Management and Production Engineering Review
Volume 15 • Number 3 • September 2024 • pp. 1–17
DOI: 10.24425/mper.2024.151486

Reducing the Operation Lead Time using Integrated Standardized Service Time and Tailor-Made Value Stream Mapping

Filscha NURPRIHATIN[1], Francka Sakti LEE[2], Johanes Fernandes ANDRY[2], Anisa Pitriani KURAHMAN[1], Ivana Tita Bella WIDIWATI[1], Ali VAEZI[3], Mastoor M. ABUSHAEGA[4]

[1] *Department of Industrial Engineering, Sampoerna University, South Jakarta, 12780, Indonesia*
[2] *Department of Information Systems, Universitas Bunda Mulia, North Jakarta, 14430, Indonesia*
[3] *Department of Logistics and Supply Chain Management, Trent University, L1J 5Y1, Canada*
[4] *Department of Industrial Engineering, Faculty of Engineering, Jazan University, Jazan, 45142, Saudi Arabia*

Received: 17 December 2023
Accepted: 08 April 2024

Abstract
This study measures the performance of service operations of a café with waiting and service time parameters for customer satisfaction. The study contributes to reducing the lead time through standardized service time using Tailor-made Value Stream Mapping, Root Cause Analysis (RCA), and Time Study. This study observes the writer during a service operation at a café. The current state of VSM is created and followed by time study and analysis. The RCA is constructed based on brainstorming activity. It is suggested to improve the current process which is reflected in the future-state VSM. Lastly, this paper compares overall performance before and after the improvement implementation to conclude the effectiveness of this study. The result shows the increasing performance for food and beverage service in terms of VA, NNVA, NVA, LT, and PCE indicators. Ultimately, the lead times for serving beverages and appetizers decreased by 2.654 and 13.13 minutes, respectively.

Keywords
Tailor-made value stream mapping; Root cause analysis; Time study; Increasing performance; Lead times.

Introduction

It is evident that competition between manufacturers has become increasingly incisive (Nurprihatin et al., 2020). Companies constantly compete for solutions to overcome challenges and competition in the current dynamic market environment (Sinha & Matharu, 2019). Many companies focus on increasing the efficiency and effectiveness of their service operation process due to the increase in competitiveness between the supply chain and the fast service time (Polas et al., 2018). Therefore, they prepare a fast-food restaurant as their option (Polas et al., 2018). Hence, this condition may threaten other food and beverage restaurants/cafes to compete in the market. This fact raises the urgency of outstanding performance in the service operation process to achieve customer satisfaction. Customer satisfaction plays an essential role in business growth. The satisfied customer can be transformed into a loyal customer that may help the company to market the product through word-of-mouth and invest in the company's financial growth for one or two periods later (Eklof et al., 2020). To maintain customer satisfaction, industries need to stabilize products and service operations (Gu et al., 2023). The performance of service operations can be measured through several parameters, such as service and waiting time (Weng et al., 2018). When these parameters achieve excellence, businesses will be more advanced in maintaining their competitiveness against competitors (Nurprihatin et al., 2019).

Developing the ability to overcome disruptions is essential for both survival and growth of a service industry due to various organizational resources that need to be developed or acquired through internal expansion and interactions in the supply chain (Ofori, 2024). In a service industry, it is imperative to deliver exemplary service in a manner that is both efficient and effective (Namin, 2017; Ngo, 2023). Enterprises within the service industry are always look-

***Corresponding author**: T. Rokicki – Management Institute, WULS-SGGW, Poland, e-mail: tomasz_rokicki@sggw.edu.pl*

ing for innovative approaches to enhance their reputation and draw in new customers since customer demands hold immense importance in this field (Kiatkawsin & Sutherland, 2020). Hence, this industry heavily depend on the vast reservoirs of knowledge that are generated by a multitude of external sources, such as discerning consumers who provide valuable insights and feedback, trusted business partners who offer invaluable expertise and guidance, and even astute competitors who inadvertently push them to improve their service offerings (Dias et al., 2023; Huang & Liu, 2019; Sun & Lee, 2021).

A practical analysis of food industries demonstrated that profitability can be affected by various factors, including alterations in prices, exclusive offers, the introduction of new restaurants in the vicinity, and the prevailing economic situation of the locality (Moreno-Gené et al., 2023). Considering the relatively small profit margin that food service industry typically operate with, their ability to generate profit hinges on how well they execute their strategies and make decisions regarding their operational costs (Alonso-Almeida et al., 2018). Hence, operators are actively exploring fresh approaches to achieve favorable and enduring financial outcomes, all the while considering the dynamic nature of the business environment (Lambert et al., 2021).

Against that background, this study is implemented in a service industry to assesses the food and beverage service operation performance of Coffee Break, a small coffee shop in Pengadegan, Jakarta. This assessment is conducted to improve the business effectiveness and efficiency by assessing the supply chain flow, starting from raw material preparation. The operation flow includes receiving raw materials, producing them, and serving them as finished products (Nurprihatin et al., 2021; Andry et al., 2022). Coffee Break was founded in 2021. This coffee shop only has one barista. They offer dine-in and takeout services/transactions and are operated for 9 hours daily (5 pm–2 am). Coffee Break will reach its peak hour every 8–10 pm. Figures 1 and 2 show the transaction and activity classification of Coffee Break in percentage. Infer that 77% of transactions in the café are dine-in. In contrast, 23% of transactions are takeout. Besides, 55% of activities on coffee are for waiting, and 39% are for servicing.

The transactions are classified into two order categories for easier problem identification: beverage and appetizer. Every type of order consists of lead, service, and waiting times. Table 1 shows the time spend on every order category. On average, the lead time for beverages is 10.754 minutes; in contrast, the lead time for appetizers is 36.725 minutes. Currently, most of the activity on Coffee Break in both categories is non-value added (NVA) or equal to 35% and 42% NVA. Therefore, there must be further identification of the service operation process.

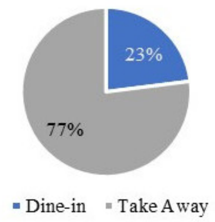


Fig. 1. Transaction classification
Source: Author's own calculation

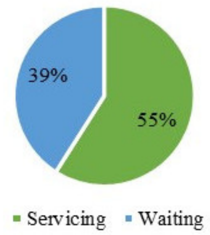


Fig. 2. Activity on coffee break
Source: Author's own calculation

Table 1
Order time category

Time category	Beverage	Appetizer
Lead time	10.754 minutes	36.725 minutes
Service time	6.937 minutes	15.249 minutes
Waiting time	3.817 minutes	21.476 minutes

Source: Author's own calculation

This study discusses the service operation performance improvement for dine-in transactions during the peak hour by integrating Tailor-made Value Stream Mapping, Root Cause Analysis, and Time Study. The Tailor-made Value Stream Mapping contributed to the service operation process and performance evaluation in current and future state value stream mapping (CS-VSM and FS-VSM). The assessment of the CS-VSM will be based on root cause analysis. Root causes analysis supports the problem-solving process based on the cause of every problem occurrence on the CS-VSM. Moreover, the times' study provides a standard time recommendation for every order category to achieve the optimum lead time for FS-VSM. The FS-VSM is created to illustrate the desired flow of value with reduced waste and accomplished lean production (Martins et al., 2021). It is expected that this study can help the business to examine its current process and improve it. As a result, the business can maximize its resources, produce high-quality outcomes, and provide customers satisfaction (Nurprihatin et al., 2022).

