

PERFORMANCE IMPROVEMENT OF COFFEE BEAN PRODUCTION BY LEAN TECHNIQUE

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ABSTRACT

Purpose: This project aims to increase the efficiency of the coffee bean processing process through lean techniques.

Design/methodology/approach: Lean technique by analyzing and recommending ways to optimize the production process according to the study of Flow Process Chart to use Motion and Time Study analysis and evaluate process efficiency with Value Stream Mapping (VSM), then analyze the problem or waste condition. Including improving work with the ECRS principle and compare the results of improving the production process.

Findings: The results of the research were able to improve non-value-added but necessary operations in the production process in 3 steps, resulting in a 10.02% increase in value-generating activities, including a reduction in time by 1.79 minutes, representing 13.57%. The distance was reduced by 2,190.25 meters, representing 96.31%, resulting in an increase in the efficiency of the coffee bean processing process

Research limitations/implications (if applicable): -

Practical implications (if applicable): -

Originality/value: This project can be implemented in other production line to improve the efficiency of the processing due to the reduction of non-value added operation using Lean technique.

Keywords: Coffee Processing, Lean, VSM, ECRS, Motion and time study, Performance improvement

Introduction

Nowadays, coffee is a caffeinated drink that has a large number of consumers, both school and working age, because of its unique aroma and taste, as well as helping to increase alertness, not drowsiness. Coffee is one of the world's most traded agricultural commodities, and growing it requires environmental factors. In Thailand, the northern region is popular for growing Arabica coffee varieties because it is an area higher than sea level and cool weather.

This research was conducted at one of a company which produces coffee bean products in Chiang Mai, Thailand. The focused activity of this study was the production of coffee bean. Lean manufacturing technique is implemented to analyze problems, limitations of the current situation, as well as to classify value of each activity in the production line. Consequently, productivity improvement techniques such as Motion and time study, VSM and ECRS are employed to identify and suggest improving strategy to increase production line efficiency in terms of production time reduction, and transportation distance

Literature Reviews

To identify and improve the current production line; (1) motion and time study (2) VSM and (3) ECRS technique are together applied in this study. The details of both concepts are briefly explained as follows.

1) Motion and Time Study

Motion study is a study and analysis of the motion of working parts in the production, including machine, tool, equipment, and work station, or workplace. This chart is a tool, which the systematic study of works systems with the purpose of (1) developing the preferred system and method usually the one with the lowest cost; (2) standardizing this system and method; (3) determining the time required by a qualified and properly trained person working at a normal pace to do a specific task or operation; and (4) assisting in training the worker in the preferred method. Marks are utilized in the

process chart to clearly identify working processes, and easier to read. The recorded processes started from obtaining raw material and follow up through production line. Signs used in process chart include "O" for Operation, "⇒" for Transportation, "□" for Inspection, "D" for Delay, and "V" for Storage [2].

1) VSM

Value stream mapping is one of the techniques which is used as a tool for emphasizing the supply chain in order to improve the supply chain efficiency by eliminating unnecessary activities or reducing the processing time. The VSM technique was applied to categorize the activities in the supply chain into three major types: value-added (VA), non-value-added (NVA), and necessary-non-value-added (NNVA) activities.

2) ECES

ECRS principles are the technique that help generate an approach to improve productivity of the production line each character has its meaning which are: E = Eliminate: is the elimination of unnecessary processes during the production. The seven areas of detected loss in present processes, which has been eliminated, are including over-production, waiting time, unnecessary change, unnecessary job, over-stocking, unnecessary transportation, and damages to products. C = Combine: is the combination of processes that allows the producer to save more time and energy used in the production. Some processes can be combined together; for instance, the production line used to have

5 steps to produce, which some of these steps could be done together at the same time, the processes then are being combined. As a result, the overall steps are reduced, allows the whole production process to complete faster and more efficient. This also eliminates the transit between processes that requires different tools to get the job done. R = Rearrange: is the rearrangement of the required processes. The rearranged processes allow the production to complete faster by removing unnecessary transit to another process, or to eliminate waiting time.

