation, this thesis investigates how operational exercises (OpExs) contribute to learning and performance at individual, organisational, and systemic levels in humanitarian health supply chains, focusing on three large-scale OpExs in Malawi involving over 100 participants from more than 25 organisations. Leveraging the Knowledge Creation Theory (KCT), it examines how knowledge is generated, transferred, and institutionalised across these levels. A qualitative case study approach was used, combining key informant interviews, focus group discussions and document analysis.

Findings show that the operational exercises enhance preparedness through three linked pathways: building individual skills and decision-making confidence, embedding lessons into organisational routines and systems, and strengthening system-wide coordination via shared procedures, trust, and communication channels. However, training benefits are often short-lived if learning is not deliberately captured, codified, and shared. Cross-agency interactions emerged as more influential than internal processes for fostering systemic resilience.

The study extends KCT to humanitarian, high-pressure, multi-stakeholder contexts in low- and middle-income countries, revealing that learning cycles are iterative, adaptive, and shaped by scenario design, trust, and operational constraints. Practical recommendations are offered to improve OpExs design and reduce training transfer failure.

Overall, the research demonstrates that well-designed, context-specific OpExs can significantly improve the effectiveness and impact of humanitarian supply chains, thereby enhancing the timeliness and appropriateness of responses to crises.

Keywords:

Knowledge Creation Theory, humanitarian logistics, training evaluation, knowledge transfer, operational exercises

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Months ago, I was aiming for the moon by applying to Cranfield to join the Humanitarian Logistics module, today, I am going beyond the moon by completing a full thesis project on the subject. Writing this thesis has been an incredible journey, allowing me to complete an international double degree. Throughout this process, I discovered a part of myself that loves research, knowledge sharing, facing challenges, and contributing, however modestly, to a greater body of work.

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List of Abbreviations

DoDMA	Department of Disaster Management Affairs
ELT	Experiential Learning Theory
EPPP	Exercises for Pandemic Preparedness Plans
FDG	Focussed Discussion Group
GHS	Global Health Security
GLC	Global Logistics Cluster
HL	Humanitarian Logistics
HLO	Humanitarian Logistics Organisation
HSC	Humanitarian Supply Chain
KCT	Knowledge Creation Theory
KII	Key Informant Interview
LMIC	Low to Middle Income Country
LOT	Learning Organisation Theory
LRT	Logistics Response Team
MoH	Ministry of Health
OCHA	Office for the Coordination of Humanitarian Affairs
OLT	Organisational Learning Theory
OpEx	Operational Exercises
SECI	Socialisation Externalisation Combination Internalisation
TTF	Training Transfer Failure
UHC	Universal Health Coverage
UN	United Nations
UNDRR	United Nation office for Disaster Risk Reduction
WFP	World Food Programme
WHO	World Health Organization

1 Introduction

1.1 Background

Humanitarian health supply chains sit at the heart of crisis response, tasked with ensuring that life-saving commodities reach the right place, at the right time, in the right quantity. Yet the scale, frequency, and complexity of humanitarian emergencies are intensifying due to a combination of climate-induced disasters, disease outbreaks, geopolitical instability, and fragile infrastructures (Altay & Narayanan, 2022). This reality underscores the pressing need for supply chains that are *"faster, better, cheaper"*, able to deliver speed without sacrificing quality, and efficiency without eroding resilience (Gatignon et al., 2010).

Achieving this balance is far from straightforward. A well-functioning supply chain is an integral part of delivering an effective response (Van Wassenhove, 2006) as well as supply chain professionals are essential in orchestrating multi-actor responses and supporting national capacity, especially during crises (Altay & Pal, 2022; Ford & Schmidt, 2000). However, while some skills can be developed in the chaos of a live emergency, they should, eventually must, be tested and reinforced in advance.

Training therefore becomes not just a technical necessity but a strategic investment in preparedness. Humanitarian logistics training has been widely acknowledged as critical yet operationally challenging (Goffnett et al., 2013; Heaslip et al., 2019). One proven approach is the use of OpExs: structured, scenario-based simulations that allow responders to practice decision-making, coordination, and technical skills in a controlled but realistic environment (Gralla et al., 2015; Stuns & Heaslip, 2019). By enabling participants to fail safely, OpExs contribute to develop a strong, trustable and resilient humanitarian response and community.

Within this landscape, the UN sister agency with whom I've worked, plays a leading role. Recognised as the global leader in humanitarian logistics, the organisation is not only responsible for its own large-scale operations but also serves as the Global Logistics Cluster (GLC) lead, coordinating multi-actor

responses during major crises. As a result, training logisticians and other actors is fully within the remit of this organisation. However, it faces challenges related to the operational context and a lack of in-depth research on the subject, particularly regarding how this learning translates into effectiveness and impact at the humanitarian system level.

1.2 Problem Statement

Despite growing investment in humanitarian logistics training, several persistent gaps continue to undermine its long-term impact on organisational and systemic performance. Kovács and Spens (2011) identify one of the three core limitations in current training practices: the underemphasis on soft skills development, such as coordination, relationship building, and cultural competence, despite their central role in field operations. Second, Gralla et al. (2015) note that training outcomes are rarely evaluated, documented, or shared in a systematic manner. Third, perhaps most critically, a recurring "training transfer failure" (TTF) has been observed, whereby individuals struggle to apply newly acquired skills within their organisational context. This phenomenon has been applied specifically to humanitarian framework by Stuns and Heaslip (2019), who associate it with high staff turnover and the irregular, often delayed, opportunity to apply training in operational settings (Reddin et al., 2021).

In parallel, humanitarian supply chains rely heavily on tacit knowledge: undocumented, experience-based insights that are difficult to codify and transfer (Caballero-Anthony et al., 2021). This reliance on informal knowledge creates major continuity challenges in complex, multi-actor responses, especially where turnover is high and institutional memory is weak (Stuns & Heaslip, 2019). Therefore, the conversion of tacit knowledge into explicit, shareable practices is essential for scaling individual learning into organisational change.

From individual behaviours to organisational routines and system-wide coordination, understanding this multi-level dynamics of learning is central to assessing the long-term value of humanitarian training on the supply chain: *"How do people learn individually"; "how do organisations learn from its people"; and "how do systems learn from its constituent organisations"?* Yet a robust

theoretical understanding of how this learning occurs, how it is scaled, and under what conditions and mechanisms it becomes institutionalised is lacking.

1.3 Research significance

Recognising the need to understand how this experiential and individual knowledge can be retained, transferred, and institutionalised to build effective and impactful humanitarian supply chains, the UN body leading this study has proposed using the Knowledge Creation Theory (KCT) by Nonaka and Takeuchi (1995) and its Socialisation, Externalisation, Combination and Internalisation (SECI) model, as the analytical framework for this research. The KCT, never been used previously in humanitarian contexts, provides a dynamic framework for understanding how operational exercises in Low to Middle Income Countries (LMICs) is created, shared, and institutionalised within organisations, therefore evaluating how OpExs lead to improvements in Humanitarian Supply Chains (HSC). This framework was chosen because it aligns closely with the experiential and collaborative nature of OpExs, where learning often begins at the individual level but must be transferred to organisations then systems levels.

Theoretically, it extends the use of the KCT and SECI model to multi-stakeholder environments in humanitarian logistics, framing OpExs as structured environments for knowledge conversion rather than just training tools. It also identifies points where this process may break down, highlighting barriers to effective knowledge transfer.

Practically, the findings help humanitarian actors improve the design and follow-up of preparedness activities by showing how knowledge conversion supports coordination and responsiveness. The study also offers guidance on addressing common obstacles to knowledge retention, such as turnover and weak organisational learning systems.

This study contributes to both theory and practice by analysing how OpExs generate, transmit and convert knowledge in humanitarian supply chains. Although simulation-based training is well established, its role in knowledge creation remains underexplored. This research offers a theory-informed view of

how experiential learning from operational exercises can become institutionalised, understandable and improve logistics and supply chain effectiveness in real emergencies.

1.4 Aim and objectives

The aim of this thesis is to investigate how multi-stakeholder operational exercises contribute to individual, organisational and systemic learning, and how this learning(s) translates into improved preparedness and effectiveness of the humanitarian health supply chain.

The study seeks to assess the achievement of learning objectives, the perceived relevance of acquired knowledge, and observable improvements in real-world supply chain effectiveness and readiness.

The objectives are as follows:

1. Examine how learning progresses from the individual to the system level in humanitarian supply chains, identifying the skills developed and the mechanisms enabling this flow of learning.
2. Identify the barriers that hinder the progression of learning from the individual to the system level in humanitarian supply chains
3. Assess the applicability of the KCT framework to humanitarian operational exercises and identify the theoretical contributions of this study.
4. Develop recommendations to improve the design, implementation and impact of future humanitarian operational exercises.

1.5 Scope

This thesis focuses on the OpExs facilitated by the UN partner I engaged with, and co-hosts by the Ministry of Health (MoH) and the Department of Disaster Management Affairs (DoDMA) in Malawi between 2022 and 2024. Geographically, the research is then limited to Malawi, with particular emphasis on high-risk districts such as Nsanje, where these exercises were conducted. The analysis is situated within the domain of humanitarian health supply chain

management, and focuses on the intersection between individual learning, organisational change, systemic effectiveness and training transfer.

1.6 Thesis structure

Chapter one: Introduction

This section will describe the background of this research as well as determine the aim and objectives of the thesis and the scope of the research.

Chapter two: Literature review

A literature review is undertaken to gain an in-depth knowledge on the relevant concepts. This sets an important foundation for the establishment of an assessment framework.

Chapter three: Methodology

This chapter describes the methodology used in this research and explains the process of data collection and data analysis.

Chapter four: Analysis and Findings

In this chapter each objective will be addressed using the data and the approach mentioned in the methodology to identify an answer for every part of the question and to draw relevant conclusions.

Chapter Five: Discussion

This chapter contribute to the proposition building, challenging the previous findings as well as outlining the limitations of the research and identify areas for further research.

Chapter Six: Conclusion

Based on the analysis and findings result, this chapter will present the conclusion about the problem mentioned in the chapters above.

2 Literature review

In this chapter, we examine the context and constraints of the humanitarian supply chain, the strategy for preparing for health emergencies, and the role of knowledge creation theory, which forms the basis of our research.

2.1 The “human” component of humanitarian supply chains

2.1.1 Humanitarian Supply Chains

In humanitarian crises, supply chains are not just logistical systems, they are lifelines. Humanitarian supply chains operate under conditions of extreme urgency, unpredictability, and resource scarcity, often in politically fragile or geographically remote settings (Yadav, 2015). Their performance directly impacts lives, as every delay or inefficiency can result in unmet health needs or prolonged suffering. Understanding the underlying factors, patterns, and human reactions that dictate these responses is part of improving them (Yadav, 2015).

For Kovács and Spens (2007), referring to the ambitions of CILT (UK) HELP forum’s guiding principles, humanitarian supply chains could be defined as : *“Right people, equipment, material, in the right place, in the right sequence, as soon as possible, to deliver the maximum relief at the least cost – saved lives, reduced suffering and the best use of donated funds.”*

Emphasising on the ‘right people’ aspect of this definition and while traditional supply chain management focuses on managing the flows of products, finances, information, and relationships, Tomasini and Wassenhove (2009) expand this framework (figure 1) in the humanitarian context by introducing two additional flows: people ("bodies") and knowledge and skills ("brains"). According to the authors, an effective disaster supply chain management requires the integration of these five flows, therefore highlighting the importance of a well-designed operational system.

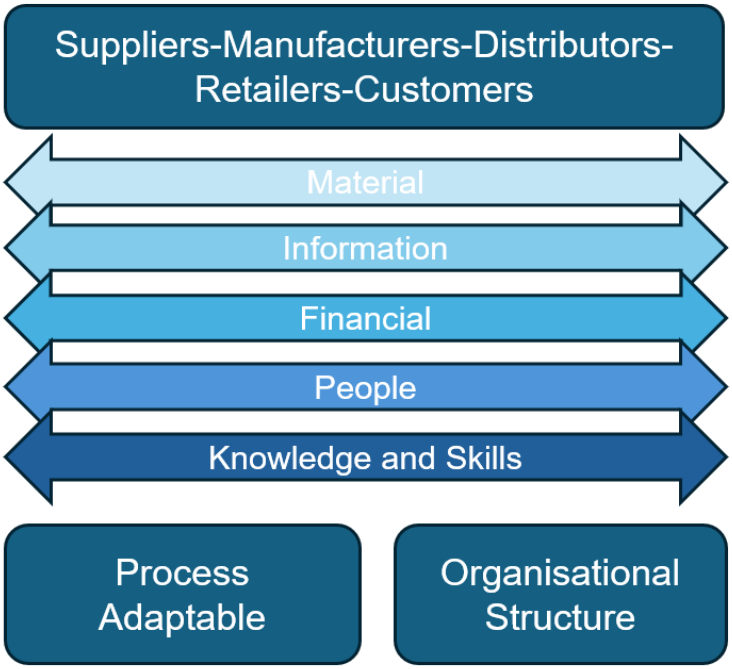

Figure 1 : The supply chain flow (adapted from Tomasini and Wassenhove, 2009)

Within this framework, the humanitarian supply chain response and therefore its *effectiveness* is typically defined as the supply chain's ability to deliver the appropriate assistance to the right location in a timely manner, whereas *impact* relates to the extent to which such operations enhance resilience and reduce vulnerability over time (Beamon & Balcik, 2008). Altay et al. (2018) further emphasise that responsiveness, agility, and coordination are key enablers of high-performing humanitarian supply chains.

Diving a little more in the context, preparedness pre-crisis activities aimed at enabling more efficient and coordinated responses, such as establishing networks, pre-positioning supplies, and building collaborative systems (Cozzolino et al., 2012; Balcik & Beamon, 2008). Investing in preparedness significantly enhances the efficiency of humanitarian response. Beyond logistics, preparedness requires coordination among stakeholders, where gaps in information sharing and unclear roles can hinder outcomes (Negi, 2022). Nonetheless, persistent barriers, such as outdated infrastructure and fragmented communication, continue to challenge the effective implementation of preparedness strategies (Pradeep Kumar Tarei et al., 2024).