Literature review

With the main objective of improving process performance, this study embraces lean management focusing on Value Stream Map (VSM) implementation. VSM is a lean tool designed to visualize production lead time using components in a system (Landeghem & Cottyn, 2022). Lean is beneficial to improve workplace management through value identification and waste elimination; it is a multi-dimensional approach to transforming business strategies in maintaining higher efficiency and customer satisfaction from a process (Balinado & Tri Prasetyo, 2020; Hamdan & Hossain, 2022). There are various tools in lean; however, the tool that has been widely used over the years is the Value Stream Map due to its advancement in providing the illustration of material flow, cycle time, downtime, and inventories across operations (Carvalho et al., 2019).

Researchers commonly use VSM originated from Toyota, focused on wastage identification and elimination (Chavez et al., 2018). VSM is a powerful method that can be used to identify both Value Added (VA) and Nonvalue Added (NVA) activities from the segmented or whole value stream (Chuensunk et al., 2018; Salwin et al., 2021; Weng et al., 2018). The VSM supports the process of identifying the root cause of the problem but cannot be used to solve the problem itself (Salwin et al., 2021). Therefore, it is usually combined with another method, such as the root cause analysis.

Many studies have proven VSM's success in lean implementation for operational performance improvement. Valentina Nino and the other researchers have induced lean principles in a healthcare facility by using value stream mapping to break down further flow complexity, which decreased complaints by 40% (Nino et al., 2021). Beyond the manufacturing floor and processes, a study conducted by Kropsu-Vehkapera and Isoherranen elaborated on how VSM can make knowledge work jobs and intangible processes more concrete and structured (Kropsu-Vehkapera & Isoherranen, 2018). Another paper on Systematic Literature Review (SLR) investigated lean frameworks, and from this review, it was found that a study used the transformation-flow-value (TFV) to conduct flow studies to evaluate value while considering customers' needs (Mangaroo-Pillay & Coetzee, 2022). In addition, Martins and others presented the analysis of lean practices adoption in Portuguese. This analysis found that almost half of their respondents claim to use VSM as one of the tools in their lean activity; this frequency is proven to be higher than other tools, such as Jidoka, TPM, and Kanban (Martins et al., 2021). From these papers, it can be concluded that VSM is an effective tool for creating a leaner and more systematic workflow.

The VSM has been adjusted into a simple method to support waste identification in business processes. It is a versatile tool that can be modified to suit necessity. The modified method is named Tailor-made Value Stream Mapping. Previously, this method had been used for evaluating the service performance in the quotation process, preparation for quotation, and service (Stadnicka & Ratnayake, 2015, 2017, 2018). Currently, there are not many studies related to Tailor-made Value Stream Map. The researchers used references in Table 2 as the primary guideline for

Table 2
Literature review

	Industry	Problem identification	Objectives
Stadnicka and Ratnayake, 2015	Aircraft-spare-parts Manufacturing Firm (AMF)	Meetings with persons from the analyzed area, persons in charge, and persons connected to the activities.	Reducing waste, shortening lead time, optimizing overall prices
Stadnicka and Ratnayake, 2016	Telecommunication industry	Value Stream Analysis (VSA), 5 Whys analysis	Minimizing disturbance, improving productivity
Larsson et al., 2021	Engineering projects (focus on knowledge work)	Interview, "walk through" the system	Reducing engineering hours, lowering costs, and increasing margin
This paper	Cafe	Interviews, meetings, and RCA	Measuring performances and reducing lead time

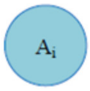
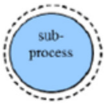
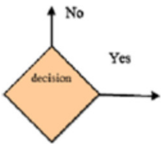
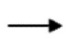
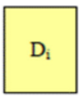
conducting this study since these references used the same Tailor-made version of VSM as this study.

Stadnicka and Ratnayake implement the approach of Tailor-made VSM to analyze a business process in an Aircraft Manufacturing Firm (AMF). This study investigated drawbacks using Focus Group Discussion (FGD) with persons familiar with the area. The result shows that the lead time decreased from 256 to 101 days while the Value-added activities improved (Stadnicka & Ratnayake, 2015). The same authors in the telecommunication industry conducted another research. Instead of using FGD, Value Stream Analysis (VSA) and 5 Whys analysis are used to develop the Tailor-made VSM of the current state. With this approach, the authors managed to decrease the lead time and increase the PCE from 83% to 97 (Stadnicka & Ratnayake, 2016). Lastly, other research implemented this adjusted VSM for knowledge work in engineering projects (Larsson et al., 2021). The waste was identified in several project phases, non-value-adding activities were reduced, and process efficiency was improved (Larsson et al., 2021).

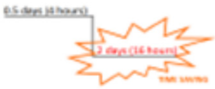
Tailor-made Value Stream Mapping

The first step in Tailor-made Value Stream Mapping is creating the CS-VSM to picture the sequence of the service operation process. The creation of service operation streamlining uses several symbols. Table 3 shows the list of symbols in Tailor-made Value

Table 3
Tailor-made value stream mapping symbols

Symbol	Meaning	Explanation
	Activity (A_i)	Activity performed in the BP
	Sub-process (SP_i)	Sub-process, which will not be analyzed in detail during VSM analysis, performed as an element of an analyzed BP
	Decision Point (D_{ei})	The decision point is when someone must approve something (YES), and the process can go further or, in the case of refusal (NO), some activity will have to be repeated, or additional activities will have to be performed
	Information or material transfer	Information or material transfer from one to another activity takes time
	Process Flow	The arrow shows the logical connection between one and another (next) step of the process
	Loop	The arrow shows the situation when some activities must be repeated; the arrow creates a loop
	Waiting time (W_i)	Waiting time, which usually appears at that point of the process because the next activity must wait for a task
	Document (D_i)	The document which is necessary to perform an activity that is a result of an activity
	Problem (P_i)	A problem that was identified in the process

Tailor-made value stream mapping symbols

Symbol	Meaning	Explanation
	Solution of the problem (S_i)	Solution of a problem, which can improve the analyzed process
	Confusion (C_i)	Confusion causes a different person to perform an activity differently because it is not precisely settled who the activity should be performed by
	Explanation of confusion (E_i)	Explanation of the confusion is usually in the form of a procedure or instruction
	Timeline	Timeline with the upper part symbolizing processing time and the lower part symbolizing waiting time. Some of these times are the lead time
	Time-saving	Time is saved because of the possibility of implementing improvement

Stream Mapping, complete with its meaning and explanation.

To calculate the service operation performance through the value stream analysis parameters Equations (1)–(3) are used.

$$T_p = \sum_{i=1}^{n} T_{VA_i}\,, \tag{1}$$

$$LT = T_P + \sum_{i=1}^{s} T_{NVA_i} + \sum_{j=1}^{m} T_{NNVA_i}\,, \tag{2}$$

$$PCE = \frac{T_P}{LT} \cdot 100\%\,, \tag{3}$$

where:

- T_p – time processing,
- T_{VA_i} – time value added in the stream mapping,
- LT – lead time,
- T_{NVA_i} – time non-value added in the stream mapping,
- T_{NNVA_i} – time not necessary value added,
- PCE – Process Cycle Time,
- n – number of T_{VA_i},
- s – number of T_{NVA_i},
- m – T_{NNVA_i}.

