EASR

Engineering and Applied Science Research

https://www.tci-thaijo.org/index.php/easr/index

Published by the Faculty of Engineering, Khon Kaen University, Thailand

Outbound logistics resilience considering customer participation level: A case study of Thailand's sugar factory

Woramol C. Watanabe[1)], Sooksiri Wichaisri[2)] and Patchanee Patitad*[1)]

[1)]Department of Logistics and Digital Supply Chain, Naresuan University, Phitsanulok 65000, Thailand
[2)]Airports of Thailand Public Company Limited, Chaing Mai 50200, Thailand

Received 12 April 2023
Revised 24 July 2023
Accepted 26 July 2023

Abstract

The sugar industry plays an important role in Thailand's economy. Due to current disruptions, the sugar supply chain is facing a drop in demand and a labour shortage. This has forced the chain to adapt to get through this crisis. To do so, the supply chain resilience concept becomes of the utmost importance and can ensure a prompt and efficient process. Especially outbound logistics are of concern, being time- and labour-consuming due to the heavy weight and large volume nature of sugar. This means the chain is fragile and lacks resilience. To enhance the resilience, process improvement initiatives and collaboration with customers are now in focus to minimise the processing time and labour. Analysis of the relationship between the level of customer participation and improvement results is also proposed to provide valuable insights for decision-makers in their investment planning. In this paper, waste that impacts the processing time is eliminated after the analysis reveals that the most time-consuming steps are preparing the product based on the order and arranging the products in the truck, primarily involving movement of the sugar. The solutions proposed to improve these processes include the implementation of push-pull forklift technology and a booking system, resulting in a 20.25% reduction in the overall processing time. By fully leveraging the booking system and optimising the forklift system, the overall processing time can be further reduced by 39.29%. To achieve the optimal performance, it is recommended to utilise the booking system to its maximum capacity, ideally reaching 100% utilisation but at least exceeding 50%.

Keywords: Value stream mapping, Process improvement, Customer cooperation, Sugarcane

1. Introduction

The sugar industry plays an important role in maintaining the economy of Thailand. Since the spread of the coronavirus, however, the countries that produce sugar have been facing several challenges [1]. Dramatic changes such as reduced sugar consumption, the shortage of labour and critical inputs have been in the spotlight [2], especially for sugar factories. Since the onset of the viral outbreak, there has been a considerable decline in sugar consumption in Thailand, which dropped to around 2.30 million tons, a decrease compared to the 2.45 million tons consumed in 2019 [3]. Besides the drop in demand, the labour shortage has become a critical issue due to the lockdown. The return of migrant workers from cane farms to their home countries has also contributed to the reduction in sugar consumption. This is forcing factories to challenge their managing and manufacturing costs and increase their ability to resist this crisis. To avoid chain disruption, a trend towards building supply chain resilience is taking place. Supply chain resilience refers to the ability of a supply chain to prepare for and adapt promptly to respond to changes by modifying processes, products, and technologies. To enhance the resilience of the supply chain, process improvement and collaboration among its members become important approaches.

The outbound logistics of the sugar industry are of concern as a time- and labour-consuming process that leads to fragility of the industry. This involves the process of managing and executing the movement of finished sugar products from the factory to their intended destinations, such as distribution centres, wholesalers, retailers, or directly to customers, and mainly involves the time-consuming physical movement of the sugar products. Because sugar products are a heavy and high-volume commodity, these processes inherently involve a significant amount of time and attention. The quantity and weight of sugar necessitate careful handling during the loading and unloading stages, further contributing to the time-consuming operations. In the context of supply chain resilience, it becomes evident that such time-consuming processes can present various challenges that have the potential to disrupt the overall efficiency and responsiveness of the supply chain.

For more effective outbound logistics of the sugar industry, the physical distribution, such as the storing, picking, loading, and shipment processes, needs to be optimised and organised well. Since 2009, according to the ScienceDirect database, outbound logistics have experienced rapid growth, as shown in many pieces of research on both academic and application aspects, especially in industrial engineering, transportation, and management. These research works mainly focus on internal processes such as improving delivery

*Corresponding author.
Email address: patchaneep@nu.ac.th
doi: 10.14456/easr.2023.41

[4, 5], warehouse management [6, 7], reducing redundancy [8, 9], and reducing internal costs [10, 11]. As is known, outbound logistics involves seeking the shortest distance to customers, while the abovementioned research on process improvement has focused only on the internal process. However, without involving customer participation in the improvement, the industry may find itself misaligned with customer expectations, with a decreased ability to proactively respond to disruptions.

Customer participation is a pivotal aspect in process improvement, particularly in the context of outbound logistics, which directly interfaces with the customer. A higher level of customer participation leads to higher efficiency and resilience [12]. Involving customers in the outbound logistics process promotes collaboration and communication, leading to greater flexibility and adaptability [13]. Organisations can better understand their delivery preferences, requirements, and expectations, which leads to enhanced customer satisfaction and accurate delivery planning. While a higher level of customer relationship management generally yields greater benefits, it is nevertheless important to consider potential limitations and expectations, such as resource availability, associated costs and the expected results, when determining the appropriate level of customer involvement in the improvement process.