2.1.2 Multi-stakeholder environment

Just as in humanitarian crises, supply chains are not just logistical systems, complexity is not merely logistical as well, it is social and institutional. Unlike commercial contexts with relatively centralised governance structures, humanitarian logistics unfolds within a dense web of stakeholders with diverging mandates, accountability lines, value systems but a need to cooperate. Drawing from stakeholder theory, Schiller et al. (2013) underscore the need for a structured, inclusive, and iterative approach to stakeholder identification, particularly when addressing complex, intersectoral challenges. Their framework highlights the multiplicity of actors each with a legitimate claim to influence or be impacted by operations. This stakeholder diversity, far from being a peripheral concern, is embedded in the very DNA of humanitarian logistics and supply chains, which must navigate not only physical terrains but also human, political, and ethical landscapes (Schiller et al. ,2013).

"As the name indicates, the centre and backbone of HL are people (lat. humanus - human)" mentioned Tadić et al. (2025). Humanitarian Logistics (HL) revolves around people, those who receive aid and those who deliver it. HL actors include both crisis-affected populations and service purchasers. According to Balcik et al. (2010), humanitarian relief environments engage international relief organisations, host governments, the military, public institutions, civil society organisations, practitioners, donors and private sector companies. Therefore, stakeholders in HL may be involved to varying degrees, having different interests, mandates, capacity, and logistics expertise (Tadić et al., 2025; Schiller et al., 2013). However, governments are primarily responsible in a disaster management. Through regulation, coordination, preparedness, they lead operations. Core actors such as humanitarian organisations, donors, logistics providers, and the military for example, will support national governments in their efforts to provide an effective response. Other contributors include media (information), academic institutions (training), private firms (service provision), and the public, who may offer support or receive aid, will also contribute to the efforts. Depending on capacity, Humanitarian Logistics Organisations (HLO) may manage activities internally or collaborate with external partners.

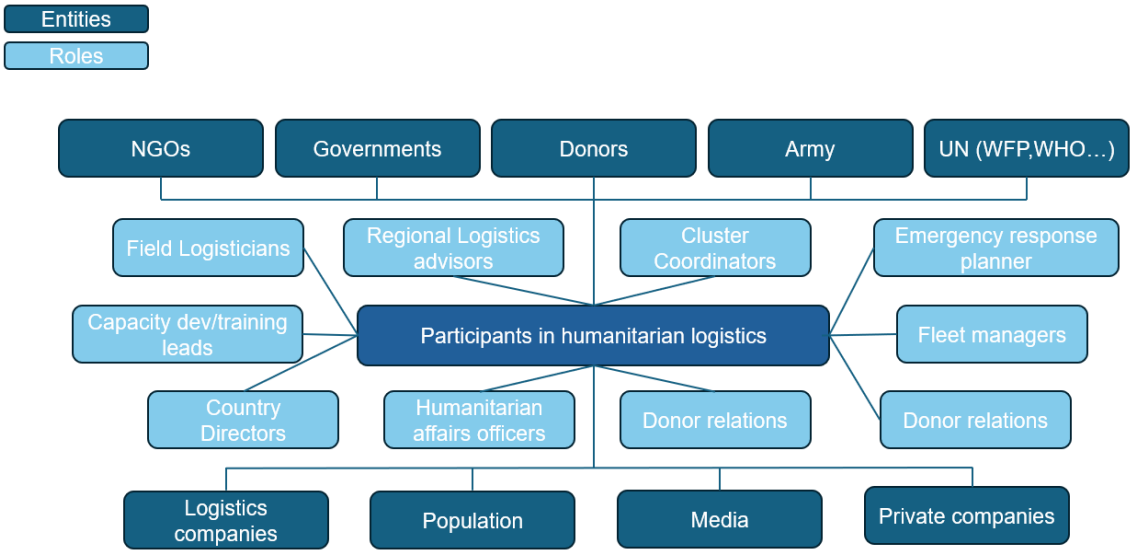

Figure 2 : Stakeholders in humanitarian logistics (author)

As shown in figure 2, the inherent diversity of actors in humanitarian supply chains can present both a source of strength and a major coordination challenge. As Schiller et al. (2013) highlights, effective multi-stakeholder engagement requires more than simply identifying relevant parties, it demands continuous negotiation of interests, shared structures, and communication mechanisms. Tomasini and Van Wassenhove (2009) argued earlier that without clear roles, mutual trust, and shared frameworks, fragmentation and duplication are likely to occur. This tension between interdependence and autonomy lies at the heart of many operational challenges in humanitarian logistics (Schiller et al., 2013). This thesis looks to explore whether a greater understanding of knowledge creation may contribute to addressing these endemic challenges.

2.1.3 Challenges

While significant efforts continue to be made to render humanitarian responses “faster, better, and cheaper” (Gatignon et al., 2010), the unique constraints of humanitarian operations such as uncertain environments, fragmented coordination, and resource scarcity, pose challenges to improvements in responsiveness (timeliness), effectiveness (quality), and efficiency (cost) (Kovács & Spens, 2009). Considering shifting geopolitical landscapes and increasing scrutiny over aid budgets (UN OCHA, 2025), the imperative for cost-effective and

agile supply chain operations is more pressing than ever. Central to this endeavour is the development of a capable, competent and well-trained workforce (Ford & Schmidt, 2000). The role of humanitarian logistics training has been widely acknowledged since its initial emphasis by Kovács and Spens (2011), who highlighted the need for both technical and soft skills in complex emergency settings. Since then, multiple studies have echoed the critical yet complex nature of training in this sector, underlining persistent challenges in curriculum design, delivery, and alignment with field realities (Goffnett et al., 2013; Heaslip et al., 2019).

Humanitarian supply chains operate under volatile and unpredictable conditions, where demand fluctuates in volume and location and reliable data is often unavailable. These factors require logisticians to design and implement supply chains in real time, often without adequate infrastructure or complete information (Kovács & Spens, 2007). Although national governments hold the formal mandate to deliver aid within their territories, their response capacity is frequently constrained, prompting humanitarian organisations to assume leadership roles in crisis settings (Dolinskaya, Besiou, & Guerrero-Garcia, 2018).

As Salem et al. (2022) argue, the performance of humanitarian operations increasingly depends on individual aid workers' ability to navigate uncertainty, coordinate across stakeholders, and maintain operational effectiveness despite limited resources. This highlights a critical shift: improving humanitarian supply chains is not solely a question of infrastructure or tools, but also one of preparedness and human capital. Regarding the current geopolitical trends, the importance of having efficient supply chains is an ever-greater topic. The next chapter therefore explores how preparedness strategies, particularly through the OpExs aim to enhance individual, organisational, and system-level readiness within humanitarian logistics.

2.2 Preparedness strategy

2.2.1 Humanitarian actors training

In humanitarian operations, the performance and adaptability of individual aid workers remain central to the success of emergency responses (Salem et al., 2022; Ford & Schmidt, 2000). Humanitarian logisticians are not only required to execute supply chain functions (e.g., procurement, inventory management, transportation), but also to demonstrate leadership, resilience, and the ability to collaborate across diverse organisations and cultures.

As defined by Murphy and Poist (1991, 1994) and Gammelgaard and Larson (2001), logisticians require three key skill groupings:

- Logistics technical skills (inventory management, transport, procurement)
- Management skills (planning, leadership, information sharing)
- Business skills (financial management, stakeholder engagement)

Training, therefore, emerges as a foundational mechanism to ensure that logisticians can meet the operational demands. As some studies underline, improving humanitarian operations largely depends on the acceptance and performance of individual aid workers (Abidi et al., 2020; Suzila Mat Jusoh et al., 2022). Consequently, capacity-building efforts must move beyond technical proficiency to also encompass the development of behavioural competencies such as adaptability, coordination, and leadership under pressure.

Salem et al. (2022) highlight that effective aid worker performance is not solely rooted in static knowledge but in an individual's ability to integrate personal adaptability with situational demands. This adaptability is often fostered through exposure to real-life or simulated crisis environments where learning occurs experientially. These training environments should be intentionally designed to mirror operational realities, including stress, resource scarcity, and the need for rapid inter-agency coordination, thus enhancing the relevance and application of the learning outcomes.

Furthermore, humanitarian logistics training must account for the interplay between individual learning and organisational preparedness. Well-trained individuals can drive coordination, reduce errors, and accelerate delivery timelines, all of which contribute to overall supply chain effectiveness (Beamon & Balcik, 2008; Ford & Schmidt, 2000). Yet, the impact of training is only maximised when it is embedded within supportive organisational structures that allow individuals to exercise leadership, make decisions, and influence practice on the ground.

As Adsanver et al. (2024) show, skills development must be approached from an integrated perspective, where preparation is based on the triple dimension of collaboration, coordination and cooperation (Triple C). Their study illustrates how these three components tend to create a common operational language, harmonise procedures and strengthen inter-agency response capacity. Beyond organisational structures, it is the entire system that benefits from such training. Effective inter-agency coordination and collaboration require that knowledge, behaviours, and tools developed within one organisation are not only internalised but also shared and adapted across others (Salem & Winter, 2025). Yet, recent study from CHORE (Salem & Winter, 2025) shows this remains uneven: in 2024, 58% of respondents reported their organisations consistently exchanged supply chain lessons with others, and 60% noted regular sharing of supply chain information, while only half indicated compatible information management systems. More critically, during 2023 and 2024, fewer than 50% reported engaging consistently in joint assessments, funding appeals, or supply planning with other humanitarian organisations. Without this broader diffusion, isolated organisational learning may fail to strengthen systemic resilience.

In humanitarian settings, the system itself is defined by the collective practices and interactions of individual organisations. Training exercises contribute to this by fostering cross-organisational learning, enabling actors to build trust, align procedures, and develop shared response strategies (Schiller, 2013; Salem et al., 2022). It is through these collaborative processes that organisational preparedness can scale into system-wide effectiveness, making the multi-

stakeholder nature of such trainings essential to improving humanitarian logistics performance.

Today, OpExs provide logisticians with a controlled environment in which they can safely make mistakes and learn from them (Pek et al., 2023), a process widely recognised as essential for building robust humanitarian response mechanisms (Gralla et al., 2015; Stuns & Heaslip, 2019)

2.2.2 Operational exercises

Within the field of training, the original classification used when describing tools for operational research is by Bradley et al. (1977), who differentiated four types, these being operational exercise, simulation gaming, simulation and analytical models. The first of these four, the ‘operational exercise’, is the most suitable description of the Malawi exercise, describing it as a “(research) experiment [that is] directly implemented in the real environment”.

According to the WHO (2017), OpExs have been recognised as a core element in emergency preparedness, as they provide organisations with a practical opportunity to develop, assess, and strengthen the functional capabilities required during public health emergencies. Through realistic and structured simulations, OpExs enable stakeholders to test emergency plans, clarify roles and responsibilities, and refine coordination among diverse teams and institutions (World Food Programme, 2024). This process not only helps identify weaknesses or gaps in existing procedures but also fosters a culture of continuous learning and improvement, ensuring that response mechanisms remain effective and adaptive in the face of evolving threats. As emphasised by the WHO (2017), these exercises are essential for building resilience and readiness within health systems, ultimately enhancing the capacity to respond efficiently to crises.

These exercises are immersive, field-based simulations designed to replicate the logistical and coordination challenges of large-scale humanitarian emergencies. Unlike conventional tabletop exercises or serious games (Gralla et al., 2015; Meesters et al., 2014), these reenactments are context-specific, reflecting the logistical constraints and institutional realities of Malawi’s emergency response

systems. Also, according to Gralla et al. (2015), immersive simulations also help build decision-making confidence and operational readiness among participants.

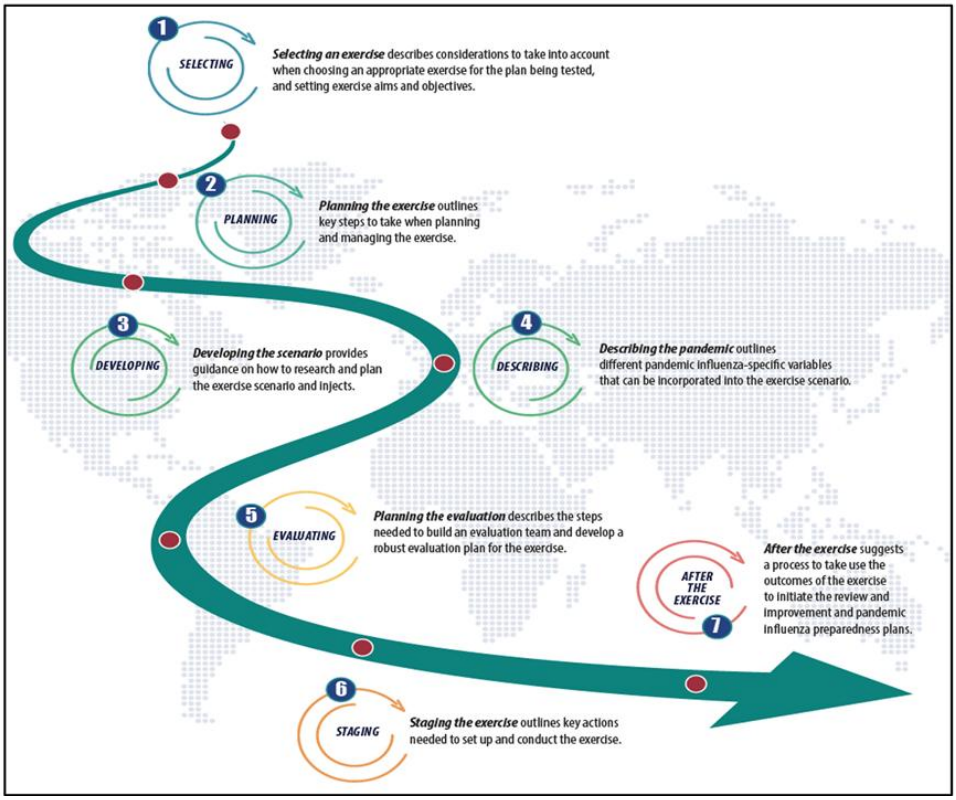

Figure 3 : EPPP's framework (Reddin et al., 2021)

The OpExs, while drawing substantially on this WFP's Response Training model (Gralla et al., 2015), form part of a long-term strategy developed in partnership with engaged countries and communities. They are globally aligned with the WHO's *Framework for Developing and Conducting Simulation Exercises to Test and Validate Pandemic Preparedness Plans*, with figure 3 illustrating the Exercises for Pandemic Preparedness Plans (EPPP). However, OpExs follow a distinct approach, particularly in their engagement with participants, as they are grounded in adult learning principles (Kolb, 1984), ensuring experiential, reflective, and context-relevant skill development.