Research Methodology

The methodology for this study includes:

1) Data Collection

This research is to study the coffee bean production process which is a wet process in Chiang Mai. In the beginning, the study was focus on data collection based on factory maps, production processes, and process activity maps of each work station, in order to clarify the current situation of the production line.

2) Problem Identification

The information received from the data collection process is used to create a process activity mapping to identify critical points in the production processes. There are several signs being employed to represent these critical points, including: "D" represents delays and/or waiting time, "⇒" to represent transportation of the product from one point to another. Moreover, each activity is classified based on VSM concept into: VA (value added), NVA (non-value added), and NNVA (necessary but non-value added).

3) System Designing for Improvement

According to the flow chart previously created from ECRS and VSM techniques, a new flow chart is being designed to eliminate non-value added works in the process, in order to minimize production time, transportation, and other unnecessary works.

4) Performance Measurement Comparison

The results between before and after improvement will be compared based on total time, transportation distance, and total number of tasks.

Results and Discussion

A. Data collection

In this study, the researcher has studied the coffee bean production process. The production line consists of 3 main steps: coffee cherry processing, green coffee bean processing, coffee bean roasting and product packaging. This can be divided into 33 activities, and the VSM is then used to visualize the current state of the coffee bean production process before improvement. From the process flow analysis, it was found that the time of production activities according to the cycle time of each process was 20.64 minutes while the total transportation distance was 3,831.5 meters as shown in Table I.

B. Problem identification

Table I shows that the production process has a process time of 20.64 minutes. The total transportation is 3,831.5 meters. The number of activity is 33. The activity consists of 16 steps of operation, 13 steps of transportation, 1 steps of inspection, and 1 stages of storage. According to VSM, the process consists of 11 VA activities, 20 NNVA activities and 2 NVA activities. Then, ECRS technique was performed to evaluate the problem condition and propose ideas for improvement.

C. System Designing for Improvement

ECRS has been employed to cut processes and reduce the transportation problem, as well as recommend an improvement of the work process, as the followings:

- 1) E-Eliminate: according to Table I, the transportation of raw materials has a large distance because the warehouse is far from the factory area, causing more distance and time. In addition, the process of containing coffee beans into sacks does not create value and adds complexity to the work process.
- 2) C-Combine: according to Table I, the coffee cherry imperfect sorting step and the coffee cherry color sorting step can be combined into one successive step to increase product value and reduce waste.
- 3) S-Simplify: Simplifying the process by developing equipment or machinery, as well as placing the warehouse in the factory area to increase process efficiency.

TABLE I. CURRENT PROCESS ACTIVITY MAPPING

Activity Mapping				D		V	VA	NNVA	NVA	Time (Minutes)	Transportation length (Meters)
Details of processes											
Coffee Cherry Processing											
1	Move coffee cherry to the well							√		0.05	0.75
2	Sort out imperfect coffee cherry						√			0.17	
3	Send to coffee cherry machine							√		0.05	0.75
4	Pulping (Mill coffee cherry skin)						√			0.12	
5	Fermenting						√			1.44	
6	Clear the mucus						√			0.12	
7	Contain in sacks							√		0.05	
8	Move to drying place							√		1.00	20.00
9	Pour into the sieve							√		0.08	
10	Drying						√			5.04	
11	Moisture check							√		0.05	
12	Contain in sacks							√		0.05	
13	Move to warehouse							√		0.16	750.00
14	Store					√	√				
Green Coffee Beans Processing											
15	Move to hulling							√		0.16	750.00
16	Hulling						√			2.92	
17	Move to sort out sizes machine							√		1.25	25.00
18	Sort out sizes of green beans						√			0.24	