Therefore, in this paper, the improvement of outbound logistics under the concept of resilience is proposed as a means to avoid supply chain fragility. Besides, the concept of the level of customer participation is included to analyse its relationship with the improvement results. This work contributes by designing a mixed improvement approach that combines the concepts of the resilience of the internal process and the level of customer involvement. This work also aims to reduce the processing time and labour that are required at the case study company. The waste inherent in the processes is identified and eliminated. In addition to analyzing the level of customer involvement in the improvement process, we have also examined the level of customer participation. The concept of the customer participation level is introduced in the overall process by a simulation technique to assess customer behaviour. Using the proposed method, the effects of customer involvement in the improvement are shown through a case study.

2. Value analysis in outbound logistics

Logistics processes and supply chains are an important sphere for creating product added value [14]. Unpredictable situations such as COVID-19 and port congestion lead to uncontrollable business processes. The logistics and supply chain has become the key factor in the struggle with disruption. As an integral part of value chains, both within and across international borders, logistics are the processes in focus to facilitate trade and commerce and help businesses get their products to customers [15]. Figure 1 shows the value chain created by Porter in 1985 [16]. There are two types of activity – primary and secondary. Two of the five primary activities are related to logistics, of which outbound logistics is one. This clearly indicates the role and importance of logistics in creating value for the customer [14]. The term ‘outbound logistics’ relates to activities like preparing the final products for customers. It is mainly associated with physical distribution, order processing and scheduling. Outbound logistics aims to fulfill customer needs, such as on-time delivery and correct products.

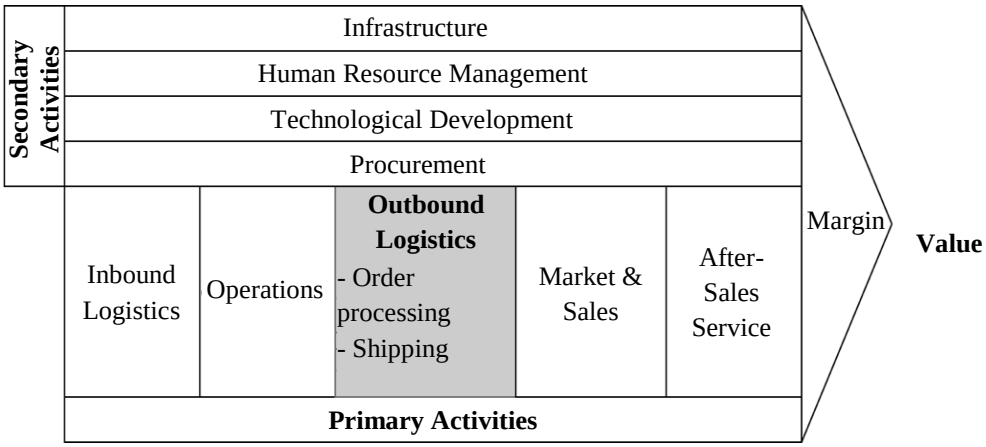

Figure 1 Value chain (adapted from Porter [16])

Outbound logistics is currently facing many challenges such as shipping and labour shortages, changes in the supply chain structure, and higher customer expectations [17]. This is forcing firms to modify and improve their operations to be resilient and more efficient. To serve the customer correctly, customer participation and cooperation should also be generated. For example, increasing the visibility of the processes may need some platform that both the firm and the customer can access. Yet, if the customer is not willing to use it, this is a wasted investment.

In the research field, there are many studies that focus on outbound logistics. Since 2021, from the Google Scholar database, there have been more than 1,000 articles on the subject of outbound logistics improvements. Considering customer participation also, there are many research works that focus on the level of customer participation, as shown in Table 1.

Table 1 presents an overview of the topics, methods, outcomes, and applications in the research related to customer participation. Most of the outcomes demonstrate a positive relationship between higher customer participation and improved performance or satisfaction. However, only limited attention has been given to the analysis of customer satisfaction levels that identifies an optimal level of such participation. This gap is particularly evident in the context of outbound logistics, where research that specifically investigates the interplay between outbound logistics and customer participation is scarce. Most existing studies primarily examine the relationship between customer participation and other factors, neglecting the direct association with outbound logistics. Given the fact that customer participation determines whether outbound logistics improvement is a success or not, the inclusion of the concept of customer participation in these frameworks means that a more practical method can be expected.

Table 1 Examples of research work

Topic	Method	Outcome measured	Application
Construction and validation of the customer participation scale [18]	Measurement scale and survey	Scale of customer participation	Service industry
Customer participation in the service process: a model and research propositions [19]	A proposed framework	Relationship of customer participation and other factors	Service industry
Customer participation in service specification and delivery [20]	Questionnaire	Effect of customer participation on perceptions of quality and satisfaction and repurchase.	Service specification and delivery
Customer participation and new product performance: towards the understanding of the mechanisms and key contingencies [21]	Survey	Intervention in customer participation	New product development
Managing customer participation in the service production process [22]	Survey	Level of customer participation (low, medium, high)	Service production process
Innovation mechanism of customer participation and new product development stages in banking: an empirical research in B-C [23]	Survey	Impact of customer on the process	New banking product development
Customer participation in services: a framework for process design [24]	A design-oriented modelling framework	How the participation of customers can be designed best	Service industry
Customer-oriented improvement and evaluation of supply chain processes supported by simulation models [25]	Simulation model	An evaluation method for process improvements that impact on enhanced customer satisfaction	An electronic manufacturer
The effectiveness of customer participation in new product development: a meta-analysis [26]	Meta analysis	Customer participation improves new product financial performance directly as well as indirectly through acceleration of time to market	New product development
The impact of customer participation: the employee's perspective [27]	Partial least square path modelling in SmartPLS	Customer participation can be a win-win situation for employees and the service firm	Service delivery process
Consumer participation in last-mile logistics service: an investigation on cognitions and affects [28]	An online panel of respondents, exploratory factor analysis and structural equation modelling.	Consumers' participation is stronger motivation on their cognitions	Last-mile delivery

3. Outbound logistics improvement

As mentioned before, since outbound logistics involves cooperating with customers, the effects on customers related to its improvement should be examined. The framework proposed here aims not only to improve the outbound logistics of the case study but to introduce the concept of customers that are willing to participate in that improvement.