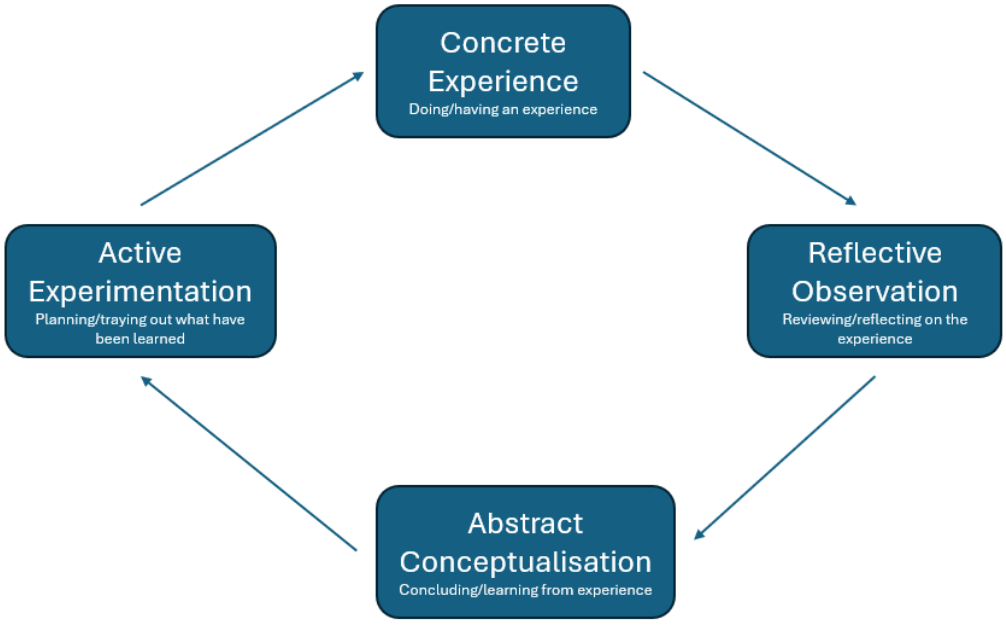

Figure 4 : The four stages of adult learning cycle (Kolb, 1984)

The relevance of Kolb's adult learning principles (1984) in the design of OpExs lies in its recognition that adults learn most effectively when they see clear value in what is being taught and when they are fully engaged in all stages of the learning process. The model highlights a four-stage cycle:

1. concrete experience,
2. reflective observation,
3. abstract conceptualisation,
4. active experimentation that facilitates not only the acquisition but also the internalisation of knowledge.

In humanitarian settings, where learning must translate directly into operational readiness, completing the full cycle is critical to ensure that individuals retain knowledge and can apply it instinctively in future crises. Kolb's approach thus supports the notion that true learning requires active engagement, reflection, and application, principles that OpExs are uniquely positioned to foster through immersive, scenario-based design.

Building on this pedagogical foundation, OpExs target specific individual and organisational capabilities necessary for effective humanitarian response. These

simulations intentionally develop both technical and relational competencies. The core learning objectives include planning, coordination, information sharing, and decision-making, skills that are essential for functioning in high-stakes, multi-stakeholder environments. In addition, OpExs offer participants the opportunity to identify operational bottlenecks and systemic weaknesses, particularly in logistics, communication flows, and preparedness planning. These outcomes not only reinforce individual readiness but also serve as critical entry points for broader organisational and systemic improvement.

In the context of disaster preparedness and logistics, the term *simulation* often refers to mathematical modelling techniques used to replicate the functioning of existing or hypothetical systems, enabling stakeholders to evaluate potential process changes or scenarios to support decision-making. This distinction is further elaborated by Reddin et al. (2021), who, in their post-COVID-19 evaluation framework, differentiate between *operational exercises* and *decision-based exercises*. Operational exercises are characterised as structured activities designed to test real-world components such as procedures, plans, technologies, interagency collaboration, tools, and command centre functionality. These include command post or functional exercises, field-based simulations replicating emergency response conditions, drills, and targeted skill tests such as evacuation, triage, or communication.

Finally, what makes the Malawi OpExs one of a kind is that, nearly identical emergencies have occurred soon after each exercise, allowing participants to apply newly learnt skills quickly. This rare, near *real-time validation* makes the OpExs an exceptional model in humanitarian logistics and health preparedness.

Please see table 1 for an overview of national emergencies in Malawi during the period in scope for this case study.

Emergency (type & name where relevant)	Duration (approximate)	Number of districts affected (approx.)	Number of people affected (approx.)	Source
Tropical Storm Ana	24/01/22 – 30/01/22	28	Over 990,000	Reliefweb, 2023
Cyclone Gombe	10/03/22 – 12/03/22	6	Over 100,000	Reliefweb, 2022
Cholera Outbreak	03/03/22 – 10/03/24	29	59,295 confirmed cases with 1,774 deaths reported	Reliefweb, 2024b
Malaria Outbreak	01/01/23 – 16/02/25	14	2,340 confirmed cases with 12 deaths reported	PMI Impact Malaria, 2024; WHO, 2025
Cyclone Freddy	12/03/23 – 21/03/23	29	Over 659,000	Government of Malawi, 2023
Flash Floods	04/03/24 – 06/03/24	1	Over 14,000	Save the Children, 2024
El Niño-Induced Drought	Jan ’24 – May ‘24	27	Over 9m	Reliefweb, 2024c
Cyclone Chido	14/12/24 – 17/12/24	14	37,740	PIH, 2024; The Guardian, 2024; ACAPS, 2024
Cyclone Jude	10/03/25 – 13/03/25	10	20,650	Reliefweb, 2025

Table 1: Overview of national emergencies in Malawi between 2022 and 2025

The concept of OpExs in the context of emergency response has been explored to some extent within the field of production and operations management. Gralla et al. (2015) marked a significant step in examining training practices within the humanitarian logistics community. Their work identified key principles of training design. Further exploration was carried out by Wagner and Thakur-Weigold (2018), who examined how simulation-based learning can enhance collaboration and efficiency across humanitarian supply chains. However, since these contributions, there has been limited academic engagement with the concept of OpExs in humanitarian logistics. The Malawi OpExs have integrated the four core

training competencies to emphasise soft skills development and apply the Kirkpatrick model (Skryabina et al., 2020; Pek et al., 2023) to assess, capture, and disseminate learning outcomes. However, despite these structured evaluation efforts, the persistence of TTF and the erosion of acquired knowledge remain evident within the exercises (ReliefWeb, 2024a).

2.3 The Knowledge Creation Theory

Organisational learning has evolved through several influential frameworks. Argyris and Schön in 1978 introduced Organizational Learning Theory (OLT), which emphasises learning from mistakes and the institutionalisation of knowledge. Kolb's (1984) Experiential Learning Theory (ELT) soon followed, focusing on learning through direct experience in a cyclical, real-world process. This was later complemented in 1990 by Senge (2013) with the Learning Organization Theory (LOT), which highlighted the organisation's capacity to learn through individual development. Building on these foundations, Nonaka and Takeuchi's (1995) KCT proposes that knowledge is created through the conversion between tacit and explicit forms and scales across individual, group, and organisational levels. It offers a dynamic framework for understanding how individuals and organisations generate, transform, and institutionalise knowledge.

At the heart of KCT lies the SECI model, see figure 2-7 which conceptualises knowledge creation as a continuous interaction between tacit knowledge, deeply embedded in personal experience and explicit knowledge, codified and shareable (Nonaka & Takeuchi, 1995). The model comprises four interrelated processes:

- **Socialisation** (tacit-to-tacit), individuals share experiences through direct interaction.
- **Externalisation** (tacit-to-explicit), individuals articulate their insights into formal documents, guidelines or training materials.
- **Combination** (explicit-to-explicit), sources of explicit knowledge are integrated into new policies, processes or systems.

- **Internalisation** (explicit-to-tacit), individuals apply new knowledge in practice and embodiment.

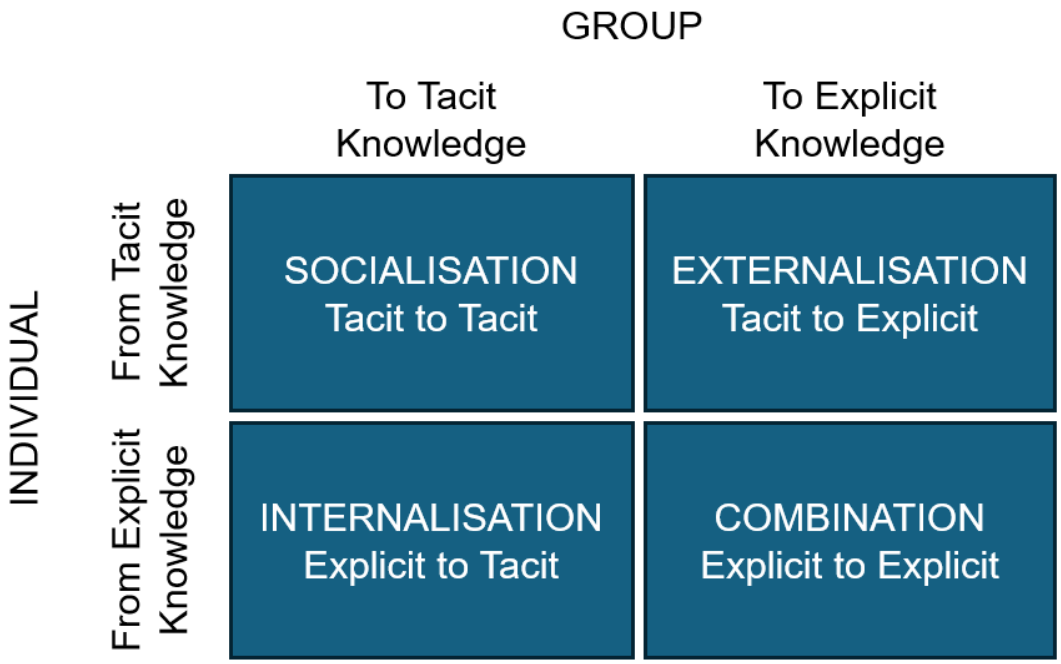

Figure 5 : Framework of Knowledge Creation mechanisms (Nonaka & Takeuchi, 1995)

Although KCT and its SECI model have been widely applied across various private sector contexts, its use in the public sector and moreover in HL remains limited and underexplored. For instance, Soo et al. (2003) demonstrate that the SECI processes are most effective when linked to problem-solving structures within organisations, highlighting the importance of creating space for dialogue and reflection, as seen in emergency simulations. Hong (2011) furthers this argument by emphasising that successful knowledge creation requires integration between individual and organisational levels, facilitated by institutional trust and clear procedural anchoring. These conditions are rarely guaranteed in humanitarian operations, making frameworks like SECI especially valuable.

A focused review of literature from 2002 to 2025 reveals only one article by Lis (2014) applying KCT directly within the humanitarian logistics field, therefore reflecting its use with regards to OpExs in military setting. This suggests that while KCT has proven its conceptual strength in capturing knowledge dynamics in

stable corporate environments, its application to the volatile, multi-stakeholder environments, high-stakes context of HL remains scarce. In the HL space, Tatham and Spens (2011) show how both tacit and explicit knowledge inform the functioning of logistics systems, a view echoed by Kusumastuti et al. (2021) and Along et al. (2022), who highlight these interactions and how much disaster-related knowledge remains informal and experience-based. Meanwhile, Caballero-Anthony et al. (2021) stress the importance of cultivating a culture of sharing alongside documentation to preserve institutional memory.

Mihi Ramírez et al. (2012) show that in public organisations, tacit knowledge is frequently lost when staff rotate or lack incentives to share expertise. Without structured mechanisms like SECI to transform individual insights into shared organisational memory, knowledge remains siloed. This limitation is echoed by Flores Torres et al. (2020) who observe that knowledge creation in disaster response is often ad hoc and under-institutionalised, calling for more formalised learning loops.

Additionally, Anand et al. (2009) highlight that the success of knowledge transfer depends on shared mental models and boundary objects such as tools, artefacts, or routines that support cross-stakeholder coordination. These findings are particularly relevant in multi-actor settings like humanitarian OpExs, where government agencies, NGOs, and technical partners must align operationally despite disparate mandates.

Therefore, despite the theoretical emphasis of the KCT and SECI model on the continuous transformation of tacit to explicit knowledge across different levels, very few studies examine these levels together within a single humanitarian framework. In fact, there is little evidence in current research of KCT being used in a truly multi-level, multi-actor environment such as that found in HL. This omission is significant given that the effectiveness of humanitarian operations depends precisely on the interplay between personal expertise, institutional practices, and systemic coordination (Tatham & Spens, 2011; Mutebi et al., 2022).

The gap highlights the importance of investigating how knowledge created during operational exercises is, or is not, translated across these three interdependent layers. In this regard, the Malawi OpEx offers a rare empirical setting to test the full dynamics of the SECI model across multiple stakeholder levels.

2.4 Conclusion

In conclusion, scholarly engagement with the use of OpExs in the domain of emergency response remains limited. Although KCT is well-established across various disciplines, its application within the context of humanitarian OpExs has been minimal. This gap is particularly notable given the theory's alignment with experiential learning and the practical demands of disaster preparedness. The lack of integration between KCT and OpExs therefore presents a valuable opportunity for empirical exploration. In the field of humanitarian logistics where knowledge is often tacit, difficult to transfer, and vulnerable to erosion, the systematic application of KCT could be a potential gamechanger.

3 Methodology

3.1 Literature review

A conceptual framework for analysing knowledge creation and transfer in humanitarian supply chains has been developed based on the literature review. As Ridley (2012) notes, literature reviews often serve multiple purposes. Chapter 2 provided the historical background and contextual understanding of humanitarian supply chains, with particular attention to stakeholder dynamics, collaboration mechanisms, and operational challenges. This laid the foundation for a deeper exploration of the preparedness strategy with the role of humanitarian logistics trainings and the role of OpExs as capacity-building interventions within the broader training ecosystem. Finally, the KCT was introduced within the field of organisational learning to frame how experiential knowledge is generated, retained, and institutionalised. This theoretical foundation directly informs the third and most critical research gap outlined in Chapter 1, namely, the issue of TTF.

To develop this literature base, an iterative search process was applied. Initial broad search strings, see table 2, were used to capture a wide scope of potentially relevant work before progressively narrowing the focus to the most pertinent sources. For validity purposes, the review was limited to publications between 2000 and 2025, ensuring contemporary relevance while allowing for inclusion of foundational contributions to the field. The main thematic areas covered through these 2 search strings included operational exercises, training in humanitarian contexts, the application of KCT, humanitarian supply chain and logistics, and knowledge management in crisis response environments. Alongside peer-reviewed sources, case-specific documents were extensively used to contextualise the analysis and gain a comprehensive understanding of the operational setting.