19	Contain in sacks	o						√		0.05	
Activity Mapping											Transportati
Details of processes		o	⇒	D		7	VA	NNVA	NVA	Time (Minutes)	on length (Meters)
					<input type="checkbox"/>						
20	Move to warehouse		⇒					√		0.16	750.00
21	Move substandard coffee		⇒					√		0.04	10.00
22	Sorting of coffee beans (by hand)	o					√			5.00	
23	Contain in sacks	o						√		0.05	
24	Move to warehouse		⇒					√		0.04	10.00
25	Store					7			√		
Coffee bean roasting and packaging											
26	Move to roasting factory		⇒					√		0.48	750.00
27	Move to roasting machine		⇒					√		0.04	5.00
28	Roasting	o					√			1.05	
29	Contain in sacks	o						√		0.06	
30	Move to warehouse		⇒					√		0.48	750.00
31	Move to packing		⇒					√		0.04	10.00
32	Packaging	o					√			0.13	
33	Store					7			√	0.07	
<-----Total >		16	13	0	1	3	11	20	2	20.64	3,831.50

After using ECRS technique, the improved flow process activity mapping can be illustrated in Table II.

TABLE II. PROCESS ACTIVITY MAPPING AFTER IMPROVEMENT

Activity Mapping				D		T	VA	NVA	NVA	Time (minutes)	Transportation length (kilomet)
Details of processes											
Coffee Cherry Processing											
1	Move coffee cherry to the mill		00					✓		0.05	0.75
2	Sorting ripest coffee cherry and color sorting machines	✓					0			0.10	0.75
3	Sort to coffee cherry machine		00					✓		0.04	0.75
4	Pulping (Mill coffee cherry skin)	✓					0			0.12	
5	Fermenting	✓					0			1.44	
6	Clear the mucus	✓					0			0.12	
7	Move to drying stage		00					✓		1	20.00
8	Pour into the sieve	✓						✓		0.05	
9	Drying	✓					0			3.60	
10	Moisture check							✓		0.05	
11	Contain in sacks	✓						✓		0.05	
12	Move to warehouse		00					✓		0.07	20.00
13	Stop					T	0				
Green Coffee Beans Processing											
14	Move to hulling		00					✓		0.05	40.00
15	Hulling	✓					✓			2.00	
16	Move to sort out stone machine		00					✓		1.25	20.00
17	Sort out stone of green beans	✓					✓			0.24	
18	Contain in sacks	✓						✓		0.05	
19	Move to warehouse		00					✓		0.07	10.00
20	Move substandard coffee		00					✓		0.05	2.00
21	Sorting of coffee beans (by hand)	✓					✓			0.00	
22	Contain in sacks	✓						✓		0.05	
23	Move to warehouse		00					✓		0.04	2.00
24	Stop					T		✓			
Coffee bean roasting and packaging											
25	Move to roasting machine		00					✓		0.04	5.00
26	Roasting	✓					✓			1.00	
27	Contain in sacks	✓						✓		0.04	
28	Move to packing		00					✓		0.07	2.00
29	Packaging	✓					✓			0.10	
30	Stop					T		✓		0.07	

←-----Total	>	15	11	0	1	3	11	17	2	17.84	141.25
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D. Performance Measurement Comparison

The comparison of existing and the proposed system is illustrated in Table III. The total duration of the process was reduced from 20.64 to 17.84 minutes. The total transportation is reduced by 2,190.25 meters. With the ECRS technique, the number of activities can be decreased by 3 activities. Therefore, percent improvement in terms of Time and Distance are 13.57% and 96.31%, respectively.

TABLE III. COMPARISON OF BEFORE AND AFTER IMPROVEMENT

	Before	After	Difference	% Reduction
Total time (Minutes)	20.64	17.84	2.80	13.57
Total distance (Meters)	3,831.50	141.25	2,190.25	96.31
No. of activities	33	30	3	9.09

Conclusion

This study emphasized on the improvement of the coffee bean production process. The core processes of this line consist of 3 main steps: coffee cherry processing, green coffee beans processing, coffee bean roasting and product packaging. Prior to the study, the total production time was 20.64 minutes, and total of 3,831.5 meters of total transportation length.

According to the process activity mapping, all of the processes, this section contains total of 33 work steps; 22 of which were NVA and NNVA processes. Hence, ECRS technique was applied in order to improve efficiency in production. The technique was applied by eliminate the long distance transportation of raw materials and contain coffee beans in sacks that do not create value. Combine coffee cherry imperfect sorting and coffee cherry color sorting steps. Developing equipment or machines to simplify the process. Including placing a warehouse in the factory area to increase process efficiency.