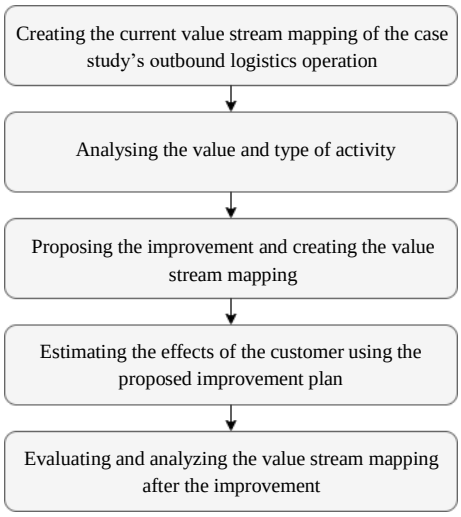

Figure 2 Outline of the proposed method

The outline of the proposed method is illustrated in Figure 2. Firstly, to understand the current case study, the case company's outbound logistics process is surveyed, and all the related data, such as the operation time and staff numbers, is collected and input into its value stream mapping. Then, to analyse the wastes in the current process, all the activities are characterised by their type and the

non-value-added activities are then identified and targeted for elimination. To eliminate the waste, the approach proposed to improve the outbound logistics of the case study concerns both internal and external processes, involving the use of new machinery and the inclusion of customer participation. To assess the impact of customer participation on the company, a simulation is conducted to estimate its effects on the waiting time of the process. The level of customer participation is analysed and inspected based on these estimations to determine the most effective level. In this study, customer participation is defined as the percentage of the total number of customers who actively engage in and utilize the proposed improvement. Finally, the results of the outbound logistics process for the case company are determined. A comparison is made between the duration and labour requirements of the process before and after the proposed improvements are implemented.

4. Case study

The case study is of a sugar factory located in northern Thailand [29], which produces three product types: white sugar, refined sugar, and raw sugar. Figure 3 illustrates the current (as-is) VSM of the factory. The set of boxes represents all processes related to the factory's outbound logistics. Each box includes five elements of information: the upper blue box shows the name of the process, the bigger white box shows the number of staff or facilities needed, and the three boxes below display the uptime of the facilities, processing times, and shifts.

The processes begin with the arrival of the customer's truck. The truck driver exchanges the ticket or order at the security checkpoint at the factory entrance and proceeds to the reception area to obtain all the necessary documents, including the order details. The truck is then weighed to determine its weight, after which the driver drives the truck to the warehouse. Upon reaching the warehouse, the driver hands over the order documents to the officer, and the truck is directed to the designated pick-up area within the warehouse.

Upon arrival at the pick-up area, a team of staff members, typically consisting of 20 individuals, prepares and loads the products into the truck based on the order details. This ensures efficient and timely movement of the products. The staff members confirm the accuracy of the order with the driver, and if it is correct, they cover the truck securely with a canvas. The truck proceeds to the reception area, where staff provide the necessary certificate for the order. Another weight check is conducted to ensure compliance with weight limits.

To exit the factory, the driver obtains the required transport permission and the order invoice. Finally, the driver returns the ticket to the security checkpoint, completing the outbound logistics process.