Search String 1	("operational exercises" OR "training exercises" OR "simulation exercises" OR "emergency simulation" OR "full-scale exercises" OR "experiential learning") AND ("humanitarian" OR "humanitarian logistics" OR "humanitarian supply chain" OR "humanitarian operations" OR "emergency response" OR "emergency logistics" OR "crisis response" OR "disaster response" OR "disaster relief")
Search String 2	("humanitarian" OR "humanitarian logistics" OR "humanitarian supply chain" OR "humanitarian operations" OR "emergency response" OR "emergency logistics" OR "crisis response" OR "disaster response" OR "disaster relief") AND ("knowledge creation theory" OR "KCT" OR "tacit knowledge" OR "SECI" OR "knowledge management" OR "knowledge transfer")

Table 2 : Literature review search strings

3.2 Theory Elaboration Case Study

This study employs a theory elaboration case study approach to explore how KCT can help mitigate TTF within humanitarian logistics training, specifically during OpExs. The design of the study closely follows the theory-driven content analysis on humanitarian logistics case studies conducted by Vega (2018) to

iteratively explore and adapt the case study's components and ensure consistency and rigour.

The research draws on the three Malawi OpExs conducted between 2022 and 2024 as a single case setting. A single case study design was chosen due to the well-established nature of KCT, the unique characteristics of the Malawi OpExs, and their longitudinal dimension across three consecutive exercises. This approach allows for a nuanced exploration of theoretical concepts within a real-world humanitarian context. By seeking out themes across the three OpExs, existing theory is made more testable (Eisenhardt & Graebner, 2007). Humanitarian logistics presents complex field conditions (Yin, 2018; Eisenhardt, 2021), such as high staff turnover (Stuns & Heaslip, 2019), delays in skills application (Reddin et al., 2021) and low procedural adherence (Comfort, 2007) that require methods sensitive to local realities. This approach reflects real-world challenges (Shaheen et al., 2024) and supports theory adaptation to context-specific conditions (Gioia et al., 2013).

The qualitative, exploratory nature of the chosen methodology permits inductive reasoning in support of the theory extension.

The design incorporates both inductive and deductive research processes as shown in figure 6 (Spens & Kovács, 2006; Wieland & Wallenburg, 2012), allowing for theoretical refinement grounded in empirical data.

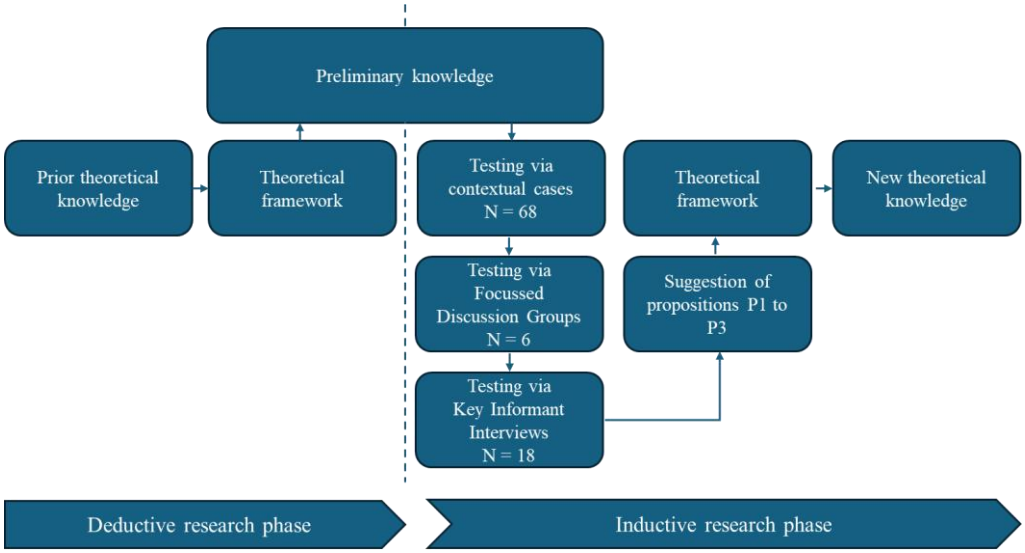

Figure 6 : Applied research design

3.3 Deductive Research Phase

Academic literature on KCT under-highlights the progression of knowledge from individual to organisational and then systemic levels. At the individual level, tacit knowledge is developed through socialisation and internalisation, forming personal expertise. Organisational learning occurs when these insights are externalised and combined into shared routines, contributing to institutional memory. Systemic learning then embeds this knowledge into networks, policies, and sector-wide practices, extending its impact beyond single actors (Nonaka & Takeuchi, 1995).

In LMICs, OpExs re often conducted with limited resources and tend to be informal (Safarpour et al., 2020; Salam & Khan, 2020). In such settings, peer interaction and experiential learning play a central role in both knowledge acquisition and retention (David, 2007). Informal learning mechanisms like socialisation and internalisation are therefore especially relevant for humanitarian logisticians, enabling them to reflect and apply knowledge more effectively than through formal, explicit methods.

At the organisational level, limited capacity to support externalisation and combination means that learning depends heavily on socially driven exchanges

and practice-based adaptation. This further emphasises the importance of tacit knowledge flows in low-resource environments.

A major obstacle to sustained learning is TTF, the gap between what is learnt and what is applied in the field. TTF is often caused by misalignments between training content and operational conditions, as well as limited organisational mechanisms for knowledge scaling and reinforcement. In LMICs, resource constraints and informal learning environments make traditional, explicit training models less effective (Safarpour et al., 2020; Salam & Khan, 2020). Therefore, peer-based and experience-oriented strategies are more likely to support lasting learning outcomes.

This study builds on these insights by investigating how knowledge generated through OpExs is captured and retained, and how it can be institutionalised to improve the effectiveness of humanitarian supply chains in LMICs.

3.4 Inductive Research Phase

3.4.1 Case selection

To examine how operational exercises contribute to knowledge creation and organisational learning within humanitarian public health supply chains, this study focuses on the Malawi OpExs conducted between 2022 and 2024. This case was selected because it is unique and exceptional. First, Malawi presents a relevant low-income country context, where humanitarian and public health supply chains are frequently tested by climate-related emergencies and disease outbreaks. Second, the Malawi OpExs are among the few documented simulation initiatives that are both field-based and embedded within national systems, offering a unique opportunity to observe multi-level knowledge creation in practice. Third, the exercises are co-facilitated by the UN institution with whom I've worked on this study, the MoH, and the DoDMA, and have engaged over 100 participants and facilitators across three editions to date, with a fourth underway at the time of writing. More than 25 international, national and regional organisations have been involved, including logistics officers, public health officials, and disaster managers and providing a rich and diverse setting to explore cross-agency

learning and stakeholders interactions. The three iterations of the OpExs simulate complex health emergencies such as cholera, measles, and flooding scenarios, making them highly suitable for analysing preparedness mechanisms and the transfer of experiential learning into organisational practices and systemic changes.

Given its contextual embedding, national ownership, and demonstrated linkages to real emergencies, the Malawi OpExs stand out as, the only simulation-based public health supply chain capacity-strengthening initiative of its kind on the African continent. It provides a rare and rich opportunity to observe how knowledge is created, converted, and institutionalised across individual, organisational, and systemic levels in a complex, resource-constrained environment.

3.4.2 Data collection

Guided by Yin (2018), the data collection process prioritised the integration of multiple sources of evidence to establish a clear chain of evidence and compile a comprehensive portfolio of case materials.

This study draws on three complementary data sources: archival case documentation, Focused Discussion Groups (FDGs), and Key Informant Interviews (KIIs). These three categories of qualitative data were collected across all three OpExs from early 2022 to mid-2025. The iterative data design supported theory development, consistent with Gioia et al. (2013)

The first data stream includes 68 internal and external documents produced before, during, and after the exercises, such as concept notes, invitations, after action review, for a total of 552 pages and 22 min. These materials served to reconstruct the learning environment and contextualise the mechanisms through which knowledge conversion may have occurred. Inclusion was based on availability, accessibility, and relevance, covering preparatory, operational, and post-exercise materials. See appendix B for an overview.

The second stream comprises six serial FDGs, held 14 months apart, involving 31 respondents from 16 organisations with direct involvement in at least two of

the three OpExs and lasting a total of 9h and 28 minutes. Participants and facilitators were selected based on involvement in at least two Malawi OpExs, whose participation in turn was predicated on prior involvement in previous emergency responses in Malawi, thus ensuring replicability and continuity. This longitudinal format using ‘serial’ FDGs, enabled the observation of changes in perception and organisational interpretation of learning over time (Baden et al., 2022). This longitudinal approach supports analysis of negotiation and shared meaning. See appendix C for details participants and appendix D for the FDG interview protocol.

Finally, 18 semi-structured KIIs were conducted, nine in 2024, then 14 months later, nine in 2025, with senior staff and people managers from 10 organisations. These interviews explored leadership perspectives on learning transfer, knowledge institutionalisation, and preparedness capacity. Although the broader data collection spanned three years, I personally participated in conducting the nine interviews held in 2025 alongside my company supervisor. All interviews followed a structured guide-protocol with strict attention paid to confidentiality. While interviews can introduce bias, they remain a focused and valuable method in case study research. See part 3.5 for more details on the KIIs.

This multi-source approach ensured triangulation, depth, and alignment with the study’s theory elaboration design, while allowing robust exploration of knowledge dynamics in a real-world humanitarian preparedness setting. See figure 7 and appendices for more details.

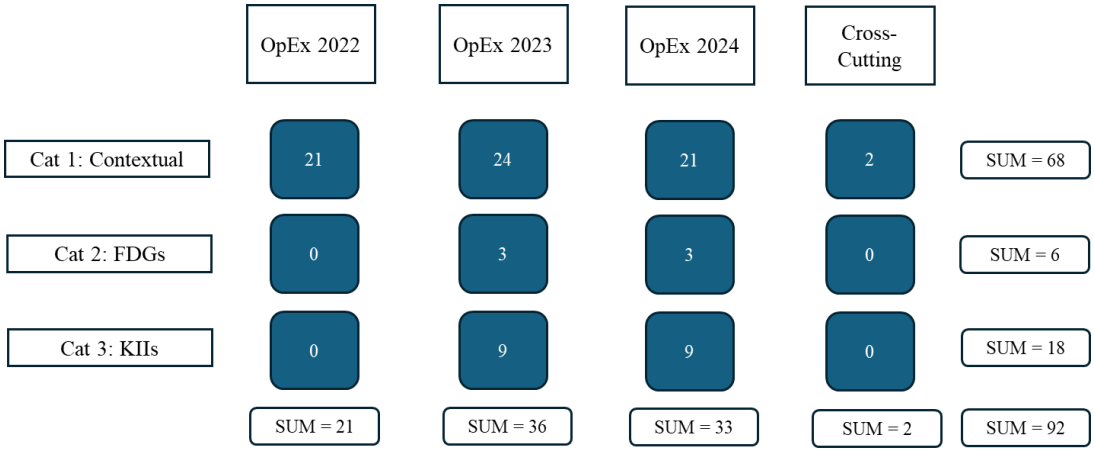

Figure 7 : Overview of data collection structure

3.5 Semi-structured interview

3.5.1 Use of semi-structured interview

Semi-structured interview is a form of the interview which is not structured and standardised completely. Due to the unstandardised characteristics, this form of the interview is commonly associated with the qualitative analysis.

3.5.2 Interviewee selection

The interviewee selection process was carried out in collaboration with the UN body team supporting this thesis, leveraging their direct network of national and regional stakeholders involved in the Malawi OpExs.

These interviews targeted senior staff and people managers from 10 organisations that had participated in at least two of the Malawi Operational Exercises. The decision to engage individuals in leadership and supervisory roles was deliberate, as these profiles are best positioned to reflect on the medium and long-term organisational impact of training, including how individual learning translates into team performance, operational readiness, and institutional routines.

It includes representatives from the MoH, the DoDMA, international organisations such as Malawi Red Cross and WHO, and various implementing partners at district and national levels such as VillageReach. This diversity ensured a broad spectrum of perspectives, reflecting on strategic functions.

Unique Interviewee Reference	Organisation	Job Profile	Date Held	Duration (minutes)
K.1	DoDMA	Relief Officer	27/02/2024	63
K.2	Ministry of Health – HTSS	Chief Pharmacist	28/02/2024	79
K.3	Ministry of Health - Health Cluster	Health Cluster Lead	26/02/2024	56
K.4	Malawi Red Cross	Head of Planning, Monitoring and Evaluation	27/02/2024	55
K.5	VillageReach	Senior Manager	26/02/2024	62
K.6	WHO	Supply Chain Specialist	26/02/2024	62
K.7	World Vision	Food/Cash Assistance Officer	27/02/2024	61
K.8	Ministry of Transport and Public Works	Under Secretary	27/02/2024	43
K.9	CMST	Branch Manager	29/02/2024	38
K.10	Ministry of Transport and Public Works	Under Secretary	03/06/2025	37
K.11	VillageReach	Senior Manager	30/05/2025	53
K.12	WFP	Logistics Officer	04/06/2025	28
K.13	Ministry of Health – HTSS	Chief Pharmacist	04/06/2025	38
K.14	WHO	Supply Chain Specialist	04/06/2025	40
K.15	Malawi Red Cross	Head of Planning, Monitoring and Evaluation	04/06/2025	40
K.16	Ministry of Health - Health Cluster	Health Cluster Lead	05/06/2025	24
K.17	VillageReach	Senior Manager Supply Chain	06/06/2025	32
K.18	CMST	Branch Manager	12/06/2025	22

Table 3 : KIIs Respondents

3.5.3 Interview protocol

The interview guide (see appendix E) was divided into five sections, each aligned with one phase of the SECI model and designed to explore different dimensions of knowledge conversion during and after the OpExs and on an individual level and organisational level.

In the first section, interviewees were asked to describe the behaviours they observed among team members during and after the OpExs, with a focus on informal knowledge sharing and peer learning. This aimed to capture evidence of socialisation and changes in individual practice.

The second section addressed how participants' learning was externalised and communicated within their organisations, including through reporting, presentations, or internal support activities.

In the third section, questions explored whether and how individual learning had been integrated into existing organisational tools, protocols, or systems, assessing how new knowledge was combined with existing explicit practices.