The service operation performance calculation result in CS-VSMs is used as one parameter for an adjustment in the FS-VSM. The creation of FS-VSM uses the same symbol and equation as CS-VSM. Finally, the final stage of Tailor-made Value Stream Mapping compares the operating performance of CS-VSMs and FS-VSMs using Equations (4)–(8).

$$VAI = \frac{T_{(VACS)} - T_{(VAFS)}}{T_{VA(FS-CS)}} \cdot 100\%, \tag{4}$$

$$NNVAI = \frac{T_{(NNVACS)} - T_{(NNVAFS)}}{T_{NNVA(FS-CS)}} \cdot 100\%, \tag{5}$$

$$NVAI = \frac{T_{(NVACS)} - T_{(NVAF)S}}{T_{NVA(FS-CS)}} \cdot 100\%, \tag{6}$$

$$LTI = \frac{LT_{CS} - LT_{FS}}{LT_{CS}} \cdot 100\%, \tag{7}$$

$$PCEI = \frac{PCE_{FS} - PCE_{CS}}{PCE_{FS}} \bullet 100\%, \tag{8}$$

where:

- VAI – Value Added Improvement,
- $NNVAI$ – Not Necessary Value Added Improvement,
- $NVAI$ – Non Value Added Improvement,
- LTI – Lead Time Improvement,
- $PCEI$ – process Cycle Improvement,
- $T_{(VACS)}$ – Time Value Added on CS-VSM,
- $T_{(VAFS)}$ – Time Value Added on FS-VSM,
- $T_{(NNVACS)}$ – Time Not Necessary Value Added on CS-VSM,

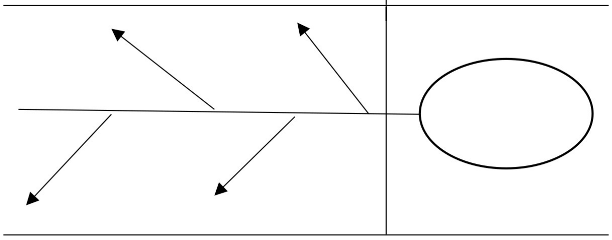
$T_{(NNVAFS)}$ – Time Not Necessary Value Added on FS-VSM,
$T_{(NVACS)}$ – Time Non-Value Added on CS-VSM,
$T_{(NVAFS)}$ – Time Non-Value Added on FS-VSM,
LT_{CS} – Lead Time on CS-VSM,
LT_{FS} – Lead Time on FS-VSM,
PCE_{CS} – Process Cycle Time on CS-VSM,
PCE_{FS} – Process Cycle Time on FS-VSM.

Root cause analysis

Root cause analysis is used to identify a problem in the CS-VSM further. This process asses the root cause of the problem in graphical format (Pan et al., 2019; Shinde et al., 2018), as shown in Table 4. The graphical format, also known as a fishbone diagram, is a statistical process control that is a part of the Total Quality Management (TQM) elements (Imeri et al., 2014).

Table 4
Root Cause Analysis Template

Causes	Effect



Source: Author's own conception

Time study

Time Study requires seven steps, such as: 1) calculating the average cycle times, 2) defining a recommended number of cycle times, 3) data uniformity test, 4) performance rating calculation, 5) normal time calculation, 6) time allowance calculation, and 7) standard time calculation. The input for time study calculation is gathered by the cycle time in CS-VSM for both categories, beverage, and appetizer. All step's calculations use Equations (9)–(13). The generation of several cycle times and performance ratings are based on the Westinghouse method which is shown in Table 5 and 6.

$$Average\ Cycle\ Time = \frac{\sum x_i}{n}, \tag{9}$$

$$UCL = \bar{x} + k\sigma, \tag{10}$$

$$LCL = \bar{x} - k\sigma, \tag{11}$$

Table 5
Recommended Number of Cycles by Time Study Manual

Cycle time (min)	Recommended number of cycles
0.10	200
0.25	100
0.50	60
0.75	40
1.00	30
2.00	20
2.00–5.00	15
5.00–10.00	10
10.00–20.00	8
20.00–40.00	5
40.00 above	3

Source: Author's own calculation

Table 6
Westinghouse Method

Skill				Effort			
+	0.15	A1	Super skill	+	0.13	A1	Excessive
+	0.13	A2		+	0.12	A2	
+	0.11	B1	Excellent	+	0.10	B1	Excellent
+	0.08	B2		+	0.08	B2	
+	0.06	C1	Good	+	0.08	C1	Good
+	0.03	C2		+	0.02	C2	
+	0.00	D	Average	+	0.00	D	Average
-	0.05	E1	Fair	–	0.04	E1	Fair
-	0.10	E2		-	0.08	E2	
-	0.16	F1	Poor	–	0.12	F1	Poor
-	0.22	F2		-	0.17	F2	
Condition				Consistency			
+	0.06	A	Ideal	+	0.04	A	Perfect
+	0.04	B	Excellent	+	0.03	B	Excellent
+	0.02	C	Good	+	0.01	C	Good
+	0.00	D	Average	+	0.00	D	Average
–	0.03	E	Fair	–	0.02	E	Fair
-	0.07	F	Poor	–	0.04	F	Poor

Source: (Cevikcan & Kilic, 2016)

$$Normal\ Time = Average\ Cycle\ Time \times P, \tag{12}$$

$$Standard\ Time = Normal\ Time \times \frac{100\%}{100\% - Allowance}, \tag{13}$$

where:
x_i – available time,
n – output,
UCL – Upper Control Limit,
LCL – Lower Control Limit,
$\bar{x}$ – mean,
k – constant,
σ – standard deviation,
P – performance rating.
If $P > 1$ – work fast; $P < 1$ – work slow; $P = 1$ – normal speed.

Research methodology

The systematic flow of the study is used to illustrate the study's steps. It is divided into several stages, including: 1) Data Collection, 2) Data Analysis and Interpretation, 3) Improvement Planning, and 4) Final Recommendation, Conclusion, and Suggestion. Each stage consists of several methods where all previous stages are used as input for the next stage. Figure 3 shows the flowchart of the research methodology used in this study.

Data Collection is the very first stage of this study. This activity aims to identify the problem that occurs in the café. A field study and literature review follow the problem identification. The field study was done through direct observation and interview sessions with one of the founders and the barista to gain information about the problem occurring and validate the problem identification. The field study also aims to identify the service family, the selection of the representative families, and the value stream component. Besides, the researchers also do a literature review to support the study's theoretical background. The preferable references are international journals, scientific articles, or books. This study will combine three different methods: Tailor-made Value Stream Mapping, RCA, and Time study. Therefore, the literature review will only focus on those three topics. Furthermore, this activity involves collecting the required data to support the analysis and interpretation process. For more detail, the data collection process is divided into two main operations such as 1) Identifying the CS-VSM and 2) Recording the time processing of every stage.

The next stage is the analyzed stage, where the gathered data from the previous process are processed. The analysis will be done using Tailor-made Value Stream Mapping and RCA. The result of the analysis will be interpreted through each analysis process. The analysis of CS-VSM is used to identify the exact current process in the food and beverage service operation. This process is also used to determine the bottleneck that resulted in a delay in the service operation process. The Root Cause Analysis (RCA) is used to identify the leading cause of each bottleneck based on the CS-VSM. The Root Cause Analysis (RCA) used in this study is a fishbone diagram.

The improvement planning will be based on the RCA and standard time. Thus, the problem will be solved based on its root cause. The improvement planning will be implemented on the FS-VSM. The output of this process is to develop a new value stream with fewer bottlenecks. After creating the FS-VSM, the researchers will give the final recommendations for service operation improvement. These recommendations are then presented to the barista and café owner as an effort to actualize the implementation of this research. This improvement part generated the optimum solution based on the calculation of Value Stream Analysis and the time study. The study's conclusion will also be generated based on the study's objectives. Moreover, the researchers will provide suggestions for future studies.

