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A Framework for Leveraging IT to Improve Humanitarian Response

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Abstract: This research presents a comprehensive framework for utilizing information technology (IT) to enhance the effectiveness of humanitarian logistics management. By employing value stream mapping, we conducted a thorough analysis of the current (AS-IS) business processes involved in humanitarian response. Through this analysis, we identified significant inefficiencies and bottlenecks that hinder the timely delivery of aid. Addressing these challenges, we propose a new (TO-BE) business process model that incorporates the implementation of a warehouse management system (WMS). This innovative approach is expected to significantly reduce lead times by 25%, thereby improving the overall efficiency and effectiveness of humanitarian operations.The proposed framework outlines the key steps and considerations for integrating IT solutions into humanitarian logistics, providing a valuable guide for organizations seeking to optimize their response capabilities and save lives.

Keyword: Humanitarian Warehouse, Waste, Value Stream Mapping, Lean Warehousing.

INTRODUCTION

Humanitarian logistics, the proficient and effective administration of the movement of commodities and services to facilitate humanitarian assistance initiatives, is essential for preserving lives and mitigating suffering during emergencies. The intricate and frequently unpredictable characteristics of humanitarian missions present considerable obstacles to conventional logistical methodologies. To tackle these issues and enhance the promptness and efficacy of humanitarian response, it is essential to utilise the capabilities of information technology (IT).

One of the primary reasons VSM is crucial in this context is its ability to visualize the entire supply chain process, from the point of origin to the final delivery of aid. By mapping out the current state of operations, humanitarian organizations can identify bottlenecks and non-value-added activities that contribute to delays. For instance, Aghda and Siswanto demonstrate how VSM can be employed to analyze the handling process in warehouses, revealing significant time wasted in various stages of operation (Rosihan Aghda & Siswanto, 2021).

This identification of waste is critical in humanitarian logistics, where timely delivery can significantly impact the effectiveness of aid efforts. Moreover, VSM facilitates a systematic approach to continuous improvement. By creating a future state map, organizations can design optimized processes that reduce lead time. For example, in the context of humanitarian logistics, Rodríguez-Espíndola et al. highlight the potential benefits of integrating Geographic Information Systems (GIS) with VSM to enhance facility location and resource allocation during emergencies (Rodríguez-Espíndola et al., 2016). This integration can lead to more efficient routing and quicker response times, which are vital in crisis situations. The application of VSM also supports the identification of specific waste types prevalent in humanitarian operations. The "seven wastes" framework—overproduction, waiting, transportation, extra processing, inventory, motion, and defects—can be effectively analyzed using VSM. This approach allows organizations to focus on eliminating these wastes, thereby improving overall efficiency and reducing lead times. Nadondu's study emphasizes the importance of eliminating unnecessary movements and optimizing scheduling to enhance productivity in logistics operations, which is directly applicable to humanitarian warehouses (Nadondu et al., 2024).

This research seeks to establish a comprehensive framework for leveraging information technology to improve humanitarian logistics management. Through the examination of the existing humanitarian logistics procedures and the identification of significant inefficiencies, we aim to uncover prospects for technology intervention. By employing value stream mapping, a lean technique designed to visualise and enhance the flow of materials and information, we will acquire a comprehensive understanding of the current business processes and their related challenges.

Our analysis leads us to suggest a novel business process model that integrates the development of a Information Technology at the warehouse. Prior to that, we performed observations and analysis about the prevalent hurdles in the warehouse, subsequently identifying the waste present in the existing business process.

WMS is an advanced software solution intended to enhance warehouse operations, refine inventory management, and facilitate the fulfilment process. Integrating WMS into humanitarian logistics is expected to yield substantial enhancements in lead times, cost reductions, and improved overall efficiency. This research will yield significant insights and pragmatic recommendations for organisations engaged in humanitarian aid, enhancing their capacity to assist those in need.

METHOD

Gaining a comprehensive understanding of the existing humanitarian logistics processes and identify areas for improvement, we employed value stream mapping. This lean methodology involves visually representing the flow of materials and information, highlighting value-added activities and identifying waste. By mapping the current state (AS-IS) of the logistics process, we were able to identify bottlenecks, inefficiencies, and non-value-adding activities that hinder the timely delivery of humanitarian aid. This analysis provided a solid foundation for developing a proposed future state (TO-BE) process that incorporates innovative IT solutions, such as a warehouse management system, to optimize operations and enhance the overall effectiveness of humanitarian response.

According to (Horsthofer-Rauch et al., 2022), the Value Stream Mapping (VSM) is a recognised technique for examining industrial processes, material flows, and information flows in the context of technology deployment. Ensuring organisational sustainability necessitates ongoing enhancements, and Value Stream Mapping (VSM) is a recognised Lean methodology for pinpointing and minimising waste. This is utilised to generate value and improve performance across several industries. The value of VSM has swiftly transitioned from traditional to intelligent, prompting heightened attention from researchers and

practitioners in this field (Batwara et al., 2023). The findings of the research (Reda & Dvivedi, 2022) indicate that VSM is a suitable analytical instrument for organisations with limited technological investment in their business operations. Consequently, we organised a focus group session with disaster organization executives to explore the challenges at the primary warehouse. The Value Stream Mapping (VSM) of the existing condition reveals the locations of waste and delineates the lead time associated with each warehousing procedure.