The fourth section focused on internalisation, examining whether these updated organisational practices were later reused or absorbed by others in the organisation, especially in response to real emergencies.

Finally, the fifth section asked interviewees to reflect on broader system-level change, such as improved inter-agency collaboration, preparedness capacity, supply chain effectiveness and recurring barriers that could lead to TTF, including resource gaps, misalignment with operational realities, or lack of leadership support.

3.6 Data Coding and Analysis

3.6.1 Data coding

Initial coding was conducted in parallel with data collection to allow early engagement with emerging themes. The process was informed by methodological guidance from Gioia et al. (2013) and aimed to explore how knowledge generated during Malawi's OpExs evolves from individual learning to

organisational and systemic change. This provided the basis for the formulation of an initial first-cycle coding manual.

The data analysis followed a structured and iterative process guided by the main analytical lenses of the research: the learning objectives of the OpExs, the key knowledge conversion processes of KCT and the multistakeholder collaboration model (Schiller, 2013). An initial open coding phase allowed for an exploratory reading of the data, during which emerging codes were identified and iteratively refined.

Coding was conducted using NVivo 14 to support the systematic organisation and traceability of insights. It was carried out collaboratively by my company supervisor and me with cross-checking and discussion to ensure consistency and agreement. The iterative nature of the process allowed for constant comparison between the data and theoretical while leaving space for interpretive insight.

As the analysis progressed, axial coding was used to cluster emerging codes into broader themes and subcategories. A final round of selective coding further refined these themes, incorporating elements from theory to better understand how participants interpreted and applied learning in context. This process enabled the identification of recurring patterns and conceptual links, laying the foundation for cross-case and within-case analyses.

3.6.2 Comparison and Data analysis

This study followed Yin's (2018) approach, applying multiple triangulation techniques to ensure rigour and validate the link between data and propositions. We analysed the data from each operational exercise together, systematically comparing emerging themes to identify recurring patterns and unique elements. Multiple data sources were used, and a diverse range of stakeholders were engaged to provide different perspectives. To further strengthen reliability, my supervisors and I, as two independent researchers, cross-checked the coding and discussed their interpretations, ensuring a shared understanding before consolidating the findings.

The coding process was organised following a structured data model. First-order codes captured descriptive elements directly emerging from the data and were grouped into 24 categories. These were then aggregated into 10 second-order themes that reflected more abstract concepts, which in turn informed four overarching theoretical dimensions. This structure supported a progressive abstraction from raw data to theoretical interpretation. The coding matrix was developed and refined iteratively, allowing for the emergence of salient mechanisms related to knowledge retention, loss, and the transition from individual to organisational and systemic learning. Therefore, an analysis is necessary for us to understand this data.

4 Analysis and Findings

This section presents the analysis and findings structured across three analytical levels, from descriptive to conceptual, following the structured thematic analysis method proposed by Gioia et al. (2013). This approach enabled the identification of key mechanisms of knowledge retention and loss while exploring how learning unfolds at the individual, organisational, and systemic levels.

The analysis is guided by the central research question: how can OpExs leverage KCT to enhance the effectiveness and impact of humanitarian health response? Four theoretical dimensions emerged from the data, each addressing a critical component of this process.

The previous analytical approach provided a transparent chain of evidence and offered an interpretive lens through which the findings could be grounded and compared. Table 4 presents an overview of the resulting data structure, which forms the foundation of the findings presented in the following sections.

First-order categories		Second-order themes		Aggregate theoretical dimensions	
1	Peer interactions and informal sharing post-training reinforce training objectives and supports learning.	a	Social engagement during and after training leads to stronger knowledge retention.	TD1	Individual learning in humanitarian logistics training is driven by social engagement, personal reflection and training realism.
2	Multistakeholder grouped exercises increase confidence to apply skills in the field.				
3	Post-training reflection helps connect concepts to real operations.	b	Reflective practices after training lead to practical, operational application of learning.		
4	Individuals apply lessons better when they debrief after training.				
5	Operational skills improve when training scenarios and curriculum are aligned with actual field realities and conditions.	c	Realism and contextual authenticity in training leads to enhanced professional performance.		
6	Learning is reinforced when individuals perceive training as practical and realistic.				
7	Training content embeds most deeply when shortly afterwards applied in a genuine emergency.				
8	Post-exercise feedback and reinforcement mechanisms help knowledge transfer, especially when openly discussed and endorsed by senior management.	d	Encouragement to externalise experiences leads to the refinement of organisational practices.	TD2	Organisational learning in humanitarian contexts is driven by a culture of externalisation and integration of experiences into collective routines and practices.
9	Learning is sustained when individuals are given space to share knowledge or train others.				
10	Debriefings across teams uncover process gaps and good practices.				
11	Organisational memory grows when training experience informs standard procedures.	e	Connecting training insights with organisational practices and routines leads to sustained learning outcomes.		
12	Lessons are retained longer when training is part of a wider strategic vision.				
13	Training insights are better embedded when organisations participate year-on-year.				
14	Joint trainings and exercises builds networks and develop trust.	f	Repeated collaboration across organisations leads to shared problem-solving.	TD3	Systemic learning in a humanitarian multistakeholder environment arises when diverse organisations collaborate and exchange insights.
15	Repeated engagement contributes to mutual understanding, helping organisations to understand each other's capacities, processes and anticipate each other's actions.				
16	Shared scenarios reveal common gaps and expose coordination bottlenecks across logistics systems.				
17	Inter-agency briefings allow ideas to circulate and evolve.	g	Cross-agency knowledge exchange leads to stronger collective practices.		
18	Cross-agency conversations lead to shared improvements in response planning.				
19	Knowledge is sustained when validated and adapted by multiple actors.				
20	Knowledge acquired in training, not embedded into daily workflows, is abstract or unrealistic.	h	Misalignment between training and operational realities prevents effective transition of knowledge.	TD4	Training Transfer Failure in humanitarian logistics training is exacerbated by misalignment, lack of organisational support and the passing of time.
21	Participating organisations nominate the wrong (too junior, too senior) calibre of staff.	i	Weak organisational support for humanitarian logistics training results in knowledge loss.		
22	Funding, organisational barriers, siloes or resistance to change prevent experimentation with new practices.				
23	Staff turn-over results in information loss.	j	Time delays and organisational changes contribute to the erosion of knowledge.		
24	Participating organisations show intermittent or once-off support for the exercise.				

Table 4 : Data structure of first-order categories, second-order themes and aggregated theoretical dimensions

4.1 Individual learning

4.1.1 Social engagement

Understanding the drivers of individual learning has long been a fundamental issue. Drawing on insights from our “knowledgeable agents” (Gioia et al., 2013), this study identified several distinct mechanisms that enhance the effectiveness of humanitarian logistics training. Both participants and their senior leadership emphasised the critical role of peer interactions and informal knowledge exchange following training sessions, which help to consolidate learning objectives and sustain the learning process. Additionally, multistakeholder group exercises were frequently highlighted as instrumental in building learners’ confidence to apply newly acquired skills in real-world operational contexts.

These observations align with the limited body of existing literature. For example, Bank and Khalil (2016) highlight how experiential learning activities in paediatric emergency settings can significantly boost participants’ confidence, an effect that persisted for up to six months post-intervention. Similarly, Pek et al. (2023), in their analysis of twenty training exercises, found that heightened participant confidence was a consistent outcome.

Building on these insights, this research advances the second-order theme that, within multistakeholder humanitarian training environments, active social engagement, both during and after training, plays a crucial role in enhancing knowledge retention.

4.1.2 Reflective practices

Another important dimension that emerged from the data concerns the value of post-training reflection. Respondents consistently noted that opportunities to reflect after training helped bridge the gap between theoretical concepts and their practical application in the field. Several participants also observed that individuals returning from OpExs demonstrated a greater ability to implement lessons learned when they had engaged in structured debriefings.

The academic literature broadly concurs on the value of reflective practices, particularly debriefing, in professional training contexts. As Weinstein et al. (2023) observe, such practices offer a structured opportunity for participants to critically evaluate and adjust their behaviours, decisions, and cognitive processes, thereby facilitating the integration of new learning into future professional practice. However, Pek et al. (2023) caution that the benefits of debriefing are often compromised by inconsistent or infrequent implementation.

This recurring pattern in the data underpins a distinct second-order theme: in this study's context, engaging in reflective activities after training is closely linked to the effective translation of learning into operational practice.

4.1.3 Realism and contextual authenticity

A further set of findings emerged from the case analysis, revealing several areas of strong consensus among respondents. Firstly, many noted that operational competencies improved most noticeably when training scenarios and curricula were closely aligned with real-world conditions. Secondly, participants reported that learning was more robust when training was perceived as directly relevant and applicable. Finally, it was widely observed that the retention and application of training content were greatest when new skills were used in actual emergency situations soon after training.

Theoretical perspectives lend support to this outcome. For instance, Weinstein et al. (2023) highlight that learning is significantly enhanced when participants are emotionally engaged in the exercise, which increases the perceived authenticity and, consequently, the retention of new knowledge. This emphasis on immersive participation is also evident in LRTs, where individuals are actively encouraged to fully engage in the simulation environment (Gralla et al., 2015).

Taken together, these findings reinforce the argument that training programs characterised by realism, contextual relevance, and a strong reflective component are more likely to yield improvements in professional performance (Pek et al., 2023). This leads to the articulation of a third second-order theme. As one interviewee articulated:

“And again, you know, part of that is to do with, if you're doing this in countries that don't have emergencies particularly. But because we've had so many in the past and significant ones, you know, I think that's where it, it really helps to. It is grounded in reality.” (K.16)

Synthesising these second-order themes reveal that, within informal multistakeholder contexts, individual learning outcomes are closely linked to processes of socialisation and internalisation, while the influence of externalisation and combination appears more limited.

“So for me I feel, socialisation and the informal teaching or learning is really very critical when we are planning to impart your knowledge or skills to people.” (K.13)

4.2 Organisational learning

4.2.1 Externalising the experience

Shifting from the focus on individual learning, our analysis next explored the principles of organisational learning as they manifest in humanitarian logistics training. Through an iterative review of the cases, three key insights were identified. First, respondents emphasised that feedback and reinforcement mechanisms following training are crucial for effective knowledge transfer, especially when these processes are openly discussed and actively supported by senior management. Second, it was frequently observed that learning is more likely to be sustained when individuals are encouraged to share their expertise or take on training responsibilities themselves. Third, cross-team debriefings were seen as particularly valuable for surfacing both process gaps and examples of good practice.

Established KCT theory (Nonaka & Takeuchi, 1995; Nonaka et al., 2000; Nonaka et al., 2008) positions externalisation as central to organisational learning and innovation. Our findings align with this but indicate that, in our context, effective internalisation requires deliberate, facilitated reflection rather than reliance on practice alone. Aligning with this, the second-order theme says that

encouragement to externalise experiences leads to the refinement of organisational practices.

4.2.2 Connecting training insights

A second, separate category of observations was identified, which observed three similar yet distinct clarifications. Whilst engaging with the respondents, it was firstly noted that the common view is that organisational memory grows when training experience informs standard procedures. Additionally, consensus appeared to exist in the notion that lessons are retained longer when training is part of a wider strategic vision. And, lastly, respondents repeatedly remarked that training insights are better embedded when organisations participate year-on-year.

The literature supports this emphasis on a sustained, embedded approach to training. Pek et al. (2023) recommend a long-term, incremental strategy to enable foundational learning at the individual and single-organisation level, while also fostering advanced capabilities across multiple organisations and national systems as experience with simulation exercises grows.

Taken together, these first-order insights converge on a broader second-order theme: aligning training outcomes with established organisational practices and routines is key to achieving lasting improvements in learning and performance. One of whom pointed out that:

> *"[T]his type of work already links to what our core strategy […] globally [is] pushing [us] towards. So it was very easy to articulate and link to our strategy." (K.5)*

Incorporating all perspectives on the concept of influencing factors on organisational learning outcomes in humanitarian logistics training, the analysis indicates that organisational learning is reinforced when individual experiences are externalised and combined with long term-organisational processes and preparedness.

4.3 Systemic learning

4.3.1 Repeated collaboration

Having explored individual and organisational learning, the analysis now turns to system-wide dynamics. Insights drawn from the case data suggest several mechanisms that contribute to the emergence of systemic learning within the context of humanitarian operations. Across interviews, participants consistently highlighted the role of joint training initiatives in fostering inter-organisational trust and connectivity. Recurrent participation in these exercises was also seen to improve mutual understanding of operational procedures and organisational capabilities, laying the groundwork for more coordinated responses. Additionally, shared simulation environments were perceived as instrumental in surfacing system-wide inefficiencies, revealing latent coordination challenges across public health and logistics structures.

Although much of the existing literature on operational exercises is grounded in middle- to high-income contexts, it does recognise the centrality of inter-organisational collaboration. Engagement with actors beyond one's immediate institution is associated not only with heightened exercise realism and efficiency (Harris et al., 2015), but also with greater cost-effectiveness and planning coherence (Alexander, 2005; Adsanver et al., 2024). Collaboration is further linked to trust-building and a more nuanced understanding of the capacities and limitations embedded in emergency response systems (Okunromade et al., 2019). These insights align with one emergent second-order theme from our data: repeated, cross-organisational engagement supports the development of shared problem-solving frameworks in humanitarian logistics training. As the Head of Planning, Monitoring and Evaluation from Malawi Red Cross noted:

> *"I started calling it a coalition.*
> *We are developing a coalition of emergency prepared experts,*
> *emergency preparedness and these are cutting across, you*
> *know, all the sectors." (K.15)*

4.3.2 Cross-agency knowledge exchange

Another pattern present in the data relates to how knowledge is generated and circulated through cross-agency interactions. Participants noted the importance of inter-agency briefings as platforms for idea-sharing and joint reflection. These exchanges were described as catalysts for improving collective planning processes and sustaining knowledge through multi-actor validation.