The production line in the coffee bean production process using lean manufacturing techniques shows that the processing time can be reduced by 13.57%. Total transportation distance can be reduced by 96.31%.

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RESILIENT SUPPLIER RELATIONSHIP MANAGEMENT FRAMEWORK FOR HUMANITARIAN ORGANISATION

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ABSTRACT

Purpose: Supplier Relationship Management (SRM) involves different strategic processes and principles of supplier development and maintenance. SRM has been proven to assist commercial firms in achieving upstream supply chain resilience. As opposed to businesses, there has been a lack of critical SRM strategic processes to help humanitarian organisations achieve their upstream resiliency. Therefore, almost all humanitarian supply chains are far from being resilient. This paper extends the work done by Banomyong et al (2022) and Bhusiri et al (2021) by adapting additional strategic processes of performance measurement guidelines from SRM to the context of humanitarian supply chain. The SRM processes are then integrated into a framework to provide a more holistic and integrative viewpoint to help organisations enhance the consistency of humanitarian assistance.

Design/methodology/approach: This paper reviewed and adapted the SRM strategic processes from well-known SRM approaches used in the commercial supply chain context. The integrated framework contains a set of SRM strategic processes with information flows configuration. The framework was validated by humanitarian experts to ensure its usefulness and applicability.

Findings: The SRM framework can be used as a guideline to streamline and implement humanitarian sourcing strategies, action plans, metrics, and processes for better relationship management with suppliers and more resilient supply chains.

Research limitations/implications: The SRM framework integrates a set of paramount processes validated by humanitarian experts and provides general guidelines for humanitarian organisations. Some adaptation might be required in case of a specific humanitarian supply chain.

Practical implications: Operating humanitarian supply chains, especially ones supporting long-term development aid programmes, requires humanitarian organisations to source and procure large amount of relief commodities from suppliers annually. More precise and systematic relationship engagement approaches with suppliers play a vital role in ensuring supply consistency and efficiency to minimise suffering of beneficiaries.

Originality/value: This framework is among the first to provide an integrative view of the SRM for humanitarian organisations to increase their upstream supply chain resilience. The integrated SRM framework covers the principles of purchasing and supplier segmentation, relationship implementation guidelines, and supplier performance measurement.

Keywords: Humanitarian supply chain, supplier categorisation, supplier relationship management, performance metrics, supply chain resilience

Introduction

Supplier Relationship Management (SRM) has comprehensively been defined by Lambert and Schwieteman (2012) as one of the macro business processes of commercial firms that could contribute to more effective and resilient upstream supply chains. It consists of individual tasks, activities, strategic processes, and principles to structure how relationships between buyers (i.e. commercial firms) and suppliers should be developed and maintained including supplier categorisation, sourcing strategies, supplier and business relationship establishment, supplier performance measurement, and continuous process improvement to name but a few. The implementation of the SRM strategic processes involves and interfaces with all other macro business processes of the firm such as customer relationship management, demand management, order fulfillment, manufacturing flow management, and so on.

The SRM processes have become more and more important to businesses in decreasing costs, utilising resources, increasing profitability, maintaining level of services to customers, and staying competitive in today's market (Amoako-Gyampah et al., 2019; Simchi-Levi et al., 2003). The SRM processes have also been recognised as strategic approaches for businesses to prepare and mitigate risks of supply shortages (Datta, 2017). Therefore, many businesses and commercial firms who applied and implemented SRM can cope with supply disruptions within short periods of time amidst the coronavirus pandemic and other external shocks.

Several strategic processes of SRM are obviously interrelated and influenced by each other. Consequently, a good information system to manage and control the flows of information (i.e. inputs and outputs of each process) is required. In addition, from the practical perspective, conducting the SRM strategic processes requires strong collaboration and coordination among business functions, divisions, departments, and stakeholders within the organisation as well as the involvement of suppliers. One single staff might be responsible for more than one process of the SRM. Therefore, it is essential to integrate a set of strategic processes from SRM into a single framework to provide a holistic and integrative viewpoint. Expected outcomes could be more superior to focusing on each specific process (Lambert and Schwieterman, 2012; Park et al., 2010).