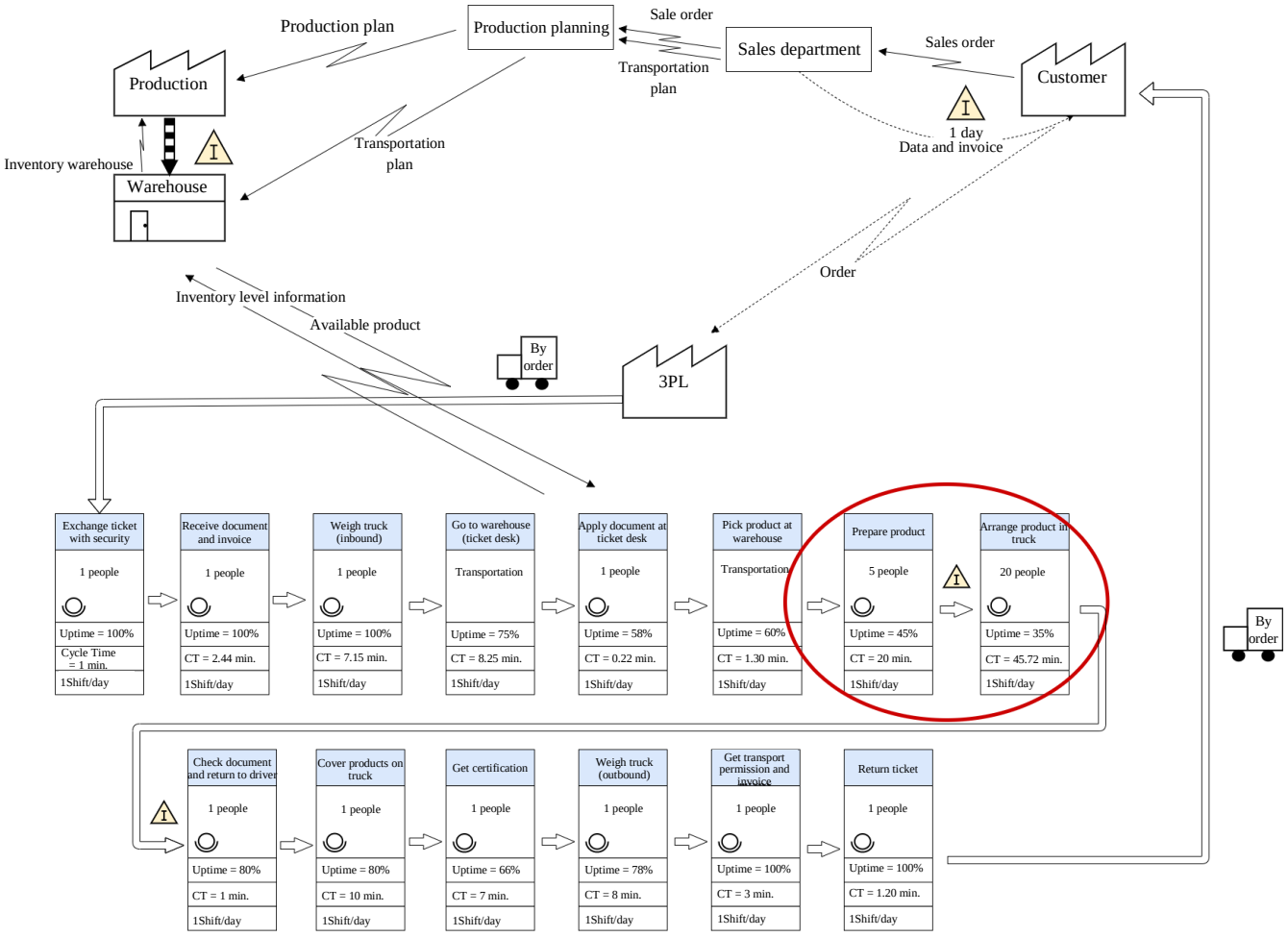

Figure 3 VSM of the current stage of the case study

The 14 processes start from the "exchange ticket with security" process and end with the "return ticket" process. These processes will in fact start when a customer sends an order to the sales department and it is then sent to production planning. The order is converted into a production plan and transportation plan. Meanwhile, the truck that is prepared by the customer will arrive at the company and then the first process will be started.

After analysing the current VSM, the "prepare product" and "arrange product in truck" processes involve a long processing time, with a high staff requirement, and low availability. So, these are considered as the two critical processes (circled in Figure 3). The details of these processes are shown below.

- The "prepare product" process: this starts after the customer's truck driver informs the ticket desk of the product, after which the product will be prepared. This process requires 5 staff with a 20-minute processing time. Because of the large number of staff required, the uptime of this process is 45%.
- The "arrange product in truck" process: for this, the sugar products need to be arranged in the truck. Currently, this process is done by 20 staff putting sugar sacks into the truck and setting them properly. Managing this number of staff at the same time will sometimes be problematic. As shown, the uptime of the process is only 35%, which is the lowest value, while the processing time has the highest value at 45.72 min.

Considering only improving the processes and their value, both processes are time- and staff-consuming work because the staff need to move sugar sacks that weigh at least 50 kg. To improve these processes, a labour-saving approach is considered first, for which using push-pull forklift technology with a suitable plant layout is proposed [29]. The "prepare product" process, as a non-value-added activity, should be eliminated. To do so, a booking system will be introduced so that the company knows when the customer will come and the factory can then prepare in advance. The details of these approaches are shown below.

- Push-pull forklift technology can be effectively used in the process of arranging the sugar sacks in the truck. The operator positions the forklift in front of the stack of sugar sacks and engages the push-pull attachment. By exerting controlled force, the operator pushes the stack towards the back of the truck, ensuring proper positioning. This technology enables efficient and precise arrangement of the sugar sacks, reducing also the need for a large number of staff members, which can be cut from 20 to 2.
- The functions of the proposed booking system are an online interface, resource availability checking, real-time updates, and confirmation and notifications. It allows the customer to interact with the booking system with up-to-date availability information, while the factory can plan to ensure the availability of the necessary resources. Using the system leads to a reduction of the overall process duration.

5. Result

Figure 4 and Figure 5 display the value stream mapping of the case study after applying only the push-pull forklift and applying both the push-pull forklift and booking system, respectively. In Figure 4, the "arrange product in truck" process is performed by using the push-pull forklift so the number of staff working in this process can be reduced from 20 to 2, which is one tenth of the current situation. The uptime is increased from 45% to 97% while the processing time decreases from 45.72 minutes to 23 minutes, which is approximately 49.69%. By applying both the forklift and the booking system (assuming that all customers use the system), the preparing processes are eliminated, so this process time is eliminated too. The uptime is increased from 45% to 90%, because the staff that needed to work on other processes before the improvement are not needed after it.

Considering the number of staff that are required in the process, investing only in the push-pull forklift can reduce this from 20 to 2. In the case that the crisis leads to a shortage of labour, this result can be considered a way of solving the problem, as obtaining only two staff is not as difficult as finding 20 in the current circumstances. In the same way as with the booking system, provided all customers are willing to use it, the large number of staff working in the preparing process will no longer be necessary.