Results and discussion

At the beginning of this research, the authors create a CS-VSM. There are two CS-VSMs presented in this report to represent the process of delivering beverages and appetizers. To identify the root cause of the bottleneck on the CS-VSM, the authors do a root cause analysis through a fishbone diagram. To assess the root cause, the authors created a discussion session with the café founder and barista. Then, a time

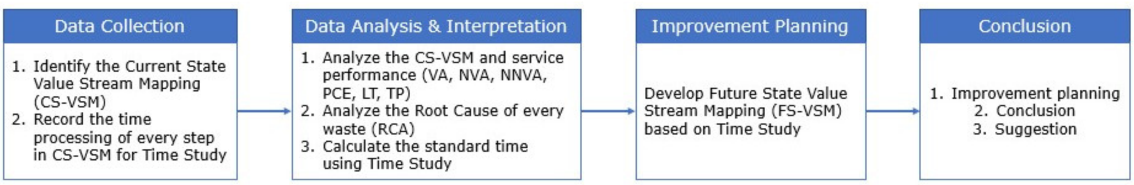


Fig. 3. Research methodology *Source: Author's own conception*

study will be carried out to observe and measure process time. This process results in the standard time needed to improve process performances. After analyzing and calculating the standard time, the authors input the standard time into the FS-VSM; therefore, the FS-VSM is developed in the standardized time.

Current-State Value Stream Map (CS-VSM)

Figure 4 and 5 show the CS-VSM of beverages and appetizers. Both categories have six main processes in sequence and four problem occurrences. The six main processes on CS-VSM are 1) waiting for the customer

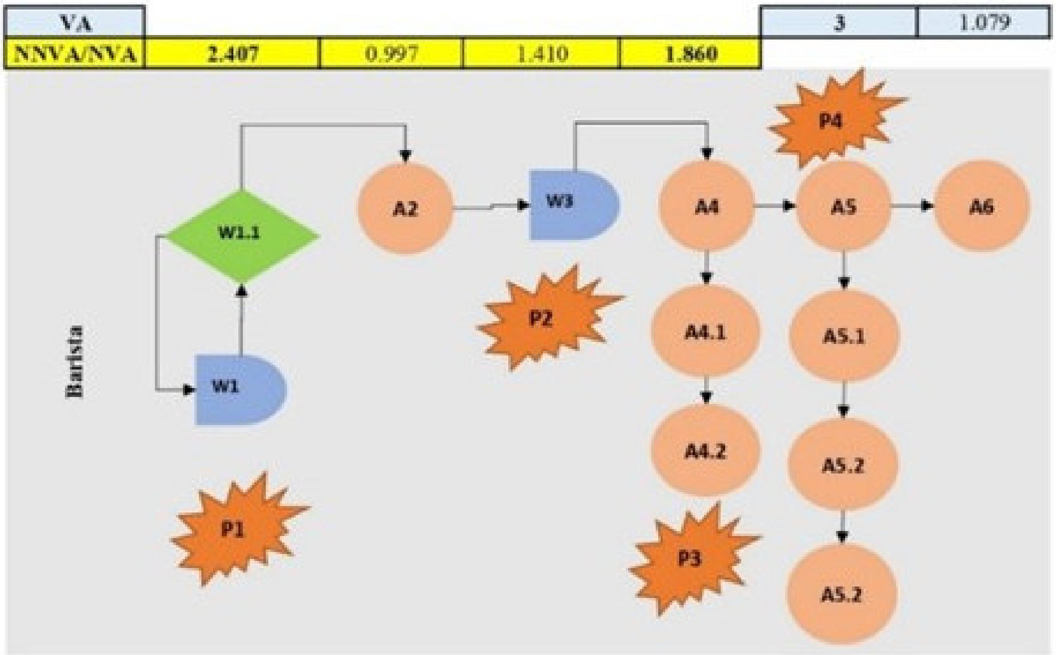


Fig. 4. CS-VSM for Beverage *Source: Author's own conception*

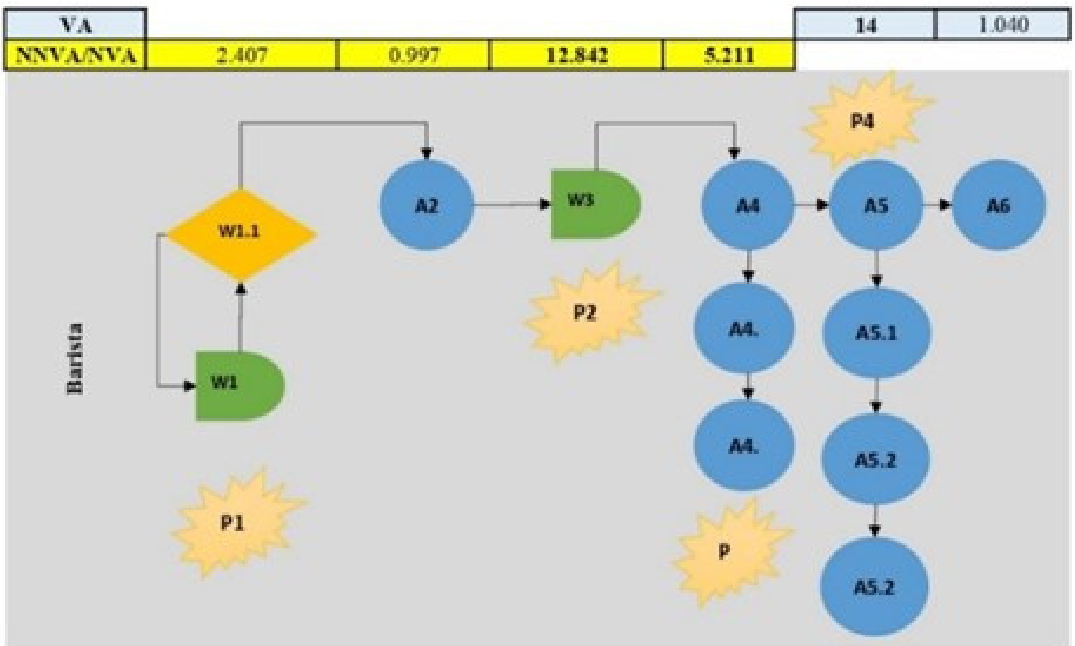


Fig. 5. CS-VSM for Appetizer *Source: Author's own conception*

to read the menu, 2) writing the order, 3) waiting for preparation, 4) preparation, 5) processing orders, and 6) delivering an order that is represented using symbols. The VA activity is represented above the NNVA/NVA on the top side of the flow chart.

Tables 7 and 8 provide the meaning of the symbol, complete with activity classification (VA, NNVA, and NNVA). Tables 7 and 8 show the process of completing beverage and appetizer orders, respectively. From the classified activities, the process of receiving, com-

Table 7
Beverage Activity Classification CS-VSM

PIC	Symbol	Activity	Min	Max	Problem	Avg (min)	VA	NNVA	NVA
Barista	W1	Waiting for the customer to read the menu	0	6	P1	2.407			2.407
	W1.1	Inform the availability							
	A2	Write the order	0	9		0.997		0.997	
	W3	Waiting for preparation	0.2	3	P2	1.410			1.410
	A4	Preparation	0.5	4	P3	1.860		1.860	
	A4.1	Check the ingredient, glass, and plate availability							
	A4.2	Take/buy/wash the ingredient, glass, and plate availability							
	A5	Process order	1.2	5	P4	3.000	3		
	A5.1	Prepare ingredient							
	A5.2	process ingredient							
	A5.3	Finishing							
	A6	Deliver the order	1	2		1.079	1.079		1.079
Total						10.754	4.08	2.86	3.817

Source: Author's own calculation

Table 8
Appetizer Activity Classification CS-VSM

PIC	Symbol	Activity	Min	Max	Problem	Avg (min)	VA	NNVA	NVA
Barista	W1	Waiting for the customer to read the menu	0	6	P1	2.407			2.407
	W1.1	Inform the availability							
	A2	Write the order	0	9		0.997		0.997	
	W3	Waiting for preparation	1	36	P2	12.842			12.842
	A4	Preparation	2	9	P3	5.211		5.211	
	A4.1	Check the ingredient, glass, and plate availability							
Barista	A4.2	Take/buy/wash the ingredient, glass, and plate availability	2	9	P3	5.211		5.211	2
	A5	Process order	6	25	P4	14.228	14.228		
	A5.1	Prepare ingredient							
	A5.2	Process ingredient							
	A5.3	Finishing							
	A6	Deliver the order	0.5	2		1.040	1.040		
Total						36.73	15.27	6.208	15.249

Source: Author's own calculation

pleting, and delivering the order are the steps carried out by the café to produce its product. The duration from each of the activities were obtained from direct observations when the café is in operation.