RESULTS AND DISCUSSION

The value stream mapping analysis revealed several inefficiencies and bottlenecks within the existing humanitarian logistics processes. These included excessive manual data entry, redundant tasks, and delays in information flow. Additionally, the lack of a centralized inventory management system contributed to stockouts and overstocking, resulting in increased costs and decreased responsiveness.

To address these challenges, the proposed framework incorporates the implementation of a warehouse management system (WMS). The WMS is designed to automate various tasks, such as inventory tracking, order processing, and putaway strategies, significantly reducing manual effort and improving efficiency. Furthermore, the WMS will enable real-time visibility of inventory levels, enabling more accurate demand forecasting and optimized resource allocation. The graphic below indicates that the time required for products handling per truck is 405 minutes for value added (VA) activities, alongside a non-value added (NVA) duration of 180 minutes, hence extending the total time necessary for the warehousing operation from incoming to outgoing.

Table 1 Process Activity Mapping

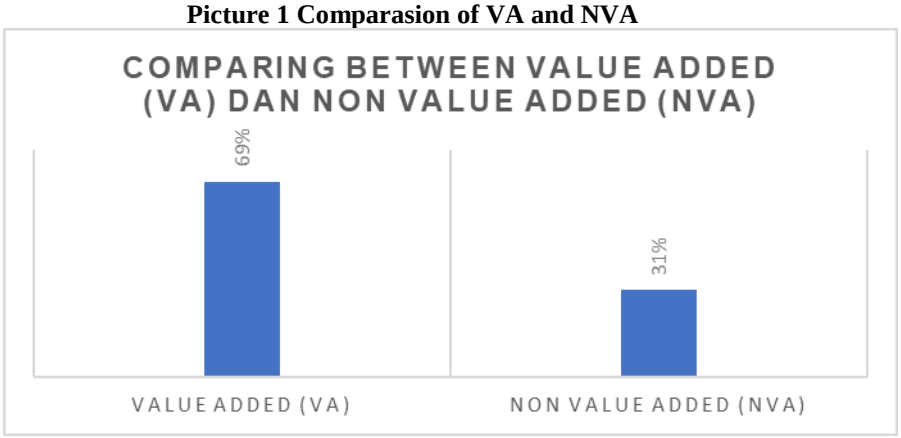
Process Activity Mapping									
				Activity					
No	**Activity (Per Truck)**	**Jumlah TK**	**Waktu (Menit)**	**O**	**T**	**I**	**S**	**D**	**Kategori**
1	Kegiatan Loading	1 to 3	60	✓					VA
2	Mengambil Surat Jalan	1 to 3	2		✓				NVA
3	Melakukan Pengecekan Surat Jalan	1 to 3	5			✓			NVA
4	Melakukan Perpindahan Barang dari Area Loading ke Area Receiving	1 to 3	13			✓			NVA
5	Kegiatan Receiving	1 to 3	30	✓					VA
6	Melakukan Perpindahan Barang dari Area Receiving ke Area Sorting	1 to 3	20		✓				NVA
7	Kegiatan Sorting	1 to 3	30	✓					VA
8	Melakukan Perpindahan Barang dari Area Sorting ke Area Penyimpanan	1 to 3	60				✓		NVA
9	Kegiatan Penyimpanan	1 to 3	5760	✓					VA
10	Melakukan Perpindahan Barang dari Area Penyimpanan ke Area Picking	1 to 3	25		✓				NVA
11	Kegiatan Picking	1 to 3	120	✓					VA
12	Melakukan Perpindahan Barang dari Area Picking ke Area QC/Checking	1 to 3	5			✓			NVA

13	Kegiatan QC/Checking	1 to 3	45	✓					VA
14	Melakukan Perpindahan Barang ke Area Loading	1 to 3	50		✓				NVA
15	Kegiatan Loading	1 to 3	60	✓					VA

Source: Research data

notes:
O = Operation / T = Transportation / I = Inspection / S = Storage / D = Delay