KCT accentuates structured internal processes for knowledge creation and development (Nonaka & Takeuchi, 1995; Nonaka et al., 2000; Nonaka et al., 2008), yet our findings point to the greater influence of cross-agency exchanges and shared conversations. In this context, inter-organisational dialogue appears to generate more lasting and adaptable knowledge than current theory anticipates. Current theoretical perspectives, such as those advanced by Anand et al. (2009), emphasise that effective knowledge transfer relies on the presence of shared mental models as well as tools, artefacts, or routines that facilitate coordination across stakeholders. These insights are particularly salient in multi-actor environments like humanitarian OpExs, where alignment among government agencies, NGOs, and technical partners is essential despite differing institutional mandates. This analysis thus identifies a further second-order theme: cross-agency knowledge exchange leads to stronger collective practices. As one interviewee reflected:

> *"[I]f you have a critical mass of people working together, I think it's easier to push, to push things forward and in terms of preparedness and so forth." (K.3)*

The findings suggest that systemic learning is more likely to occur when organisations engage in repeated collaboration and jointly develop knowledge through shared operational experiences. In informal, multi-stakeholder settings, such co-creation processes foster alignment, mutual understanding, and cross-organisational continuity. This supports the idea that systemic learning strengthens when knowledge is collectively constructed across organisational boundaries. A participant further highlights that, saying:

"That's the beginning of cohesiveness.
And from there, people know each other because people are
the same players that will be on the ground responding." (K.12)

4.4 Training Transfer Failure

4.4.1 Misalignment between training and reality

While the three theoretical dimensions discussed above highlight factors that promote knowledge retention, the following section considers respondents' perspectives on the elements that contribute to the loss of training content. Respondents emphasised that consistently applying newly acquired skills in emergency contexts is essential to mitigate the commonly observed challenges of low compliance and limited operational discipline (Comfort, 2007).

One perspective emerging from respondents' views on the underlying causes of TTF centres on the theme of 'misalignment'. Many respondents highlighted that learning tends to dissipate when training curricula do not correspond to actual operational realities on the ground. Also, they noted that knowledge gained during training is often lost when it is not integrated into daily work routines, or when the training content remains abstract or lacks practical relevance. Leading then to a second-order theme, which states that misalignment between training and operational realities prevents effective transition of knowledge. As one interviewee explained:

"We had the SIMEX. But the greater part of what they would
learn would get lost in the wind because some of the things that
they would learn would not even relate, not even practice."
(K.12)

These insights lead to a second-order theme, which states that misalignment between training and operational realities prevents effective transition of knowledge.

4.4.2 Weak organisational support

Through iterative analysis of the cases, another perspective emerged concerning the role of organisational support. Four main categories were identified within this theme. First, respondents frequently noted that organisations sometimes select participants who are either too junior, too senior, or lack the appropriate professional background for the training, which can undermine learning outcomes. Second, it was commonly reported that knowledge is often lost due to factors such as inadequate funding, organisational barriers, siloed structures, or resistance to change, all of which hinder the adoption of new practices.

KCT posits that knowledge emerges through purposeful interaction among willing individuals within supportive contexts (Nonaka & Takeuchi, 1995; Nonaka et al., 2000; Nonaka et al., 2008). However, our findings suggest a contrasting reality: unsuitable staff selection and systemic barriers can limit and cut learning and innovation. This reveals a gap between theoretical assumptions and the operational realities of knowledge application in complex, multi-actor humanitarian logistics settings. Aggregating these insights to the level of a second-order theme results in the statement that weak organisational support for humanitarian logistics training may be said to result in knowledge loss.

4.4.3 Erosion of knowledge

The final cluster of responses highlights the impact of knowledge erosion over time. Firstly, respondents pointed to the high rates of staff turnover commonly experienced in the sector, which contribute significantly to the loss of institutional knowledge. Then, they emphasised that when organisations engage in training on an irregular or one-off basis, rather than providing sustained, long-term support, the retention of learning is further compromised. A recognition of the effect of the passing of time in emergency response training is not new, with the effects of high staff turnover and delays between training and the next emergency extensively discussed.

Overall, the findings permit to formulate a second-order theme that asserts that time delays and organisational changes contribute to the erosion of knowledge. As one interviewee notably remarked:

> *"So when you're starting to impart knowledge into the ministry and you're trying to engrave knowledge into the ministry, the people go promoted, some people got seconded, so now we are back to what we had in the first place." (K.11)*

Building on the preceding analysis, the findings indicate that Training Transfer Failure is more prevalent in low-resource, high-turnover, and crisis-driven environments when training content does not reflect operational realities, when organisational reinforcement is weak, and when retention mechanisms fade over time. Such misalignments and constraints critically hinder the long-term application of training.

Overall, table 5 provides illustrative data and proof quotations that inform the data structure presented in table 4.

Aggregate theoretical dimensions, Second-order themes, First-order categories		**Illustrative Data**
Individual learning in humanitarian logistics training is driven by social engagement, personal reflection and training realism		
Social engagement during and after training leads to stronger knowledge retention		
1	Peer interactions and informal sharing post-training reinforce training objectives and supports learning.	"Yes, informal mentoring has been very vital for me. I will do, I would say "informal mentoring" plays a very critical role in the learning or teaching. Though most of the times we could we prefer the formal but this is a very critical role because people build interest when something posted on the informal sequence much [more] as [when] it is linked to the formal." (K.14)
2	Multistakeholder grouped exercises increase confidence to apply skills in the field.	"So what the [SimEx] has done is to help me speak with more confidence and as in terms of uh prepositioning at the same time they are aware that this is not a one man's show. [...] And so it has just posted my confidence levels in terms of coordination [and how to] present issues." (K.6)

Reflective practices after training lead to practical, operational application of learning.		
3	Post-training reflection helps connect concepts to real operations.	“After the sessions we have some time when we are doing our only personal business, we could basically reflect on how the different sessions we've gone through for that particular day have impacted both the normal work that we are employing within our organizations and also our personal life.” (K.13)
4	Individuals apply lessons better when they debrief after training	"I remember when I came from the exercise, I had to brief my my colleagues on what was the experience and what is expected of us. So I've seen that there is a great improvement in the way we are responding to issues.” (F.2)
Realism and contextual authenticity in training leads to enhanced professional performance		
5	Operational skills improve when training scenarios and curriculum are aligned with actual field realities and conditions.	"And again, you know, part of that is to do with, if you're doing this in countries that don't have emergencies particularly. But because we've had so many in the past and significant ones, you know, I think that's where it, it really helps to. It is grounded in reality.” (K.16)
6	Learning is reinforced when individuals perceive training as practical and realistic.	"So I would say our exercise was good because we actually get involved in the actual application of what is supposed to be done on the ground. So it was easy for me to understand that they apply when we go back to our normal week." (K.1)
7	Training content embeds most deeply when shortly afterwards applied in a genuine emergency.	"B[y] the time we are attending this simulation exercise [...] as always in Malawi we had an emergency response. [When] we went there, it was in August whereby the response started in March." (K.7)
Oragnisational learning in humanitarian contexts is driven by a culture of externalisation and integration of experiences into collectives routines and practices		
Encouragements to externalise experiences leads to the refinement of organisational practices		

8	Post-exercise feedback and reinforcement mechanisms help knowledge transfer, especially when openly discussed and endorsed by senior management.	"[M]y supervisors, they always support me and they [...] always encourage me to be part of these meetings." (K.7)
9	Learning is sustained when individuals are given space to share knowledge or train others.	"I am involving my junior staff more in the process. I used to do all the reporting myself. But now, I've started mentoring two colleagues on how to do basic analysis. They're the ones who'll carry it forward, right? I think it's a small step in building a culture of info-sharing that doesn't rely on just one person." (F.21)
10	Debriefings across teams uncover process gaps and good practices.	"We held review meetings [...] so that we could share lessons learnt. I know from the different organizations and perspectives that we are in as the people who have undergone the SimEx that this helps. We held specific monitoring visits [with the] different members who have undergone the SimEx so that we can understand how they are applying the skills [on the] job." (K.4)
Connecting training insights with organisational practices and routines leads to sustained learning outcomes		
11	Organisational memory grows when training experience informs standard procedures.	"So in terms of information management, [...] after the SimEx I was able to write down things that aren't issues about coordination itself, issues about planning issues about the maybe change management and about information, maybe processes sharing management as you're mentioning that was so borrowing a leaf from my technical report that was submitted and that sort of thing that were shared in that report." (K.9)
12	Lessons are retained longer when training is part of a wider strategic vision.	"This type of work already links to what our core strategy […] globally [is] pushing [us] towards. So it was very easy to articulate and link to our strategy." (K.5)
13	Training insights are better embedded when organisations participate year-on-tear.	"[It's important] to consider the SimEx as an annual an annual event. Why? Because you know. In the organization we, the people, are on the move. [T]oday, you are in organization, next tomorrow you move out of the humanitarian sector and new people are coming in and the [...] skills [won't] die [just] because one has left." (K.4)

Systemic learning in humanitarian multistakeholder environment arises when diverse organisations collaborate and exchange insights		
Repeated collaboration across organisation leads to shared problem-solving		
14	Joint trainings and exercises build networks and develop trust.	“That’s the beginning of cohesiveness. And from there, people know each other because people are the same players that will be on the ground responding.” (K.12); "I started calling it a coalition. We are developing a coalition of emergency prepared experts, emergency preparedness and these are cutting across, you know, all the sectors." (K.15)
15	Repeated engagement contributes to mutual understanding, helping organisations to understand each other's capacities, processes and anticipate each other's actions.	“This the culture is actually so embedded and the language like they were sitting in the in the groups, you know, when you walk around and listen, everybody's talking the same language.” (K.15)
16	Shared scenarios reveal common gaps and expose coordination bottlenecks across logistics systems.	“it's a trend that has been very visible across the board from WFP staff as well as from the stakeholders as well as you know the likes of Red Cross, the government itself. We see people that are taking more and more deeply leadership roles in the follow up SIMEX and other and other activities. I think it goes beyond just the simulation exercises. The confidence levels are growing beyond the simulation exercise.” (K.15)
Cross-agency knowledge exchange leads to stronger collective practices		
17	Inter-agency briefings allow ideas to circulate and evolve.	"But the very fact that we had everybody from DODMA, [from] NGO's, [from] Ministry of Health at a senior level as well, I think really contributed towards us and it felt as though it was a team, if you know what I mean." (K.3)

18	Cross-agency conversations lead to shared improvements in response planning.	"I learned a lot [...] from my experience through which have gained from the training. It was clear that some members of different organizational had different understandings. The[re] were different openings in terms of understanding of our respon[se], things that are needed, which would hamper a seamless response to an emergency, and the insight[s] for example, as I said earlier on, you have issues [when] people [undertake] different kinds of assessment[s]." (K.6)
19	Knowledge is sustained when validated and adapted by multiple actors.	"[I]f you have a critical mass of people working together, I think it's easier to push, to push things forward and in terms of preparedness and so forth." (K.3)
	Training Transfer Failure in humanitarian logistics training is exacerbated by misalignment, lack of organisational support and the passing of time.	
	Misalignment between training and operational realities prevents effective transition of knowledge	
20	Knowledge acquired in training, not embedded into daily workflow, is abstract or unrealistic.	“When the workload is high, it’s easy for some people to skip the documentation or only do the bare minimum” (F.19); "We had the SIMEX. But the greater part of what they would learn would get lost in the wind because some of the things that they would learn would not even relate, not even practice” (K.12)
	Weak organisational support for humanitarian logistics training results in knowledge loss	
21	Participating organisations nominate the wrong (too junior, too senior) calibre of staff.	"I'd say the training transfer failures could be due to lack of practice as well as maybe Irrelevance due to the poor selection of the participants.” (K.12)
22	Funding, organisational barriers, siloes or resistance to change prevent experimentation with new practices.	"To allow people to apply what they learn, you go and learn and you come back and they say yeah, but here this is how we do this is how this is our commitment. So this is what you have to do here. Yeah, so that would be structured to organizations that are less flexible and are not changing and adapting to the environment.” (K.17)

Time delays and organisational changes contribute to the erosion of knowledge.		
23	Staff turn-over results in information loss.	“So when you're starting to impart knowledge into the ministry and you're trying to engrave knowledge into the ministry, the people go promoted, some people got seconded, so now we are back to what we had in the first place.” (K.11); “[W]hat concerns me [is how] we ensure the consistency or the continuation of the people that have been trained. [Us responders, we] go away when [there are] no emergencies” (K.3)
24	Participating organisations show intermittent or once-off support for the exercise.	"And I think unless you've got this institutionalised within preservice training or part of a curriculum, then it may get lost and it's not an obligation on part of the person being trained to actually retake, retain that knowledge" (K.16)

Table 5 : Illustrative data and proof quotations

4.5 Summary

This case study’s uniqueness lies in its unprecedented context, allowing us to observe mechanisms consistent with established theory while also challenging its boundaries. The findings reveal both alignments and divergences from KCT’s assumptions, highlighting areas where the theory may require refinement in complex, multi-actor humanitarian settings. These insights open the door to advancing the discussion on the practical value of KCT in OpExs and to exploring more deeply the underlying mechanisms of how and why it operates in this environment.

5 Discussion

The study examines how knowledge is created, transferred, and institutionalised across individual, organisational, and systemic levels within a multi-stakeholder context.

The discussion examines how knowledge generated during OpExs can be retained and mobilised to support organisational learning, enable systemic change, and ultimately improve the effectiveness of humanitarian health supply chain response. The chapter outlines the findings developed from the data and reflects on the academic, operational, and strategic value of using KCT as a framework in humanitarian health supply chain preparedness.

5.1 From individual learning to supply chain effectiveness

The findings of this study suggest that the contribution of OpExs to humanitarian supply chain effectiveness can be conceptualised as a sequential but fragile process, beginning at the individual level, reinforced at the organisational level, and under certain conditions, manifesting systemically through coordinated field performance. While this pathway mirrors assumptions in existing learning and knowledge management theory (Nonaka & Takeuchi, 1995; Beamon & Balcik, 2008), our results show that the translation from one level to the next is neither automatic nor guaranteed. Instead, each stage is exposed to attrition, contextual constraints, and political-economy realities that can fragment or block the flow of knowledge entirely.

5.1.1 Preparedness and confidence

Humanitarian supply chains start with people. The most immediate and observable mechanism through which OpExs generate value is the preparedness of individual participants. Across interviews, respondents consistently reported gains in self-efficacy, technical clarity, and decision-making confidence, even considering themselves to be "*better logisticians because you don't hesitate when making decisions" (K.8).*

These improvements were linked not to abstract classroom teaching but to the realism of the Malawi OpExs design: full-scale simulations, geographic specificity, and multi-day immersion in plausible scenarios that demanded sustained problem-solving under pressure.