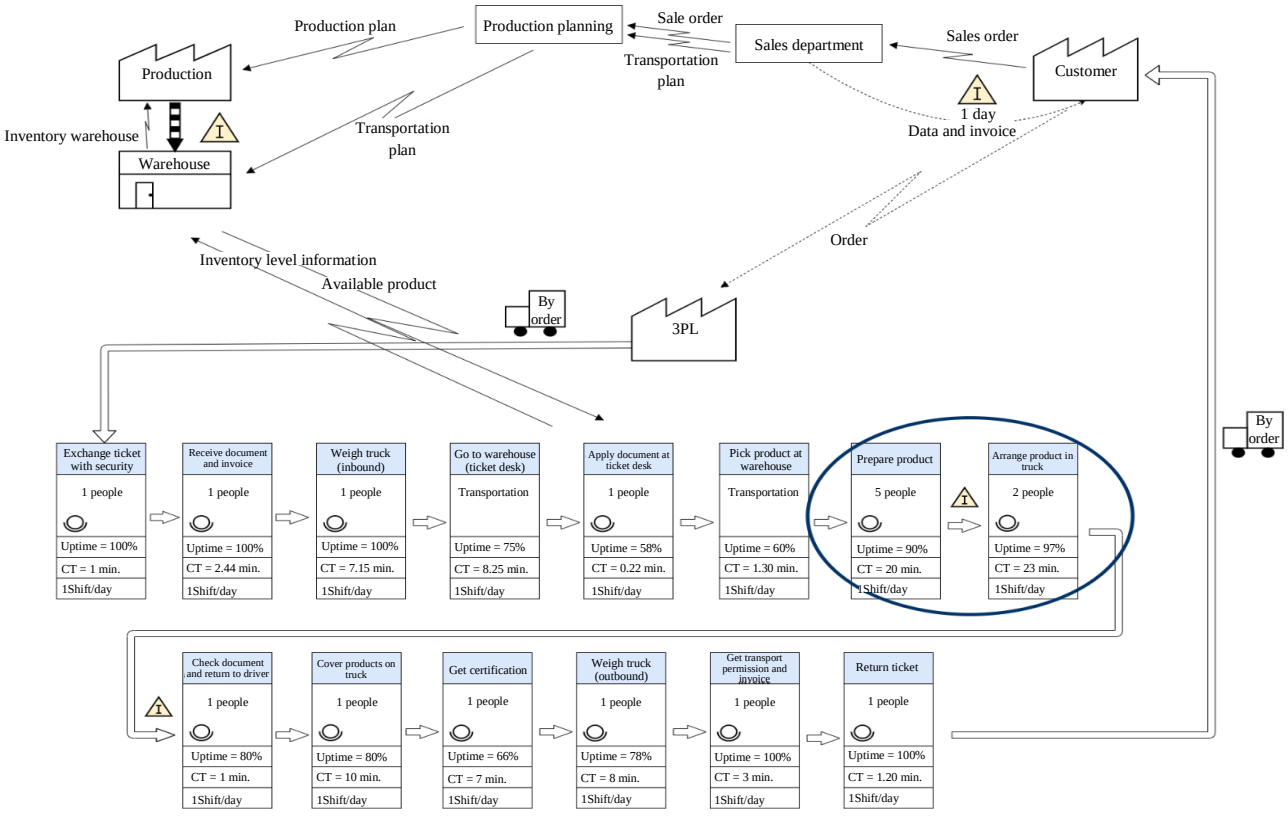

Figure 4 VSM of case study after improvement by applying the push-pull forklift

As seen in Table 2, the total time of the processes is decreased by 23.75 minutes or 20.25% with the application of the push-pull forklift. With both the push-pull forklift and the booking system, the total time is decreased by 37.29% or around 43.78 minutes.

Table 2 Process and time comparison for outbound sugar sacks of the case study

Activity	Type of value	Type of activity	Current VSM (min)	After improvement VSM with the push-pull forklift (min)	After improvement VSM with the push-pull forklift and the booking system (min)
Exchange ticket with security	NNVA	I	1.00	1.00	1.00
Receive document and invoice	VA	I	2.44	2.44	2.44
Weigh truck (inbound)	NVA	I	7.15	7.15	7.15
Go to warehouse (ticket desk)	NNVA	T	8.25	8.25	8.25
Apply document at ticket desk	NNVA	O	0.22	0.22	0.22
Pick product at the warehouse	NNVA	T	1.30	1.30	1.30
Prepare product based on order	NVA	O	**20.00**	**20.00**	-
Arrange products in the truck	VA	O	**45.72**	**23.00**	**23.00**
Check document and return to driver	NVA	I	1.00	1.00	1.00
Cover products on truck	NNVA	O	10.00	10.00	10.00
Get certification	VA	I	7.00	7.00	7.00
Weigh truck (outbound)	NNVA	I	8.00	8.00	8.00
Get transport permission and invoice	VA	O	3.00	3.00	3.00
Return ticket to security	NNVA	O	1.20	1.20	1.20
		Total	116.28	93.56	73.56

**VA = Value-added, NA = Non-value-added, NNVA = Necessary non-value-added*
I = inspection, T = Transportation, O = Operation

Both procedures require a high investment. Applying the push-pull forklift can be considered as an internal process so it is easier to control its efficiency. However, the booking system needs to work with the customers, so it is difficult to determine if the company should invest in the system and whether this would be practical or not.