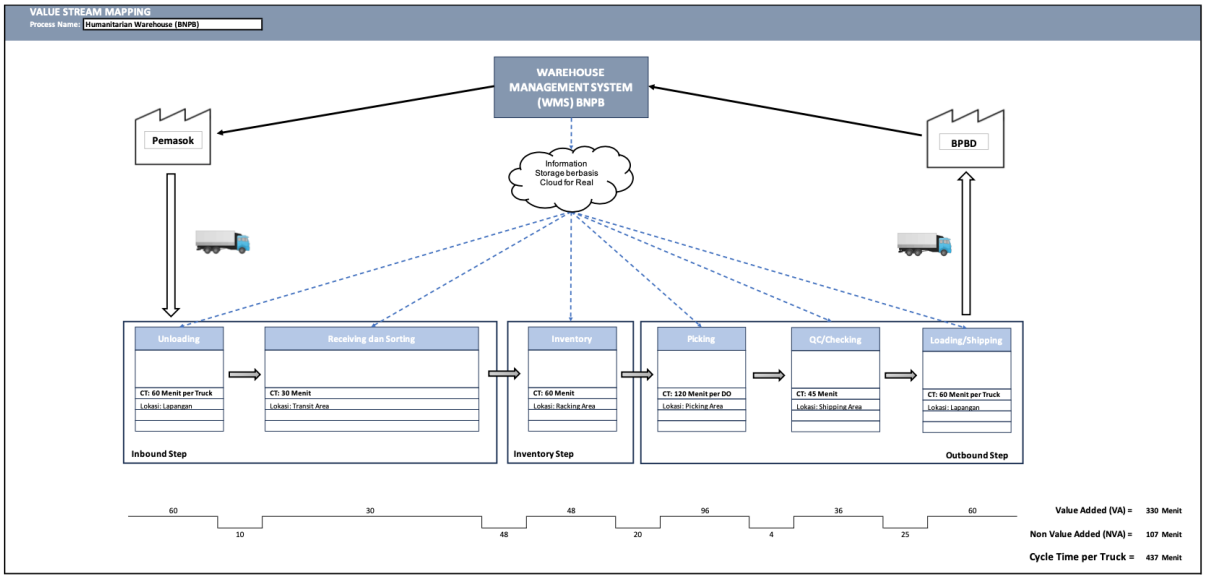
Picture 1 Comparasion of VA and NVA



Source: Research data

The picture indicates that 69% of warehouse procedures are categorised as value added (VA) and 31% as non value added (NVA). This conclusion indicates that the warehousing process necessitates ongoing enhancement, particularly to diminish the amount of procedures classified as non-value added (NVA), so enabling more efficient operations. Comprehending the categories of waste in business operations is crucial for organisations aiming to enhance efficiency and productivity. Waste is defined as any activity that fails to enhance the value of a product or service from the customer's viewpoint. The primary concepts of lean manufacturing are the identification and removal of waste, with the objective of optimising processes and minimising costs. By delineating the present operating condition, enterprises can pinpoint inefficiencies including overproduction, delays, superfluous movements, faults, and surplus inventories (Willian et al., 2023).

Different categories of waste can be classified according to lean manufacturing concepts. The "seven wastes" framework delineates overproduction, waiting, transportation, excessive processing, inventory, motion, and defects as critical areas necessitating enhancement (Anshori & Karya, 2022). (Alam & Farmaciawaty, 2020) emphasise that in inventory management, waste may manifest as surplus stock, which occupies capital and storage capacity, thus diminishing overall efficiency. Novirani's research also indicates that faults, delays, and surplus inventory are prevalent in the production process, underscoring the necessity for systematic waste reduction techniques (Novirani et al., 2024). The utilisation of VSM aids in recognising waste and enables the creation of a future state map that suggests enhancements. Diah et al. shown that by removing 17 non-value-adding operations, they significantly reduced waiting time and enhanced productivity (Diah et al., 2018). The continuous improvement process is crucial for sustaining competitiveness in the continually evolving corporate landscape of today.



Source: Research Results

Picture 2 VSM To-Be Map

Researchers examine the optimisation of process lead time under two scenarios: moderate and optimistic. Under reasonable conditions, a disaster management agency utilising lean warehousing without supplementary technology can enhance process value and decrease process lead time by 14.5%. Under favourable circumstances, the implementation of a warehouse management system results in a 25% reduction in process lead time.

CONCLUSION

Based on the findings of this research, it is evident that the implementation of both warehouse management systems and lean warehouse management practices can significantly reduce lead times in humanitarian warehouses. The results demonstrate a 25% decrease in lead time when technology is implemented and a 14.5% decrease when only lean practices are adopted.While both approaches offer substantial benefits, the optimal choice for a humanitarian organization may depend on various factors such as budget constraints, operational scale, and the specific needs of the target population. Future research could explore the long-term impacts of these changes on organizational efficiency, sustainability, and the ability to meet humanitarian needs more effectively.

By understanding the trade-offs and synergies between technology and lean practices, humanitarian organizations can make informed decisions to optimize their operations and maximize their impact.One limitation of this study is the relatively small sample size of humanitarian warehouses examined. While the findings provide valuable insights, they may not be representative of the entire population of such facilities, particularly those operating in different regions or with unique operational characteristics. Future research could expand the sample size to increase the generalizability of the results.Finally, the research did not delve into the long-term sustainability of the implemented changes. It is important to assess whether the initial benefits of technology and lean practices are maintained over time, and if there are any unintended consequences or challenges that may arise. Future research could examine the sustainability of these approaches and identify strategies for overcoming potential obstacles.

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