As opposed to businesses and their commercial supply chains, almost all humanitarian supply chains are far from being resilient. One of the rationales is that there has been a lack of important SRM strategic processes in the humanitarian supply chain context. As far as the authors are concerned, only a few SRM processes have individually been proposed for humanitarian organisations to apply to their supply chains such as purchasing portfolio and supplier categorisation (Bhusiri et al., 2021; Lamenza et al., 2019) and supplier relationship guideline development (Banomyong et al., 2022). While the integrative framework for the SRM to guide humanitarian organisations in the processes of managing relationships with suppliers has not been observed yet.

Disasters and other uncertainties over the past few years have shown humanitarian organisations how essential upstream supply chain resilience was. Temporary border closure followed by panic buying and stockpiling caused empty shelves. Many organisations have consequently faced supply interruptions. Many projects and operations were delayed or cancelled. With more frequency and larger magnitude of disasters in addition to global economic recessions and other uncertainties, supply disruptions could more easily take place, causing interrupted humanitarian supply chains. Therefore, it is imperative to boost humanitarian supply chain resilience.

This paper considers extending the previous works of Bhusiri et al. (2021) and Banomyong et al. (2022) by introducing and adapting additional strategic processes of supplier performance measurement development in the SRM to the context of humanitarian supply chain. The SRM processes are then integrated into a framework to provide a more holistic and integrative viewpoint to help humanitarian organisations ensure the consistency of humanitarian assistance. These SRM strategic processes for humanitarian organisations include:

- The process of categorising purchasing portfolios and suppliers. This is to achieve a better understanding of the importance of different suppliers against the purchasing power of the buying organisation so that more appropriate sourcing strategies and actions towards different suppliers can be devised to decrease operating costs and resources and to ensure the availabilities of strategic commodities (i.e. items and services);
- The process of developing supplier relationship establishment guidelines. This is to cope with the needs of practical guideline to ensure the right engagement level, resources allocated, and planning developed for the success of implementing and maintaining the SRM;
- Developing guidelines for opportunities to engage with suppliers and measuring supplier performances. This is an additional SRM strategic process developed in this paper to define the guidelines of business opportunities & requirements and performance metrics with different

suppliers to regularly measure and monitor supply performances and risks, especially from strategic suppliers. This can also be considered as a proactive management of strategic suppliers (Campbell, n.d.) and proactive improvement of humanitarian supply chain resilience.

The organisation of the paper is as follows. The next section is the literature review, followed by an explanation of the methodology. Then SRM framework for humanitarian organisations to apply to their supply chains is described. The last section concludes the paper.

Literature Review

Commercial supply chain and the SRM

Lambert and Schwieterman (2012) defined five strategic processes for SRM under a single framework that businesses could use to implement in their supply chains as follows. The first two processes are to review corporate, marketing, manufacturing, and sourcing strategies as well as to identify criteria for supplier segmentation. First, a review of products & services that are critical to the organisation's success is executed. Then, initial identification of suppliers who are also critical to the organisation's success can be executed. A mapping of organisation's supply chain can be drawn to have a better visualisation on issues, risks, and opportunities with suppliers. The organisation preliminarily identifies the suppliers with whom it needs to develop long-term relationships (i.e. the so-called strategic suppliers) according to corporate, marketing, manufacturing, and sourcing strategies. Suppliers can further be segmented into a 2x2 matrix using two defined dimensions (i.e. supply risks and potential to add value). It must be noted that the matrix of Lambert and Schwieterman (2012) is similar to one proposed by Kraljic (1983) with dimensions of importance of purchasing and complexity of supply market. There are criteria on each dimension such as volume and competitive pricing for potential to add value dimension and quality, capacity, and complexed specification for supply risk dimension.