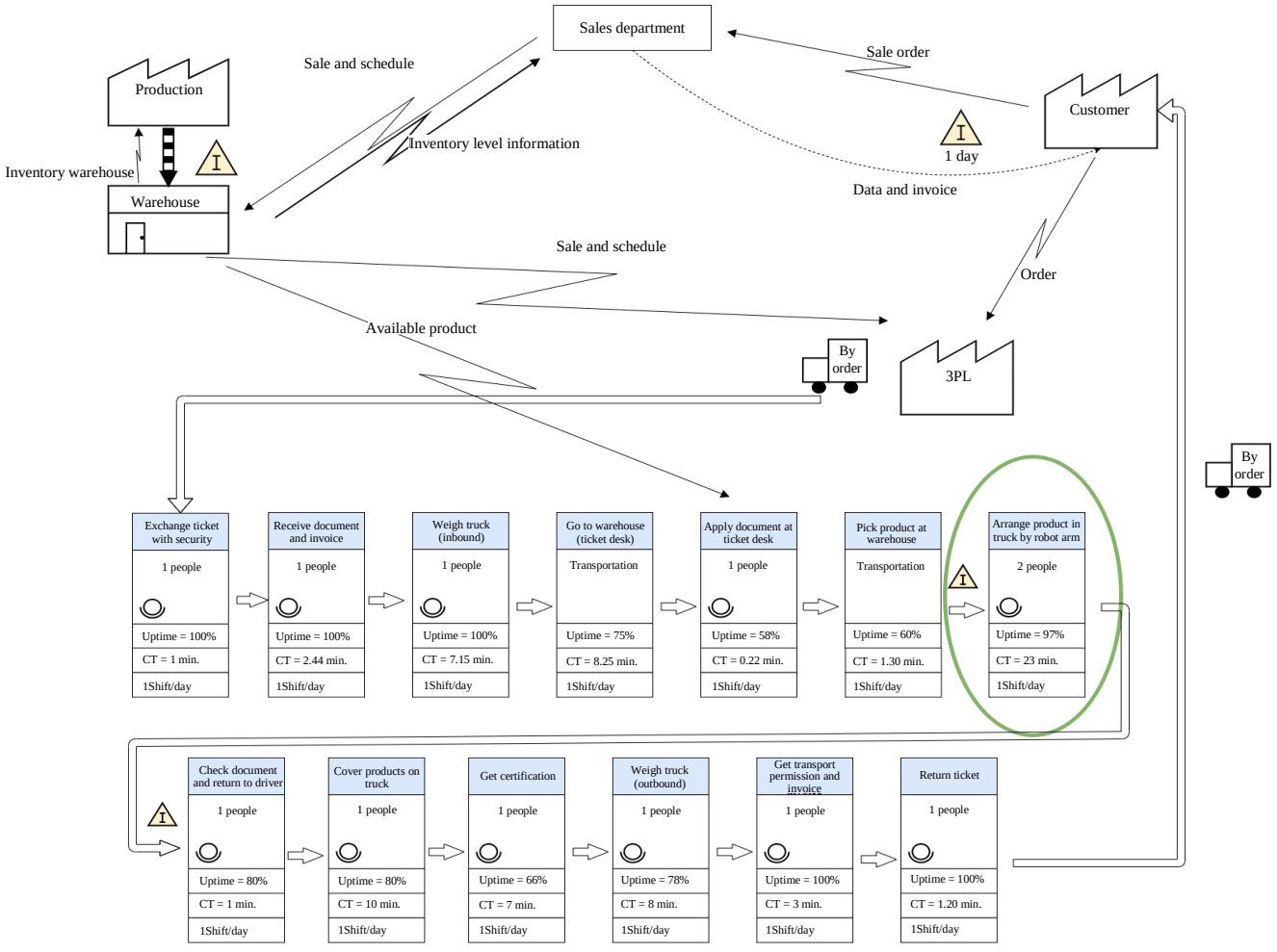

Figure 5 VSM of case study after improvement by applying both the push-pull forklift and the booking system

6. Customer participation analysis: The booking system

The actual effects of applying a booking system should be investigated to compare the efficiency of the overall processes. In addition, the number of customers that are likely to use the booking system should be explored to find the minimum level needed to improve the overall efficiency. However, the concrete effects of using the booking system are difficult to determine. Thus, a method to infer the minimum level of customers needed to use the booking system from observed data with several assumed parameters has been developed and simulated. The proposed method has been applied for the scenarios shown in Table 3.

Table 3 The scenarios

Scenario	Customers participating: Customers not participating
1	0:100
2	30:70
3	50:50
4	70:30
5	100:0

A simulation technique is a technique that aims to aid in solving the practical problems of research and analyse complex systems [30]. Arena software is applied in this paper to demonstrate all the scenarios of the case study. The data used in the simulation module is collected from the actual data of the case study factory. The processing time of all the activities is described as a triangular distribution. The arrival of the customer truck is shown as an exponential distribution by -0.001 + 153 * BETA (1.11, 0.748). The operation time per day is 8 hours. The number of repetitions used in this research is 30.

Table 4 Simulation result

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Average total time (min)	103.57	96.34	91.75	84.83	76.49
Average process time (min)	95.23	88.51	85.07	81.51	74.32
Average waiting time (min)	8.34	7.83	6.68	3.32	2.17
Waiting time reduction (%)		6.12	19.9	60.19	74.03

Table 4 presents the simulation results and shows that the criteria of scenario 5 yield the best value. The average total time of 103.57 minutes in scenario 1 is decreased to 76.49 minutes in scenario 5, or by approximately 26.15%. By comparison with the average total time of scenario 1, the results for the other scenarios are 96.34 minutes (scenario 2), 91.75 minutes (scenario 3), and 84.83 minutes (scenario 4).