Infer that the total time to process the beverage and appetizer order in CS-VSM is 10.754 and 36.725 minutes, respectively. Therefore, the total value-added activities for each category equals 38% and 42%; the rest is still considered NNVA and NVA, Fig. 6 and 7.

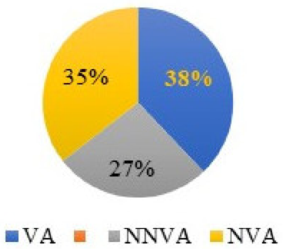


Fig. 6. Current activity classification for beverage
Source: Author's own calculation

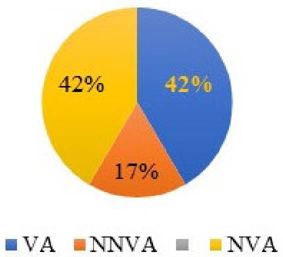


Fig. 7. Current activity classification for appetizer
Source: Author's own calculation

Root cause analysis

Figure 8 informs 4-problems that occurred on the CS-VSMs such as 1) time-consuming for the customer to read the menu, 2) inconsistent speed of process order, 3) time-consuming preparation process, and 4) delay in processing the order. Based on the root cause analysis, that four-problem caused the ineffective F&B in the operation process. The complete cause of every problem is shown in Fig. 8.

Time Study

This study uses 101 samples for beverages and 57 samples for an appetizer. Three processes are converted into a standardized time such as preparation (A4), process order (A5), and delivery (A6). The average time and standard deviation of every process are shown in Table 9. In addition, Table 10 shows the recommended number of cycle times in beverages and appetizers. Table 11 shows the result of UCL and LCL of three processes on the beverage and appetizer. Based on its uniformity test, all activities in both categories are normally distributed. As mentioned, the performance rating is assessed based on the Westinghouse parameter. The barista's total performance rating is 0.97 or equal to a slow working rate since the $P < 1$, as shown in Table 12.

Table 13 shows the normal time of three processes for beverages and appetizers. Based on the calculation, the normal time for preparation, processing of the order, and beverage delivery are 2, 2.91, and 0.86 minutes. In contrast, the normal time for preparation, processing of orders, and delivery of appetizers are 3.23 minutes, 13.80 minutes, and 0.82 minutes. The

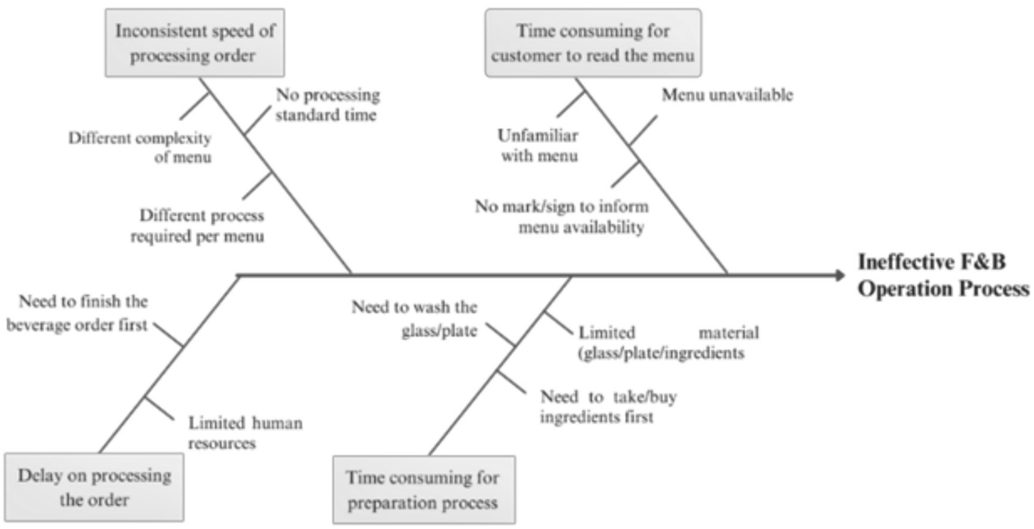


Fig. 8. Root cause analysis *Source: Author's own conception*

Table 9
Average time and standard deviation

#	$\bar{x}$ beverage	$\bar{x}$ appetizer	σ beverage	σ appetizer
Preparation (Mins)	1.183	5.21	0.917	2.33
Process the Order (Mins)	5.218	14.23	3.189	5.71
Delivery of the Order (Mins)	0.891	0.85	0.146	0.20

Source: Author's own calculation

Table 10
Recommended number of cycle times

Symbol	Activity	Beverage	Appetizer
A4	Preparation	30	10
A5	Process Order	10	8
A6	Delivery	40	40

Source: Author's own calculation

Table 11
UCL and LCL result

Symbol	Activity	$\bar{x}$	σ	k	$UCL(\bar{x}+k\sigma)$	$LCL(\bar{x}-k\sigma)$
A4	Preparation Beverage	1.183	0.917	2	–0.3	4.02
	Preparation Appetizer	5.21	2.33		–2.2	9
A5	Process Order Beverage	5.218	3.189		0.6	5
	Process Order Appetizer	14.23	5.71		2.8	26
A6	Delivery Beverage	0.9	0.15		0.5	1
	Delivery Appetizer	0.8	0.20		0.6	1

Source: Author's own calculation

Table 12
Performance rating

Factor	Level	Score
Skill	Average(D)	0
Effort	Good (C2)	0.02
Condition	Fair (E)	–0.03
Consistency	Fair (E)	–0.02
Normal Work Condition		1
Total Performance Rating (P)		0.97

Source: Author's own calculation

time allowance of the process is 18%, which consists of the time to take an ingredient, glass/plate, and the barista's personal needs. The time allowance shown in Table 14 is used for calculating the standard time. Finally, Table 15 concludes the normal time for preparing, processing orders, and delivering beverages and

Table 13
Normal time

#	Preparation (Min)	Process order (Min)	Delivery order (Min)
Beverage	2	2.91	0.86
Appetizer	3.23	13.80	0.82

Source: Author's own calculation

Table 14
Time allowance

Activity	Time (s)
Take ingredients, glass/plate	2
Personal need	20
Total time	22
Percentage	18%

Source: Author's own calculation

Table 15
Normal time

#	Preparation (Min)	Process order (Min)	Delivery (Min)	Total (Min)
Beverage	1.5	2.4	0.7	4.6
Appetizer	2.6	11.3	0.7	14.6

Source: Author's own calculation

appetizers. The total time for the beverage is 4.6 minutes. On the other hand, the total time for an appetizer is 14.6 minutes.