After the matrix is constructed, four categories of purchasing portfolios and suppliers can be formed including strategic, bottleneck, leverage, and non-critical categories. Each category results in different approaches, strategies, and action plans towards suppliers in that category. For example, the organisation can seek to obtain major cost savings from suppliers in the leverage category, while the organisation should look into having close relationships with strategic suppliers. Outputs from the 2x2 matrix are valuable information for the organisation to develop relationship implication guidelines for implementing strategies and actions towards different suppliers. Involvement should be at the right level. Resources should appropriately be allocated. These are to ensure the success of implementation whilst also utilising organisational resources. Next process is to develop strategic guidelines for different business opportunities, requirements, and terms and conditions of the transactions (i.e. product and service agreement or PSA) with suppliers, which could lead to the next process of developing performance metrics once required specifications and deliverables of suppliers are known. Continuous improvement process to explore new enhancement possibility can also be executed. As a result, new projects with suppliers can be executed.

Having an understanding of the importance and complexity of different suppliers could assist the businesses in having appropriate approaches towards suppliers. Cost reduction can be expected through negotiation, economy-of-scale purchasing and transporting, fixed purchasing cost against seasonal and panic buying. Resources can be utilised by mitigating unnecessary workloads and burdens. Also, availability and continuity of supply can be ensured through supply network diversification, strategic partnership development, safety and spare stocks, and item substitution. Upstream supply chain can be more resilient (Datta, 2017; Ketchen et al., 2014; Pereira et al., 2014).

Humanitarian supply chain and SRM

Humanitarian organisations need to operate their supply chains under uncertain environments. Humanitarian supply chains encompass operational activities in the domains of emergency relief operations and development aid programmes (Haavisto and Kovacs, 2014; Van Wassenhove, 2006). Operating

humanitarian supply chains to support long-term development aid programmes is similar to the commercial supply chains, where large amounts of relief commodities from different suppliers need to be searched, sourced, procured, purchased, and managed annually (Bhusiri et al., 2021). A lack (or incompleteness) of important SRM strategic processes in humanitarian supply chain context result in humanitarian supply chain delays and disruptions. For instance, it has been reported by HELP Logistics et al. (2020) that some humanitarian organisations faced challenges of up to 30 days of delays when procuring relief commodities from international suppliers amidst the pandemic.

Few research works have adapted the individual processes of the SRM into humanitarian supply chain context. These include the works of Lamenza et al. (2019) and Bhusiri et al. (2021) with an aim of introducing the categorisation matrixes to humanitarian organisations. Different matrix dimensions have been redefined to achieve the goals and purposes of the focused humanitarian supply chains. A set of validated criteria has also been provided. The difference between these two studies is that the former focused on emergency relief supply chain, while the latter worked on humanitarian supply chain to support development aid agency. Later Banomyong et al. (2022) developed relationship implication guidelines as a consequence of the work of Bhusiri et al. (2021).

From a practical perspective, there are few humanitarian organisations implementing SRM such as International Federation of Red Cross and Red Crescent Societies (IFRC) and World Food Programme (WFP) (Rucha and Abdallah, 2017). However, they could not fully achieve the outcomes expected from SRM. As mentioned, there is a lack of important SRM strategic processes in the humanitarian supply chain context. Also, there is no existence of the integrative framework for the SRM in humanitarian supply chain context.

Methodology

The additional SRM strategic process of development of guidelines for business opportunities and performance metrics has been adapted from the work of Lambert and Schrieferman (2012) and Keith et al. (2016). The adaptation has been conducted to meet goals and objectives in the context of humanitarian supply chain in general and development aid programme in particular. Then, this additional process has been combined with the SRM strategic processes that have already been adapted in the work done by Bhusiri et al. (2021) and Banomyong et al. (2022). This step formed the SRM framework for humanitarian organisations. The framework has then been validated with (and modified by) humanitarian experts through online meetings. These humanitarian experts have extensive experiences in international humanitarian organisations at regional as well as national offices. Their mandates have covered development and relief practices. The humanitarian experts have also been equipped with goals, purposes, and contents of the study. Feedback from the validation resulted in the revised framework, which is described in the next section.