This type of experiential learning aligns with adult learning principles (Kolb, 1984) by situating participants in contexts where they see immediate relevance, are forced to take ownership of decisions, and must adapt dynamically to changing conditions. Knowing who to contact, through which channels, and how to act within the first hours is critical in a setting like Nsanje, where floods, cyclones, and cholera outbreaks recur with little warning. By rehearsing these responses in a high-pressure yet controlled environment, OpExs participants build, an ability to act decisively without prolonged deliberation.

Yet, our findings also point to gaps. While technical skills, such as stock tracking, cold chain management, and field reporting, can be readily strengthened in simulation, certain soft skills, including inter-agency negotiation, political navigation, and adaptive leadership, proved harder to embed. These are precisely the skills most needed in chaotic multi-stakeholder emergencies (Van Wassenhove, 2006; Kovács & Spens, 2011). Without deliberate facilitation and post-exercise mentoring, gains in these areas risk remaining superficial or context dependent.

5.1.2 Capturing and embedding knowledge

The second layer of impact lies in how organisations absorb and institutionalise the knowledge and skills brought back by trained individuals. In high-turnover, resource-constrained environments typical of humanitarian logistics, the organisational ability to recognise, assimilate, and apply external knowledge referring to its “absorption capacity” is a decisive factor in whether training produces lasting change.

Our findings reveal that some agencies involved in the Malawi OpExs have embedded structured debriefs, revisions to SOPs, and cross-team briefings into their standard post-exercise processes. These mechanisms reduce dependence

on fragile tacit memory and ensure that lessons learnt are transformed into codified, shareable practices. In these cases, organisational learning supports critical supply chain functions such as stock pre-positioning, rapid mobilisation of transport assets, and streamlined information flow management.

However, such mechanisms are not universal. Many respondents described ad hoc or inconsistent processes, where learnings remain siloed within the specific individuals who attended the exercise. This aligns with prior literature documenting the loss of tacit knowledge in public and humanitarian organisations due to turnover, weak incentives, and the absence of formalised knowledge transfer processes (Mihi Ramírez et al., 2012; Flores Torres et al., 2020). In several cases, the lack of managerial follow-up meant that the only sustained change after the exercise was the personal skill set of the attendee, which is valuable, but insufficient to shift organisational performance.

This finding underscores the role of leadership. Organisations that had clear senior buy-in for the OpExs were more likely to transform individual gains into organisational assets. Conversely, where managers saw the exercises as peripheral or compliance-driven, knowledge capture was minimal. This mirrors Beamon and Balcik (2008) assertion that supply chain effectiveness is shaped not only by individual competencies but by the organisational systems that enable, or constrain, their application.

5.1.3 Building interoperability in multi-stakeholder environments

At the third level, OpExs offer an opportunity to enhance systemic performance by building interoperability between organisations. In theory, multi-agency exercises like the Malawi OpExs create a shared operational vocabulary, improve mutual role awareness, and harmonise procedural protocols. Respondents described benefits such as smoother cross-agency information exchange, reduced duplication of effort, and faster resource deployment in subsequent real emergencies. This is in line with the analysis of Adsanver et al. (2024) that capacity building through Triple C is essential to increasing the effectiveness of humanitarian operations. By recreating a collaborative, multi-stakeholder environment, OpExs promote the practical application of coordination and

cooperation skills acquired in training, thereby improving the speed, relevance and reliability of responses as everyone speak the same language.

> *“this the culture is actually so embedded and the language like they were sitting in the in the groups, you know, when you walk around and listen, everybody's talking the same language."*
> *(K.15)*

Repeated collaboration was also seen to contribute to institutional trust, a key enabler for joint problem-solving under time pressure (Tomasini & Van Wassenhove, 2009). In a sector where actors often operate with divergent mandates, objectives, and timelines, such trust can be the difference between a fragmented or a coherent response.

Yet here too, our data points to significant caveats. Systemic alignment is not just a product of shared training; it also requires that each participating organisation internalise and operationalise the collective lessons. In practice, differences in organisational mandates, competition for funding, and political sensitivities often mean that knowledge is not openly shared or adopted across institutional boundaries. This confirms earlier findings in disaster management research (Caballero-Anthony et al., 2021) that inter-agency collaboration is both highly valuable and structurally fragile.

Moreover, systemic learning is undermined when OpExs participation is inconsistent, either because agencies rotate attendees for reasons of equity or because political or budgetary constraints limit engagement. This disrupts the continuity of relationships and knowledge flows, weakening the very interoperability the exercises aim to build.

5.1.4 A fragile chain of transmission

Taken together, these findings show that the pathway from individual preparedness to system-wide supply chain effectiveness is best understood not as a smooth transfer, but as a fragile chain of transmission, with multiple points where value can be lost. Individual learning is necessary but not sufficient; it must be deliberately captured, codified, and adapted by organisations, and then

actively shared and integrated across the broader network. Each stage is contingent on enabling conditions: leadership support, resource availability, and a willingness to adapt, that are often unevenly distributed across the humanitarian system.

This has two key implications. First, it challenges linear models of knowledge transfer that assume learning naturally flows upward from individuals to organisations and systems. Instead, our data supports a more dynamic, multi-directional view, where knowledge can also originate from systemic interactions and filter back to shape organisational and individual practices. Second, it raises questions about the adequacy of current theoretical frameworks, including KCT, in capturing the realities of multi-stakeholder humanitarian environments.

5.2 Applicability of the KCT framework

5.2.1 The uniqueness of this case study

The KCT has proven to be a useful lens through which to examine the dynamics of learning and knowledge transfer in humanitarian logistics training. While KCT is well established in private sector contexts, its relevance to temporary, cross-organisational collaborations in crisis simulations remains underexplored. This study extends current understanding by applying KCT to multi-stakeholder OpExs in humanitarian health supply chains in a LMIC context, where both the operational environment and the learning conditions differ markedly from those in stable, single-organisation settings.

Previously, no documented application of KCT in a multi-stakeholder humanitarian environment had been carried out, and this is where the power of our case lies. When several actors work together towards the same objectives, not in competition, the dynamics are different, as are the challenges. In the private sector, cross-organisational collaborations are relatively rare and tend to follow different behavioural patterns (Soo et al., 2003; Hong, 2011; Lievre & Tang, 2015), in humanitarian response, they are the norm but are shaped by diverse mandates, funding pressures, and organisational cultures. In the case of Malawi's OpExs, KCT provided a structure for identifying learning mechanisms at

individual, organisational, and systemic levels, showing that SECI model stages do not unfold in a fixed linear sequence. Instead, the process is iterative and situational, influenced by the realism of the scenario, pre-existing trust between participants, and the operational mandates of each stakeholder organisation (Dubey et al., 2017; Tatham & Kovács, 2010). This reinforces the idea that the learning process in humanitarian contexts is adaptive, non-linear, and shaped by real-time operational and relational dynamics.

In this context, individual learning emerged primarily through socialisation and internalisation, reinforced by hands-on simulation and peer interaction. However, the transition to organisational and systemic learning was less consistently supported. Externalisation and combination appeared underutilised, which weakened long-term retention and contributed to TTF (Mihi Ramírez et al., 2012). This finding adds to the TTF literature by positioning OpExs as a potential countermeasure: when designed to deliberately activate all stages of the SECI cycle, they can embed knowledge into shared routines, language, and inter-agency networks, thereby improving the likelihood of transfer into real-world operations. Addressing the current imbalance requires structured mechanisms during and after training to capture field-based insights, create shared documentation, and integrate knowledge into broader systems and coordination frameworks (Anand et al., 2009).

5.2.2 Theoretical contributions

Beyond these operational implications, the study contributes theoretically in three additional ways. First, it challenges the assumption, implicit in much KCT literature, that knowledge creation requires stability and prolonged collaboration. Our findings show that even in short-term, high-pressure environments, SECI processes can emerge, provided the context is sufficiently enabling. This suggests that KCT can be extended to more dynamic, crisis-driven settings, including those in LMICs.

Second, it positions OpExs as valuable research settings, offering live laboratories to observe decision-making, coordination, and knowledge flows as they happen, rather than relying solely on retrospective accounts. The

longitudinal scope of this study further captures how knowledge is created, institutionalised, or lost over successive exercises, offering insights into the resilience, or fragility, of learning processes over time.

Third, by focusing on a LMIC context, it addresses a documented gap in the literature and proposes avenues for future research on organisational memory, knowledge erosion, and the specific dynamics of tacit-to-explicit conversion in resource-constrained, multi-actor environments.

Therefore, successful use of the KCT framework elsewhere would require careful contextualisation, not only to disaster typologies, stakeholder composition, and operational constraints, but also to cultural norms, political contexts, and learning preferences. This case demonstrates that KCT is both applicable and valuable in humanitarian supply chain environments, its impact depends on the intentional design of training processes that embrace its full dynamic and contextual nature. By doing so, it is possible to leverage KCT not only as an analytical tool, but as a framework to actively strengthen preparedness strategies in complex, multi-stakeholder humanitarian systems.

5.3 Recommendations for improved design of the OpExs

This case study demonstrates that, within the tested context, OpExs can act as effective platforms for tacit knowledge development at both the individual and organisational levels. Based on the findings, several actionable recommendations emerge.

Firstly, training must be delivered regularly and supported by structured knowledge retention mechanisms. Given the high staff turnover and potential delays between training and emergencies, the risk of knowledge erosion is high. Introducing refresher sessions, check-up with participants, mentorship schemes, and improved documentation protocols would help preserve institutional memory and operational readiness over time.

> *“It's always a fluid situation. People are being trained, but they are moving away. They get promoted into other departments and so on and so forth. There is always going to be a question*

that if you go back in 2-3 years from today, there is an emergency and we say in this particular district, can we have those people who did the [OpEx] so that they can manage this?" (K.17)

Secondly, consistent multi-stakeholder involvement is essential. When participation is random, knowledge continuity and coordination weaken. Encouraging sustained engagement from key actors can build shared ownership and reinforce long-term preparedness.

"Maybe that's something that should be investigated to bring together the organizations and then maybe share proper lessons learned and how they've improved their internal systems, how they've internalized the lessons learned from from there." (K.12)

Thirdly, OpExs must remain closely aligned with local operational and cultural contexts. When training content reflects real-world conditions, participants are more likely to perceive it as relevant and apply it effectively in practice. The cultural dimension and the environment in which an exercise takes place are critical factors that must be considered to enable comprehensive and meaningful learning. Understanding participant expectations, recognising cultural norms and practices, and being attentive to how individuals learn and transmit knowledge are fundamental starting points for designing impactful training interventions.

"And let's be real. There's also a cultural side. Some people still hold onto information like power. If we don't tackle that mindset, even the best tools won't be enough." (F.22)

Finally, OpExs should be embedded into broader organisational and national preparedness frameworks. Rather than being treated as isolated events, they should contribute to national disaster risk reduction strategies and capacity development plans, enhancing both strategic alignment and long-term impact.

"I must say the training is something that has to be done every year. For it is on that. This is preparedness. You don't get tired

of getting prepared, even if it seems there's nothing happened. Just like an insurance, you keep on getting insurance. So I would equate this to an insurance whereas you keep on investing and the involved for the organization that early stages as much as possible." (K.6)

5.4 Limitations and future research

5.4.1 Independence in humanitarian response

While this research has examined the effectiveness of OpExs in strengthening humanitarian health logistics in Malawi, it is equally important to situate these findings within the broader operational and political environment in which such trainings occur. Independence, both operational and financial, remains a critical yet complex issue. Despite being described as autonomous, many humanitarian actors operate within systems shaped by external funding cycles, donor agendas, and international coordination frameworks. One participant noted concerns that projects risk losing their original intent when adapting to donor priorities to secure funding.

"So I think the funding mechanisms also have to block knowledge and see that adapt to this because otherwise organization are just going to follow on the market say so if there is no disaster and the donors are saying different things and then this will follow up."(K.17)

Such dependencies can influence the design and delivery of operational exercises. If training content is driven more by external expectations than by national priorities, its relevance and long-term ownership may be compromised. These reflections do not aim to undermine the value of the OpExs. On the contrary, this case study shows that they can be powerful tools for strengthening emergency response capacity, building inter-agency networks, and improving health logistics. However, recognising the constraints surrounding them is essential for understanding their full impact. The broader political and financial

ecosystem, including global funding priorities, shifting donor interests, and regional power dynamics, cannot be overlooked.

This section does not attempt to answer all these questions. However, it highlights the importance of addressing the underlying conditions in which training and preparedness efforts operate. If we are to improve the effectiveness of humanitarian supply chains, we must also question how power, funding, and influence shape what gets taught, retained, and applied. OpExs are a step in the right direction, but they do not operate in a vacuum. Recognising their dependencies may help design stronger, more resilient models of humanitarian learning that serve both national goals and global agendas.

5.4.2 Methodological limitations and research opportunities

This research is inherently context-specific, focusing on humanitarian health supply chains in Malawi's unique political, social, and operational environment. As such, findings may not be directly generalisable to other countries or disaster contexts. Rooted in local disaster scenarios and designed with national actors, they reflect local needs and capacities. But these positive outcomes might not be easily replicated elsewhere without accounting for the same level of contextual specificity. The highly tailored nature of the Malawi OpExs contrasts with more standardised models such as the LRT approach (Gralla et al., 2015), which may limit transferability. Although neighbouring countries or international agencies often observe or join the exercises, scaling them must involve more than just duplication. It should include a reflection on what makes them work: political support, trust between actors, and a learning culture anchored in local systems

Methodologically, the reliance on FGDs and KIIs introduces risks of social desirability bias, selection bias, and power imbalances. The qualitative approach offers depth but limits triangulation, and the absence of quantitative validation may reduce the robustness of conclusions. Additionally, the rapidly evolving humanitarian landscape may affect the temporal relevance of these findings.

Future research should aim to test these propositions empirically in Malawi and in other comparable LMICs contexts to assess external validity. Comparative

studies in high-income or more formalised emergency settings could also reveal differences in tacit knowledge dynamics and coordination mechanisms. Finally, extending this research to explore the broader applicability of the KCT framework could contribute to a more generalised understanding of cost-effective, agile, and context-sensitive humanitarian logistics training.

6 Conclusion

This research set out to examine how OpExs contribute to learning and performance across individual, organisational, and systemic levels in humanitarian supply chains, with a specific focus on the Malawi case. The analysis has demonstrated that OpExs can serve as powerful catalysts for enhancing the effectiveness and impact of humanitarian responses. By preparing logisticians and other stakeholders to anticipate, coordinate, and make timely, data-driven decisions, OpExs foster the operational readiness required to achieve supply chains that are faster, better, and cheaper. These exercises enable actors to develop a shared operational language, align procedures, and build trust.