Future-State Value Stream Map (FS-VSM)

Figures 9 and 10 show the FS-VSM of beverages and appetizers after adjustment based on the standardized time. No process erases, only time is adjusted. After the adjustment, the beverage's total lead time is reduced to 8.1 minutes. On the other hand, suggest that the total lead time of the appetizer is reduced to 23.6 minutes. Table 16 and 17 show detailed information related to the time on every process sequence on the FS-VSMs. Alternatively, the adjustment increases VA activity by 69% on beverages and increases VA activity by 51% on the appetizer, as shown in Figs. 11 and 12.

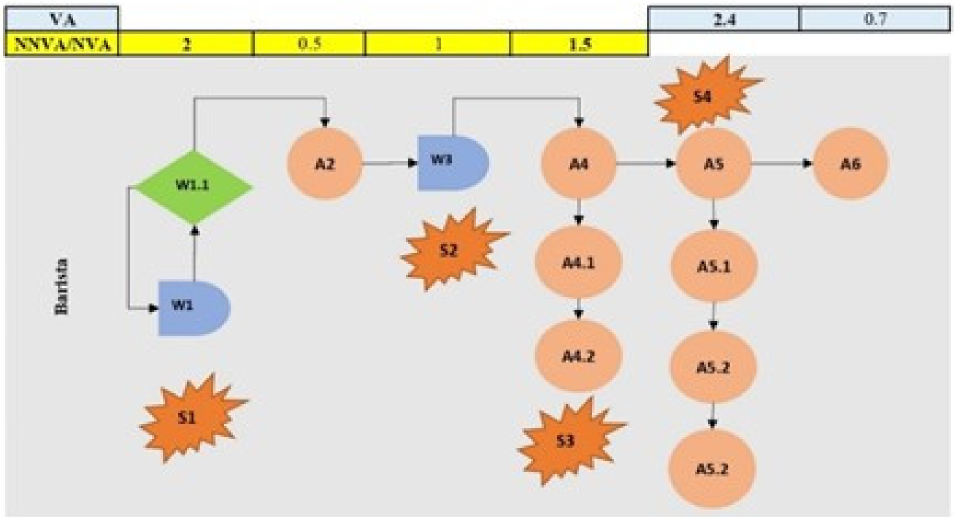


Fig. 9. FS-VSM for beverage *Source: Author's own conception*

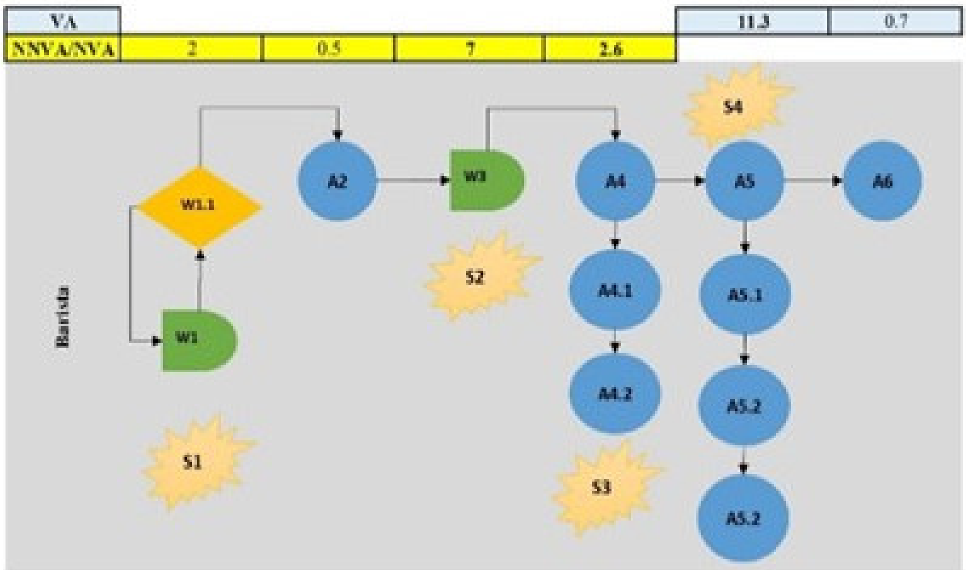


Fig. 10. CS-VSM for for appetizer *Source: Author's own conception*

Table 16
Beverage activity classification FS-VSM

PIC	Symbol	Activity	Solution	Time (min)	VA	NNVA	NVA
Barista	W1	Waiting for the customer to read the menu	S1	2			2
	W1.1	Inform the availability					
	A2	Write the order		0.5		0.5	
	W3	Waiting for preparation	S2	1			1
	A4	Preparation	S3	1.5		1.5	
	A4.1	Check the ingredient, glass, and plate availability					
	A4.2	Take/buy/wash the ingredient, glass, and plate availability					
	A5	Process order	S4	2.4	2		
Barista	A5.1	Prepare ingredient	S4	2.4	2		S4
	A5.2	process ingredient					
	A5.3	Finishing					
	A6	Deliver the order		0.7	0.7		
Total				8.1	3.1	2	3

Source: Author's own calculation

Table 17
Appetizer activity classification FS-VSM

PIC	Symbol	Activity	Solution	Time (min)	VA	NNVA	NVA
Barista	W1	Waiting for the customer to read the menu	S1	2			2
	W1.1	Inform the availability					
	A2	Write the order		0.5		0.5	
	W3	Waiting for preparation	S2	7			7
	A4	Preparation	S3	2.6		2.6	
	A4.1	Check the ingredient, glass, and plate availability					
Barista	A4.2	Take/buy/wash the ingredient, glass, and plate availability	S3	2.6		2.6	
	A5	Process order	S4	11.3	11.3		
	A5.1	Prepare ingredient					
	A5.2	process ingredient					
	A5.3	Finishing					
	A6	Deliver the order		0.7	0.7		
Total				23.6	12	3.1	8.5

Source: Author's own calculation

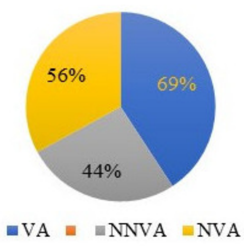


Fig. 11. Future activity classification for beverage
Source: Author's own calculation

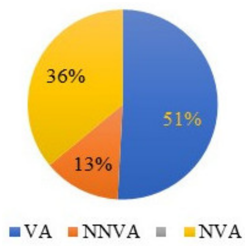


Fig. 12. Future activity classification for appetizer
Source: Author's own calculation

Performance analysis

Figures 13 and 14 illustrate the performance comparison between the CS-VSMs and FS-VSMs on the beverage. Figures 15 and 16 show the performance comparison between CS-VSMs and FS-VSMs on the appetizer. Both are presented based on the LT, VA, NNVA, NVA, service time, and waiting time in minutes.