Results and Discussions

Adapting the SRM framework into humanitarian supply chain context

Figure 1 depicts the proposed SRM framework, where five main strategic processes are included. The main differences between commercial supply chain and humanitarian supply chain are the stakeholders and processes involved. Therefore, the set of supply chain macro processes and functions have been redefined including humanitarian preparedness, operation and distribution management (i.e. assessment, sourcing, transport, warehousing, distribution, last-mile), demand fulfillment, demand management, aid programme management, and donor and partnership management (Raillani et al., 2020). The implementation of the SRM strategic processes presented in figure 1 needs to involve and interface with other macro processes.

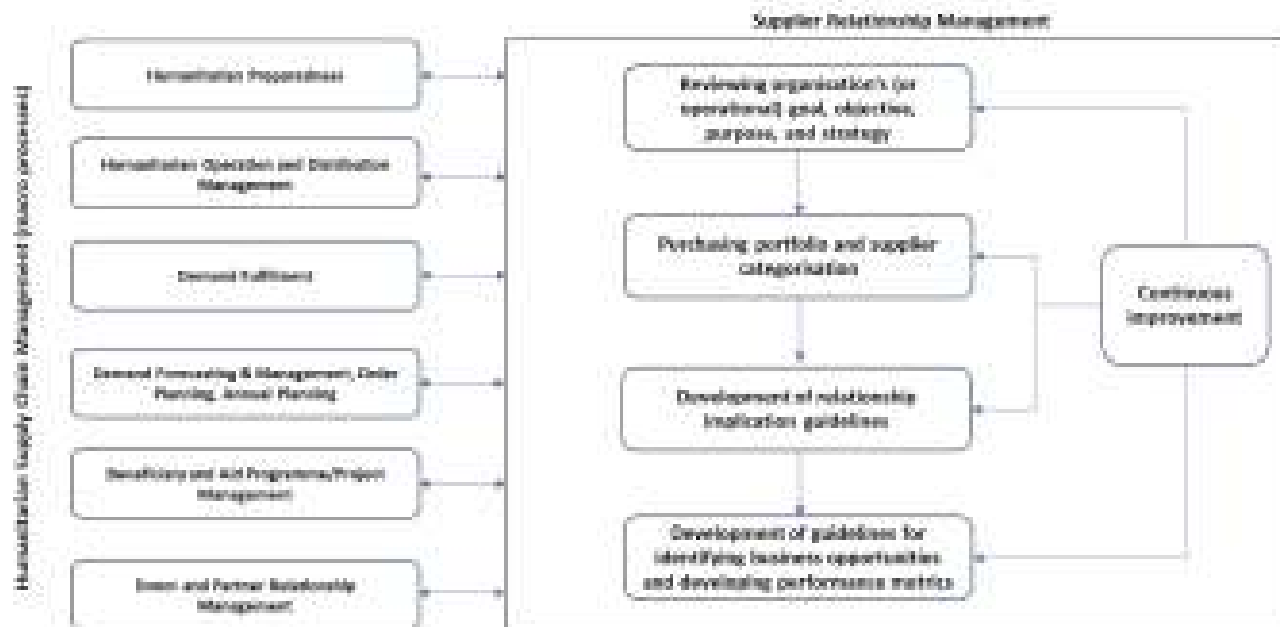


Figure 1: The proposed SRM framework
 Source: adapted from Lambert and Schwieterman (2012) and Raftani et al. (2020)

Comprehensively reviewing, identifying goals and strategies of the aid agency and its operations need to be first conducted. This will lead to properly define matrix dimensions and criteria for purchasing and supplier segmentation. Sourcing strategic and engagement approaches can consequently be devised, followed by a development of implementation guidelines according to each obtained category of the segmentation. Based on observation, there is a severe lack of knowledge and understanding of how to implement the engagement approaches with suppliers. Therefore, relationship implication guidelines are crucial in humanitarian supply chain context. Each category can result in different business transaction opportunities (or business models) with suppliers in that category. The guidelines for business opportunities and performance metrics, which are interconnected, are required to drive improvement. In addition, continuous improvement can be employed to enhance the SRM strategic processes.