The average processing time is considerably decreased when the number of customers using the booking system increases, but the average waiting time does not show the same trend. Figure 6 compares the average waiting time in each scenario.

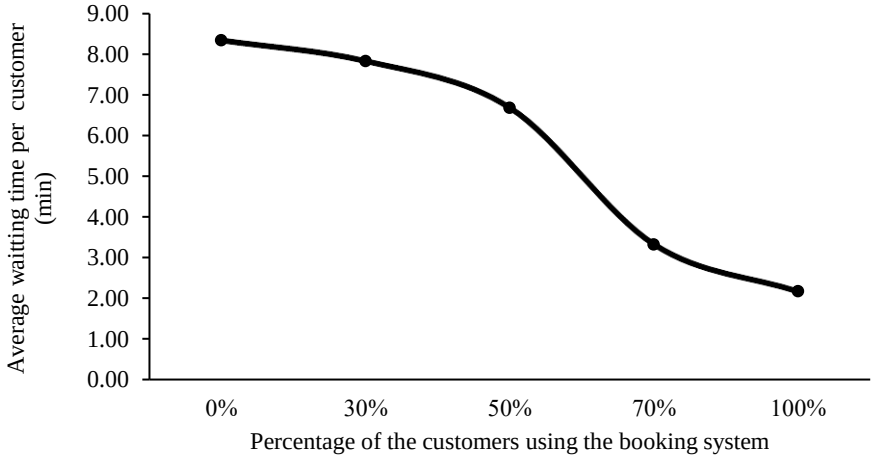

Figure 6 Average waiting time under five scenarios

In Figure 6, the line shows the average waiting time of a customer using the booking system under the five scenarios. The horizontal axis presents the percentage of customers using the booking system under the five scenarios. It is evident that the slope of the graph can be separated into two sections. When the percentage of customers is less than 50%, the slope indicates a slight decrease but when it is more than 50%, the slope shows a more noticeable decrease. Overall, the total time required for the process is decreased, but for the best performance, the booking system should be used by 100% of customers, or at least more than 50%.

From analysing all five scenarios, it is clear that improving the booking system depends on the customer side. Therefore the trade-off between the benefits to the company and the cost-worthiness must be considered. And to achieve the best performance of the overall process, all the constituent processes should be in focus. When some processes rely on other parties such as suppliers or customers, the effects of the successful application should be observed. The advantages of using this model must be taken into consideration as well, to encourage the organisation to collaborate with other stakeholders.

7. Discussion

The study utilised VSM to analyse the value of the outbound logistics processes of a case company and identified a process that required improvement. To enhance the resilience of the process, we proposed improvements that reduced the processing time and minimised the workforce. Additionally, we introduced the concept of customer participation to analyse the overall process performance. The findings of our study provide empirical evidence of the potential for enhancing the outbound logistics process of the case company by reducing its operation times and labour requirements. These improvements enhance the flexibility of the process, allowing for greater resilience of its supply chain to unforeseen disruptions. Our study contributes to the understanding of customer involvement in the improvement of outbound logistics. The findings confirm the positive impact of higher customer participation on the organisation's process performance, thus aligning with earlier work in the literature. Additionally, our research extends previous studies by using a simulation technique to investigate the relationship between the level of customer participation and improvements in waiting time. These findings provide decision-makers with valuable insights for investment decisions aimed at enhancing customer satisfaction.

8. Conclusion

This paper aims to improve the outbound logistics of a Thai sugar factory as a case study. The process improvement and customer collaboration contribute to the supply chain resilience. To capture the processes of the company's outbound logistics, value stream mapping (VSM) is used. The types of processes are also categorised. The result of the analysis using VSM shows that the "prepare product" and "arrange product in truck" processes are problematic because they are time- and labour-consuming. To improve these processes, push-pull forklift technology and a booking system are proposed. As a result, the total time is decreased by 20.25% when applying only the push-pull forklift, and by 37.29% when applying both the push-pull forklift and the booking system for all customer users.

The research extends the literature review by providing a case study example of how customer participation, through a booking system, improves performance in outbound logistics. It addresses the identified gap in analyzing customer satisfaction levels and the interplay between customer participation and outbound logistics. The paper further addresses this gap by proposing solutions for waste reduction and process improvement, resulting in significant reductions in processing time. By leveraging the booking system and optimizing the forklift system, the overall processing time can be further reduced. This case study contributes to the literature by providing a tangible example of how customer participation enhances outbound logistics, emphasizing the importance of considering customer involvement in designing logistics frameworks for improved practical outcomes.

Along with some valuable findings, this study also has some limitations. The outbound logistics of the case study is analysed only from the value perspective; therefore, cost and finance perspectives also should be prescribed for any future study or work. One limitation of this work is the absence of validation tests, primarily due to resource constraints, including limited funding and lack of specialized equipment. Future research endeavors with adequate resources should consider incorporating validation tests to further strengthen the reliability and robustness of the findings. In this paper, the scenarios and the level of the participating customers that are used are assumptions, whereas, in actual cases, there are more complex conditions. Thus, these should be extended or examined to capture more substantial situations.

9. References

[1] Data Bridge Market Research. COVID-19 impact on sugar in the food and beverage industry [Internet]. 2020 [cited 2022 Feb 5]. Available from: https://www.databridgemarketresearch.com/covid-19-resources/covid-19-impact-on-sugar-in-the-food-and-beverage-industry.

[2] Solomon S, Rao GP, Swapna M. Impact of COVID-19 on Indian sugar industry. Sugar Tech. 2020;22(4):547-51.