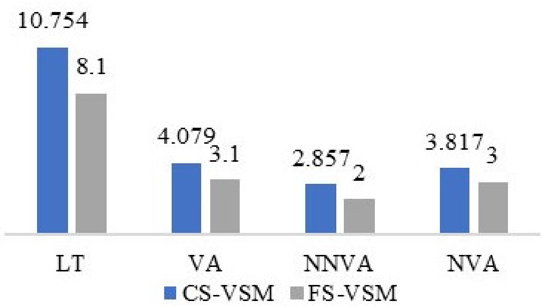


Fig. 13. CS-VSM vs FS-VSM beverage activity category (Min) *Source: Author's own calculation*

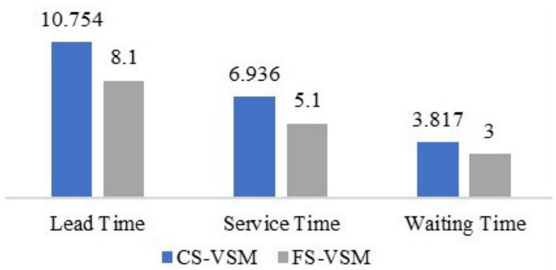


Fig. 14. CS-VSM vs FS-VSM beverage time category (Min) *Source: Author's own calculation*

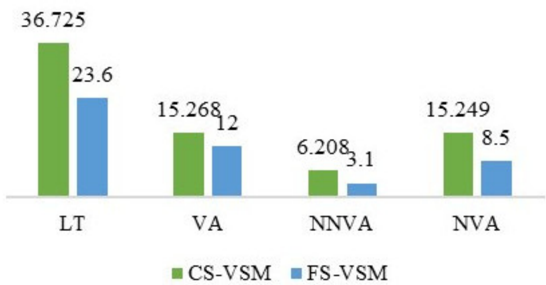


Fig. 15. CS-VSM vs FSM appetizer activity category (Min) *Source: Author's own calculation*

There are reductions in time of overall indicators on beverages and appetizers after the adjustment based on the standard time. Therefore, there is an improvement in VA, NNVA, LT, and PCE performance. Table 18 shows the percentage of improvement in both categories, beverages, and appetizers.

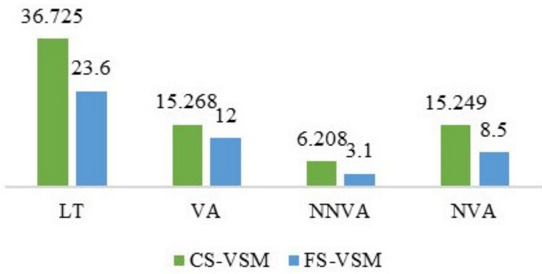


Fig. 16. CS-VSM vs FSM appetizer activity category (Min) *Source: Author's own calculation*

Table 18
Improvement percentage

#	VAI	NNVAI	NVAI	LTI	PCEI
Beverage	24%	29%	21%	25%	2.6%
Appetizer	21%	50%	44%	36%	20%

Source: Author's own calculation

Conclusions and recommendation

In conclusion, the service operation flow of the CS-VSM is represented by the six main processes, namely waiting for the customer to read the menu, writing the order, waiting for preparation, preparation, processing the order, and delivery. Four problems occur on the CS-VSM such as 1) time-consuming for the customer to read the menu, 2) delay in processing the order, 3) time-consuming the preparation process, and 4) inconsistent speed of processing order. The causes of the first problem occurrence are 1) menu unavailability, 2) unfamiliarity with the menu, and 3) no mark to inform the menu availability. The causes of the second problem are limited human resources and the need to finish the previous order. Moreover, the root cause of the third problem is the limited resources such as glasses, plates, and ingredients. Finally, the root causes of the last problem are that there is no standard processing time due to the different menu complexity.

The improvement process suggests that the performance of the beverage service operation is increased by 24% in VA activity, 29% in NNVA activity, 21% in NVA activity, 25% in LT, and 2.6% in PCE. Moreover, the service performance also increases on the appetizer by 21% in VA activity, 50% in NNVA activity, 44% in NVA activity, 36% in LT, and 20% in PCE. The improvement was achieved through standardized service time in the beverage and appetizer categories. The standard time for preparing the order is 1.5 minutes for a beverage and 2.6 minutes for an appetizer. Hence, the standard time for processing the order for beverage and appetizer is 2.4 minutes and 11.3 minutes. Lastly, the standard time for delivering the order is 0.7 minutes.

Finally, the recommendations for the coffee break are 1) use a sign/mark for the unavailable menu to reduce the time for the customer to read the menu, 2) use a photo to illustrate the menu and reduce the time for the customer to ask about the menu, 3) facilitate the barista with the training to optimize performance, 4) add more resources (plates, glasses, and ingredients), the number of resources can be adjusted based on the average number of customers visited the café, 5) recruit more baristas so the process of beverage and appetizer can be done simultaneously, 6) use a standard time from this report as a reference for developing a new SOP for optimizing the process of every menu creation.

This research is limited to one case only, such as the dine-in process in a café during peak hours. This framework can be used as a reference to develop a standardized service time in takeout conditions or others. Moreover, the researchers can integrate the existing framework with simulation modeling for simulating the FS-VSMs before implementation. The simulation modeling may help reduce the cost of implementation and may support the process of finding the optimum solution in terms of the number of baristas, and other resources (table, plate, glass, etc.).

References

Alonso-Almeida, M. del M., Bagur-Femenias, L., Llach, J., & Perramon, J. (2018). Sustainability in small tourist businesses: the link between initiatives and performance. *Current Issues in Tourism*, *21*(1), 1–20. DOI: 10.1080/13683500.2015.1066764

Andry, J.F., Nurprihatin, F., & Liliana, L. (2022). Supply chain disruptions mitigation plan using six sigma method for sustainable technology infrastructure. *Management and Production Engineering Review*, *13*(4), 88–97. DOI: 0.24425/mper.2022.142397

Balinado, J.R.O. & Tri Prasetyo, Y. (2020). *The impact of 5S lean tool to service operation: a case study in Toyota Dasmarinas-Cavite service operations*. 2020 The 6th International Conference on Industrial and Business Engineerin, 185–190. DOI: 10.1145/3429551.3429580

Carvalho, C.P., Carvalho, D.S., & Silva, M.B. (2019). Value stream mapping as a lean manufacturing tool: A new account approach for cost saving in a textile company. *International Journal of Production Management and Engineering*, *7*(1), 1. DOI: 10.4995/ijpme.2019.8607

Chavez, Z., Mokudai, T., & Uyama, M. (2018). Divergence between value stream mapping western understanding and material and information flow chart principles: a Japanese automotive supplier's perspective. *Journal of Service Science and Management*, *11*(02), 219–241. DOI: 10.4236/jssm.2018.112016

Cevikcan, E., & Kilic, H. S.(2016). Tempo rating approach using fuzzy rule based system and westinghouse method for the assessment of normal time. *International Journal of Industrial Engineering*, *23*(1), 49–67. https://www.researchgate.net/publication/306144149_Tempo_rating_approach_using_fuzzy_rule_based_system_and_westinghouse_method_for_the_assessment_of_normal_time

Chuensunk, P., Puttibarncharoensri, P., & Tantisiriphaiboon, Y. (2018). An application of value stream mapping to improve a purchase order process. *Journal of Supply Chain Management*, *12*(1).