Thanks to these findings, the first two objectives, which consist of examining how learning progresses from the individual to the systemic level and identifying the obstacles that hinder this progression, have been achieved. The study shows that when individuals acquire and integrate these competencies into their routines, the benefits cascade through organisations and, ultimately, across the wider humanitarian system. This transfer of learning, however, is not automatic, it requires deliberate mechanisms to capture, codify, and disseminate knowledge, supported by enabling conditions such as leadership commitment, adequate resources, and a willingness to adapt. When these conditions are met, OpExs do not just improve efficiency, they also enhance the impact of humanitarian supply chains by ensuring that the right people, with the right skills, are in the right place, at the right time, delivering responses that are closely aligned with the needs of affected populations.

From a theoretical perspective, the research contributes to advancing the applicability of KCT in humanitarian contexts and therefore, achieving the second objective on the KCT extension. While KCT is well established in private sector and stable organisational settings, its use in temporary, multi-stakeholder collaborations, especially in LMICs contexts, remains underexplored. This case study extends current understanding by showing that even in short-term, high-pressure environments such as humanitarian OpExs, SECI model can emerge.

Importantly, the findings suggest that these processes do not follow a linear progression but are iterative, adaptive, and influenced by the nature of the scenario, pre-existing trust, and stakeholder mandates.

The research also highlights a gap between theoretical assumptions and operational realities. KCT presupposes enabling environments with stable structures and strong knowledge-sharing incentives, yet, in humanitarian settings, systemic barriers such as organisational siloes, staff turnover, and funding dependencies often constrain knowledge transfer. One of the most significant insights here is that inter-organisational exchange, through shared experiences, joint problem-solving, and harmonised procedures, can sometimes be more influential than internal organisational learning in driving systemic resilience. This calls for a more nuanced theoretical framing that accounts for the complexities of multi-stakeholder humanitarian environments.

In doing so, the thesis also contributes to the literature on TTF, suggesting that well-integrated OpExs can mitigate TTF by embedding learning into shared routines, documentation, and networks. Moreover, it positions OpExs as valuable research settings, offering opportunities to observe real-time decision-making, coordination, and knowledge flows under simulated crisis conditions.

Nevertheless, the research is not without limitations. Its scope is context-specific, focusing exclusively on humanitarian health responses in Malawi. The findings may not be fully generalisable to other contexts due to the country's unique political, logistical, and socio-cultural conditions. The bespoke nature of the Malawi OpExs, tailored to local realities, differs from more standardised training models, which limits transferability. Methodologically, reliance on qualitative data from FGDs and KIIs introduces risks of bias, and the absence of quantitative validation restricts the robustness of conclusions. Furthermore, the rapidly evolving humanitarian landscape may reduce the temporal relevance of the findings over time. However, throughout this process, recommendations for improving OpExs were made and can be considered in response to the fourth and final objective.

Future research should build on these insights in several ways. Comparative studies across different countries and disaster typologies could test the external validity of the propositions, while longitudinal designs could examine the persistence of learning and knowledge transfer beyond the immediate post-training phase. System dynamics approaches could also be employed to model the interplay between individual, organisational, and systemic learning, providing a richer analytical framework for preparedness strategies.

In conclusion, this study underscores the dual operational and theoretical significance of OpExs. Operationally, they represent a practical tool for strengthening the agility, coordination, and impact of humanitarian supply chains. Theoretically, they offer a unique lens for testing and refining KCT in complex, multi-actor environments. By recognising both their potential and their limitations, humanitarian actors can design future OpExs that are more contextually relevant, strategically aligned, and systematically integrated, thereby not only enhancing supply chain effectiveness but also contributing to more timely, appropriate, and impactful humanitarian responses.

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APPENDICES

Appendix A : Ethical approval letter

22 May 2025

Dear Miss Adjahi ,

Reference: CURES/25259/2025
Project ID: 28555
Title: Evaluating the Effectiveness of Supply Chain Simulation Exercises in Public Health: A Case Study Perspective

Thank you for your application to the Cranfield University Research Ethics System (CURES).

We are pleased to inform you your CURES application, reference CURES/25259/2025 **has been reviewed. You may now proceed with the research activities you have sought approval for.**

If you have any queries, please contact CURES Support.

We wish you every success with your project.

Regards,

CURES Team

Appendix B : Contextual cases for illustrative purposes

#	Case Title / Description	Data Type	Created in support of / with use of data from OpEx 2022	Created in support of / with use of data from OpEx 2023	Created in support of / with use of data from OpEx 2024
22.1	Invitation letter	Word doc	x		
22.2	Concept note	Word	x		
22.3	Learning needs analysis	Excel file	x		
22.4	Inject matrix	Excel file	x		
22.5	Satisfaction survey (immediate upon exercise conclusion)	Word	x		

22.6	Lessons learnt exercise - concept note	Word doc	x		
22.7	Lessons learnt exercise - opening remarks	Word doc	x		
22.8	Lessons learnt exercise – report	PDF	x		
22.9	Video (long version)	MP4	x		
22.10	Video (beneficiary success story)	MP4	x		
22.11	Video (animated)	MP4	x		
22.12	Newspaper clipping 1	JPEG	x		
22.13	Newspaper clipping 2	JPEG	x		
22.14	Newspaper clipping 3	JPEG	x		
22.15	Twitter post 1	PNG	x		
22.16	Twitter post 2	PNG	x		
22.17	Twitter post 3	PNG	x		
22.18	Twitter post 4	PNG	x		
22.19	Twitter post 5	PNG	x		
22.20	Final report	PDF	x		
22.21	Final report - executive summary	PDF	x		
23.1	Invitation letter	Word doc		x	
23.2	Joint invitation letter	Word		x	
23.3	Concept note	PDF		x	
23.4	Consultation report	PDF		x	
23.5	Flyer	PDF		x	
23.6	Inject matrix	Excel		x	
23.7	Observation matrices - summary grid	Excel		x	
23.8	Video (long version)	MP4		x	
23.9	Video (short version)	MP4		x	
23.10	Press event - talking points	Word		x	
23.11	Video (national news)	MP4		x	
23.12	Twitter post 1	PNG		x	
23.13	Twitter post 2	PNG		x	
23.14	Twitter post 3	PNG		X	
23.15	Satisfaction survey	PowerPoint		x	
23.16	Debrief on evaluation methodology	Word		x	

23.17	Lessons learnt exercise - concept note	Word doc		x	
23.18	Lessons learnt exercise - opening remarks	Word doc		x	
23.19	Lessons learnt exercise - presentation	PDF		x	
23.20	Lessons learnt session – minutes	Word		x	
23.21	Final report	PDF		x	
23.22	Final report - executive summary	PDF		x	
23.23	Cyclone Freddy: After Action Review (midpoint report)	PDF		x	
23.24	Cyclone Freddy: After Action Review (final report)	PDF		x	
24.1	Joint invitation letter	Word			x
24.2	Concept note	PDF			x
24.3	Consultation report	PDF			x
24.4	Flyer	PDF			x
24.5	Communications and media plan	Word			x
24.6	Invitation media event	Word			x
24.7	Inject matrix	Excel			x
24.8	Satisfaction survey - participant questionnaire	Word			x
24.9	Satisfaction survey - facilitator questionnaire	Word			x
24.10	Satisfaction survey - processed results	Excel			x
24.11	Lessons learnt exercise - concept note	PDF			x
24.12	Lessons learnt exercise - presentation	PowerPoint			x
24.13	Video (Long Version)	MP4			x
24.14	Video (Short Version)	MP4			x
24.15	Online news clipping 1 - Zodiak Online	PNG			x
24.16	Online news clipping 2 - MIJ Online	PNG			x

24.17	Online news clipping 3 - Times 360 Malawi	PNG			x
24.18	Twitter post 1	PNG			x
24.19	Twitter post 2	PNG			x
24.20	Twitter post 3	PNG			x
24.21	Final Report	PDF			x
L34.1	ReliefWeb article - front page	PDF	x	x	
L34.2	ReliefWeb article - report	PDF	x	x	

Appendix C : FDG Respondents

Unique Interviewee Reference	Organisation	Job Profile	FDG Session Attended	Date Held	Duration (minutes)
F.1	CMST	Registered Pharmacist	A	28/02/2024	111
F.2	DHO Phalombe	Pharmacist	A	28/02/2024	111
F.3	DHO Chikwawa	District Pharmacist	A	28/02/2024	111
F.4	DODMA Thyolo	Disaster Risk Management Officer	A	28/02/2024	111
F.5	DHO Lilongwe	Pharmacist In Charge	B	28/02/2024	65
F.6	WHO	Logistics Assistant	B	28/02/2024	65
F.7	World Vision	Administrative Officer	C	29/02/2024	65
F.8	DODMA Blantyre	Disaster Risk Management Officer	C	29/02/2024	65
F.9	CMST	Distribution Manager	C	29/02/2024	65
F.10	CHAM	Warehouse Assistant	D	24/04/2025	123
F.11	WHO	Supply Chain Officer	D	24/04/2025	123
F.12	CHAM	Training Officer	D	24/04/2025	123
F.13	Malawi Red Cross Society	Head of Planning	D	24/04/2025	123
F.14	CMST	Branch Manager	D	24/04/2025	123
F.15	VillageReach	Senior Manager	D	24/04/2025	123

F.16	VillageReach	Supply Chain Officer	D	24/04/2025	123
F.17	CHAM	Head of Supply Chain	D	24/04/2025	123
F.18	Malawi Red Cross Society	Head of Supply Chain	D	24/04/2025	123
F.19	Africa CDC	SARCC Technical Officer Logistics	E	25/04/2025	132
F.20	AMREF	Project Manager	E	25/04/2025	132
F.21	World Vision	Project Coordinator	E	25/04/2025	132
F.22	MoTPW	Under Secretary	E	25/04/2025	132
F.23	MoTPW	Administrative Officer	E	25/04/2025	132
F.24	Africa CDC	Health Emergency Preparedness Specialist	E	25/04/2025	132
F.25	MoH Health Cluster	Public Health Advisor	E	25/04/2025	132
F.26	SADC HEOC	Logistics Officer	F	28/04/2025	72
F.27	IOM	Head of Humanitarian People and Response	F	28/04/2025	72
F.28	MSF	Energy specialist	F	28/04/2025	72
F.29	UNICEF	Procurement Specialist	F	28/04/2025	72
F.30	World Vision	Officer - Commodities	F	28/04/2025	72
F.31	MUST	Senior Drone Instructor	F	28/04/2025	72

Appendix D : FDG Interview Protocol

Competency 1: Planning

- Following the training has your confidence in planning (in a timely manner, based on preparedness activities and rapid and efficient assessment of needs) grown? Please provide some examples of how you have applied/observed this skill in your current position.

- Do you perceive this level of planning to be higher than in the past? Please discuss and rate the level of improvement on a scale from 1-5 in your group.
- What enablers supported the application of the content from the SimEx?
- What barriers hindered the implementation of knowledge/skills from the SimEx?

Competency 2: Coordination

- Following the training, has your confidence in coordinating with other actors effectively grown? Provide some examples of how you have applied this skill in your current position.
- Do you perceive this level of coordination to be higher than in the past? Rate the level of improvement on a scale from 1-5.
- What enablers supported the application of the content from the SimEx?
- What barriers hindered the implementation of knowledge/skills from the SimEx?

Competency 3: Information Sharing

- Following the training, has your confidence in gathering, analysing, and circulating information grown? Provide some examples of how you have applied this skill in your current position.
- Do you perceive this level of information management and decision making to be higher than in the past? Rate the level of improvement on a scale from 1-5.
- What enablers supported the application of the content from the SimEx?
- What barriers hindered the implementation of knowledge/skills from the SimEx?

Competency 4: Decision-Making

- Following the training, has your confidence in making timely decisions and mobilising resource based on gathered and analysed information grown? Provide some examples of how you have applied this skill in your current position.
- Do you perceive this level of information management and decision making to be higher than in the past? Rate the level of improvement on a scale from 1-5.
- What enablers supported the application of the content from the SimEx?
- What barriers hindered the implementation of knowledge/skills from the SimEx?

Ability to Transfer Learning from Training to the Job

- To what degree did the SimEx influence your practice of health emergency preparedness. Kindly use a scale from 1-5 to illustrate your answer.
- Were there other beneficial outcomes of the SimEx for your professional practice not stated in PART II above? If yes, please specify.

- Have you used the materials provided during the SimEx since you took part in the training? If yes, please explain what materials you have used and for what purpose.
- What kind of follow up support would help you do your work better?
- Looking back to the course were there any skills/ information that were not covered that you would have benefitted from and feel we should include in future courses?
- Do you have any recommendations or other comments on the SimEx?

Appendix E : KII Interview Protocol

Socialisation (Tacit-to-Tacit)

- Thinking specifically about the staff who participated in the SimEx, can you describe moments where they demonstrated what they had learnt through social interactions with others (e.g. showing, sharing, collaborating)?
- Following the SimEx, have the participants' informal or experiential learnings been shared more broadly within your organisation? For example, through informal mentoring, team discussions, or shadowing?

Externalisation (Tacit-to-Explicit)

- Again, thinking specifically about the staff who participated in the SimEx, after the exercises, were they given opportunities to explain, document, or present what they learnt—either formally or informally?
- Has your organisation done anything to capture, record, or formalise insights shared by returning staff (e.g. internal reports, debriefs, knowledge-sharing sessions)?

Combination (Explicit-to-Explicit)

- Still thinking specifically about the staff who participated in the SimEx, did those team members apply or adapt any frameworks, SOPs, checklists, or tools that they were exposed to during the exercises?
- Has your organisation incorporated any of these tools or practices into its standard ways of working or planning processes?

Internalisation (Explicit-to-Tacit)

- With reference specifically to the staff who participated in the SimEx, have you noticed returning participants demonstrating more confident or instinctive decision-making, without needing to refer to manuals or instructions?
- Would you say any insights from the exercises have since become embedded in your team's culture, routines, or informal norms over time?

Systemic Impact

- As a senior leader yourself, have you observed learning or improvements in other participating organisations other than your own, perhaps at the inter-agency or system level? Have other participating organisations reported adapting or aligning their practices based on shared exercise experiences?
- Do you believe these exercises have contributed to greater effectiveness (i.e. faster, cheaper, better future responses) at the broader system level? If so, how?
- Reflecting on the concept of “training transfer failure” when knowledge is lost following exercises, what are the biggest obstacles in transferring learnings from operational exercises into real-world emergency response logistics?