[3] SugarAsia. Tackling Covid-19 impact on Thailand's cane sugar industries [Internet]. 2020 [cited 2023 Jul 15]. Available from: https://sugar-asia.com/tackling-covid-19-impact-on-thailands-cane-sugar-industries/.

[4] Nogueira GPM, de Assis Rangel JJ, Croce PR, Peixoto TA. The environmental impact of fast delivery B2C e-commerce in outbound logistics operations: a simulation approach. Clean Logist Supply Chain. 2022;5:100070.

[5] Schoon AL. Multi-criteria decision support for transportation network (re-)design at outbound logistics, Tata Steel Europe [thesis]. Netherlands: University of Twente; 2019.

[6] Eil WJ. The impact of order characteristics uncertainty on different configurations of the outbound logistics of a 3PL warehouse [thesis]. Netherlands: Delft University of Technology; 2022.

[7] Han-klup W, Samanchuen T. Design and simulation of outbound functions in warehouse operations with queueing theory. 18th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON); 2021 May 19-22; Chiang Mai, Thailand. USA: IEEE; 2021. p. 451-5.

[8] Watanabe WC, Patitad P, Janmontree J. Optimizing information flow in international trade transaction. J Syst Manag Sci. 2022;12(6):398-414.

[9] Watanabe WC, Patitad P. Reducing information redundancy for an international trade transaction: a lean information management approach. Ind Eng Manag Syst. 2022;21(2):183-91.

[10] Moonsri K, Sethanan K, Worasan K. A novel enhanced differential evolution algorithm for outbound logistics of the poultry industry in Thailand. J Open Innov Technol Mark Complex. 2022;8(1):15.

[11] Hakim IM, Abbas FMH. Optimization model of truck utilization to minimize outbound logistics cost. Proceedings of the 5th International Conference on Industrial and Business Engineering (ICIBE 2019); 2019 Sep 27-29; Hong Kong. New York: Association for Computing Machinery; 2019. p. 62-6.

[12] Yi X, Ul Haq J, Ahmed S. Impact of customer participation in value co-creation on customer wellbeing: a moderating role of service climate. Front Psychol. 2023;13:877083.

[13] Qadir I, Ali A. Importance of logistics processes for customer service and firm performance: evidence from furniture industry of Pakistan. Management: Journal of Sustainable Business and Management Solutions in Emerging Economies. 2017;22(3):27-36.

[14] Kilibarda MJ, Andrejić MM, Popović VJ. Creating and measuring logistics value. 1st Logistics International Conference Belgrade; 2013 Nov 28-30; Belgrade, Serbia. p. 197-202.

[15] Twinn I, Qureshi N, Conde ML, Guinea CG, Rojas DP, Luo J, et al. The impact of COVID-19 on logistics. International Finance Corporation; 2020.
[16] Porter ME. The competitive advantage: creating and sustaining superior performance. NY: Free Press; 1985. (Republished with a new introduction, 1998)
[17] Zhenhub. 4 logistics challenges and how to overcome them [Internet]. 2022 [cited 2023 Feb 6]. Available from: https://zhenhub.com/blog/logistics-challenges-and-how-to-overcome-them/.
[18] Chen SC, Raab C. Construction and validation of the customer participation scale. J Hosp Tour Res. 2016;41(2):131-53.
[19] Uzkurt C. Customer participation in the service process: a model and research propositions. Int J Serv Oper Manag. 2010;6(1):17-37.
[20] Cermak DSP, File KM, Prince RA. Customer participation in service specification and delivery. J Appl Bus Res. 1994;10(2):90-7.
[21] Morgan T, Obal M, Anokhin S. Customer participation and new product performance: towards the understanding of the mechanisms and key contingencies. Res Policy. 2018;47(2):498-510.
[22] Wattanakamolchai S. Managing customer participation in the service production process. 2008;8(1):1-9.
[23] Wu X, Sun Q. Innovation mechanism of customer participation and new product development stages in banking: an empirical research in B-C. 2012 International Joint Conference on Service Sciences; 2012 May 24-26; Shanghai, China. USA: IEEE; 2012. p. 270-4.
[24] Amorim M, Moscoso P, Lago A. Customer participation in services: a framework for process design. Int J Qual Res Serv. 2015;2(1):47-61.
[25] Reiner G. Customer-oriented improvement and evaluation of supply chain processes supported by simulation models. Int J Prod Econ. 2005;96(3):381-95.
[26] Chang W, Taylor SA. The effectiveness of customer participation in new product development: a meta-analysis. J Mark. 2016;80(1):47-64.
[27] Chen CCV, Chen CJ, Lin MJJ. The impact of customer participation: the employee's perspective. J Bus Ind Mark. 2015;30(5):486-97.
[28] Wang X, Yuen KF, Wong YD, Teo CC. Consumer participation in last-mile logistics service: an investigation on cognitions and affects. Int J Phys Distrib Logist Manag. 2019;49(2):217-38.
[29] Patitad P, Watanabe WC. Developing the model of managing warehouse for sugar product: case study of Phitsanulok Province, Thailand. IEEE 7th International Conference on Industrial Engineering and Applications (ICIEA); 2020 Apr 16-21; Bangkok, Thailand. USA: IEEE; 2020. p. 533-8.
[30] Guseva E, Varfolomeyeva T, Efimova I, Movchan I. Discrete event simulation modelling of patient service management with Arena. J Phys Conf Ser. 2018;1015(3):032095.