Dias, Á., Silva, G.M., Patuleia, M., & González-Rodríguez, M.R. (2023). Developing sustainable business models: local knowledge acquisition and tourism lifestyle entrepreneurship. *Journal of Sustainable Tourism*, *31*(4), 931–950. DOI: 10.1080/09669582.2020.1835931

Eklof, J., Podkorytova, O., & Malova, A. (2020). Linking customer satisfaction with financial performance: an empirical study of Scandinavian banks. *Total Quality Management & Business Excellence*, *31*(15-16), 1684–1702. DOI: 10.1080/14783363.2018.1504621

Gu, M., Zhang, Y., Li, D., & Huo, B. (2023). The effect of high-involvement human resource management practices on supply chain resilience and operational performance. *Journal of Management Science and Engineering*, *8*(2), 176–190. DOI: 10.1016/j.jmse.2022.12.001

Hamdan, N.R., & Hossain, A.M. (2022). Applying of lean management to increase organization efficiency: "ABC" plant case study. *The International Journal of Science & Technology*, *10*(5). DOI: 10.24940/theijst/2022/v10/i5/ST2205-001

Huang, C.-E., & Liu, C.-H. (2019). Impacts of social capital and knowledge acquisition on service innovation: an integrated empirical analysis of the role of shared values. *Journal of Hospitality Marketing & Management*, *28*(5), 645–664. DOI: 10.1080/19368623.2019.1540957

Imeri, S., Kekale, T., Takala, J., & Liu, Y. (2014). Understanding the impact of 'hard' and 'soft' elements of tqm in south-east european firms. *Management and Production Engineering Review*, *5*(3), 9–13. DOI: 10.2478/mper-2014-0022

Kiatkawsin, K., & Sutherland, I. (2020). Examining Luxury Restaurant Dining Experience towards Sustainable Reputation of the Michelin Restaurant Guide. *Sustainability*, *12*(5). DOI: 10.3390/su12052134

Kropsu-Vehkapera, H., & Isoherranen, V. (2018). Lean approach in knowledge work. *Journal of Industrial Engineering and Management*, *11*(3), 429. DOI: 10.3926/jiem.2595

Lambert, A., Jones, R.P., & Clinton, S. (2021). Employee engagement and the service profit chain in a quick-service restaurant organization. *Journal of Business Research*, *135*, 214–225. DOI: 10.1016/j.jbusres.2021.06.009

Landeghem, H. Van, & Cottyn, J. (2022). Extending value stream mapping for lean production planning and control. *Management and Production Engineering Review*, *13*(3), 75–82. DOI: 10.24425/mper.2022.142384

Larsson, D., Gildseth, A., & Ratnayake, R.M.C. (2021). *Value stream mapping for knowledge work: a study from project-based engineering-to-order organization.* Advances in Production Management Systems. Artificial Intelligence for Sustainable and Resilient Production Systems conference paper, 345–353. DOI: 10.1007/978-3-030-85910-7_36

Mangaroo-Pillay, M., & Coetzee, R. (2022). Lean frameworks: A systematic literature review (SLR) investigating methods and design elements. *Journal of Industrial Engineering and Management*, *15*(2), 202. DOI: 10.3926/jiem.3677

Martins, D., Fonseca, L., Ávila, P., & Bastos, J. (2021). Lean practices adoption in the Portuguese industry. *Journal of Industrial Engineering and Management*, *14*(2), 345. DOI: 10.3926/jiem.3291

Moreno-Gené, J., Daries, N., & Cristobal-Fransi, E. (2023). Effects of restaurant expenses on enhanced profitability: Do Michelin-starred restaurants perform differently? *International Journal of Gastronomy and Food Science*, *34*. DOI: 10.1016/j.ijgfs.2023.100811

Namin, A. (2017). Revisiting customers' perception of service quality in fast food restaurants. *Journal of Retailing and Consumer Services*, *34*, 70–81. DOI: 10.1016/j.jretconser.2016.09.008

Nino, V., Martinez, K., Gomez, K., & Claudio, D. (2021). Improving the registration process in a healthcare facility with lean principles. *Journal of Industrial Engineering and Management*, *14*(3), 538. DOI: 10.3926/jiem.3432

Ngo, Q.-H. (2023). The effectiveness of strategic alignment between open innovation and generic strategies: Empirical evidence from restaurant SMEs in Vietnam. *Journal of Open Innovation: Technology, Market, and Complexity*, *9*(1). DOI: 10.1016/j.joitmc.2023.100016

Nurprihatin, F., Angely, M., & Tannady, H. (2019). Total productive maintenance policy to increase effectiveness and maintenance performance using overall equipment effectiveness. *Journal of Applied Research on Industrial Engineering*, *6*, 184–199.

Nurprihatin, F., Elvina, Rembulan, G.D., Christianto, K., & Hartono, H. (2021). Decision support system for truck scheduling in logistic network through cross-docking strategy. *Journal of Physics: Conference Series*, *1811*(1), 012009. DOI: 10.1088/1742-6596/1811/1/012009

Nurprihatin, F., Jayadi, E.L., & Tannady, H. (2020). Comparing heuristic methods' performance for pure flow shop scheduling under certain and uncertain demand. *Management and Production Engineering Review*, *11*(2), 50–61. DOI: 10.24425/mper.2020.133728

Nurprihatin, F., Rembulan, F.D., & Pratama, Y.D. (2022). Comparing probabilistic economic order quantity and periodic order quantity model performance under lumpy demand environment. *Management and Production Engineering Review*, *13*(4), 16–25. DOI: 10.24425/mper.2022.142391

Ofori, D. (2024). Necessary condition analysis of organisational capabilities for a resilient service operation in the hotel industry in Ghana. *Heliyon*, *10*(4). DOI: 10.1016/j.heliyon.2024.e26473

Pan, Y., Dai, W., & Xiong, Y. (2019). Investigation on the Material Failure in a Small Scale Automotive Camera Module via Root Cause Analysis and Experimental Validation. *IEEE Access*, *7*, 72818–72825. DOI: 10.1109/ACCESS.2019.2920023

Polas, M.R.H., Rahman, M.M., Miah, M.A., & Hayash, M.M.A. (2018). The impact of waiting time towards customers satisfaction in fast food establishments: evidence from Bangladesh. *Journal of Business and Management*, *20*(5), 11–21.

Salwin, M., Jacyna-Gołda, I., Bańka, M., Varanchuk, D., & Gavina, A. (2021). Using value stream mapping to eliminate waste: a case study of a steel pipe manufacturer. *Energies*, *14*(12), 3527. DOI: 10.3390/en14123527

Shinde, D.D., Ahirrao, S., & Prasad, R. (2018). Correction to: fishbone diagram: application to identify the root causes of student–staff problems in technical education. *Wireless Personal Communications*, *100*(2), 665–665. DOI: 10.1007/s11277-018-5502-2

Sinha, N., & Matharu, M. (2019). A comprehensive insight into Lean management: Literature review and trends. *Journal of Industrial Engineering and Management*, *12*(2), 302. DOI: 10.3926/jiem.2885

Stadnicka, D., & Ratnayake, R.M.C. (2015). *Simple approach for value stream mapping for business process analysis*. 2015 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), 88–94. DOI: 10.1109/IEEM.2015.7385614

Stadnicka, D., & Ratnayake, R.M.C. (2016). Minimization of service disturbance: VSM based case study in telecommunication industry. *IFAC-PapersOnLine*, *49*(12), 255–260. DOI: 10.1016/j.ifacol.2016.07.609

Stadnicka, D., & Ratnayake, R.M.C. (2017). Enhancing performance in service organisations: a case study based on value stream analysis in the telecommunications industry. *International Journal of Production Research*, *55*(23), 6984–6999. DOI: 10.1080/00207543.2017.1346318

Stadnicka, D., & Ratnayake, R.M.C. (2018). Development of additional indicators for quotation preparation performance management. *Journal of Manufacturing Technology Management*, *29*(5), 866–885. DOI: 10.1108/JMTM-01-2017-0016

Sun, K.-A., & Lee, S. (2021). How does franchising alter competition in the restaurant industry? *Journal of Hospitality and Tourism Management*, *46*, 468–475. DOI: 10.1016/j.jhtm.2021.02.002

Weng, J., Di, X., Wang, C., Wang, J., & Mao, L. (2018). A bus service evaluation method from passenger's perspective based on satisfaction surveys: a case study of Beijing, China. *Sustainability*, *10*(8), 2723. DOI: 10.3390/su10082723