Review of humanitarian supply chain for development aid programme: goals and objectives

Different development aid programmes governed by different agencies in different countries have similar goals and purposes to mitigate the suffering and improve the quality of lives of vulnerable people. These could be captured from our questionnaires fulfilled by humanitarian practitioners. The role of supply chain to support the development aid programmes is to source, procure, and purchase commodities for generic purposes (e.g. office and administration activities) and specific purposes (e.g. construction projects and sanitation projects). Common purchased commodities include construction materials, agricultural seeds, school kits, stationeries, and so on. An absence or insufficiency of critical commodities may cause project delay, project disruption or organisation's ineffectiveness (Bhusiri et al., 2021). The natures of suppliers and markets that development aid agencies procure from are either monopoly or oligopoly. These further create challenges to the aid agencies to secure commodities at reasonable prices. Categorising and managing relationships with suppliers are based on total volumes purchased or spending. Suppliers with high spending annually can easily be defined as strategic suppliers to the aid agencies, and negotiation takes place as a sourcing strategy. Item or service costs offered by suppliers are ones of simple performance metrics.

Purchasing portfolio and supplier categorisation

Two matrix dimensions are defined for the supply chain supporting development aid programme. One dimension is defined as the strategic importance of purchase, which refers to the influence of the purchased commodities and suppliers on the overall performances of the aid agency. These strategic importance criteria can go beyond volume purchased, cost, and finance, which additionally include effectiveness, responsiveness, and reliability of the purchased commodities and suppliers. Another dimension is risks and vulnerabilities of the supply that potentially result in sourcing difficulties and supply disruptions. Three main types (or criteria) of supply risks are comprised including market risk, commodity risk, and logistics risk. More details can be found in Bhusiri *et al.* (2021). As a consequence of the matrix development, four categories of purchasing portfolio and supplier can be formed as shown in figure 2. Each category is associated with its characteristics, objectives, and strategic actions to enhance upstream supply chain resilience.

Relationship implication guidelines

Once sourcing strategies and approaches are defined for each purchasing portfolio segment, the implementation action plans should be defined. The guidelines for relationship implementation in humanitarian supply chain context consist of four main aspects. The first aspect is resource aspect, where the guidelines should indicate responsible (or accountable/dedicated) person for building and fostering relationships. A responsible person can be for each (strategic) supplier in the segment or for the entire segment in other categories. Level of business engagement and business meeting with the suppliers should be defined. Next is strategic planning aspect. Types of organisation plan and business transaction should be defined for each (strategic) supplier or each segment. Also, the organisation should define what type (and how deep) of information can be shared to the suppliers. Since the customer in humanitarian supply chain context is either beneficiary or donor (Rucha and Abdallah, 2017), the third aspect is revised to beneficiary/donor aspect. This is the aspect to collaborate with suppliers to align with requirements, specifications, and expectations from beneficiaries and donors and to reduce supply risks. The last aspect is measurement aspect. This is to develop standard supplier metrics that can be used to assess the supplier's performance. Figure 3 shows a summary of relationship implication guidelines for humanitarian organisations. More details can be found in Banomyong *et al.* (2022).

Guidelines for business opportunities & requirements and performance metrics

Different types of business opportunities and performance metrics with suppliers in different categories can briefly be explained in this sub-session. In non-critical category, business opportunities with suppliers can be traditional transactions (or arm's length transactions), where simple exchanges of commodities for monetary gained are conducted (Keith *et al.*, 2016). In the traditional transactions, developing relationships between the humanitarian organisation and suppliers are not required. No contract or the PSA is also required if no benefit is gained, or no risk is involved. Suppliers are just requested to deliver the agreed amount of works such as one bag of construction cement, one hour of training programme delivered, and one month lease. Payments in the form of cash, cheque, bank transfer, and so on can be made once the transactions are completed (or in later time) (Keith *et al.*, 2016). Basic information of commodity specification, amounts requested, and preferred delivery options can be shared to the suppliers. Simple delivery performances (e.g. delivery in-full and on-time (DIFOT) and commodity return rate) can be employed to measure the supplier performances.

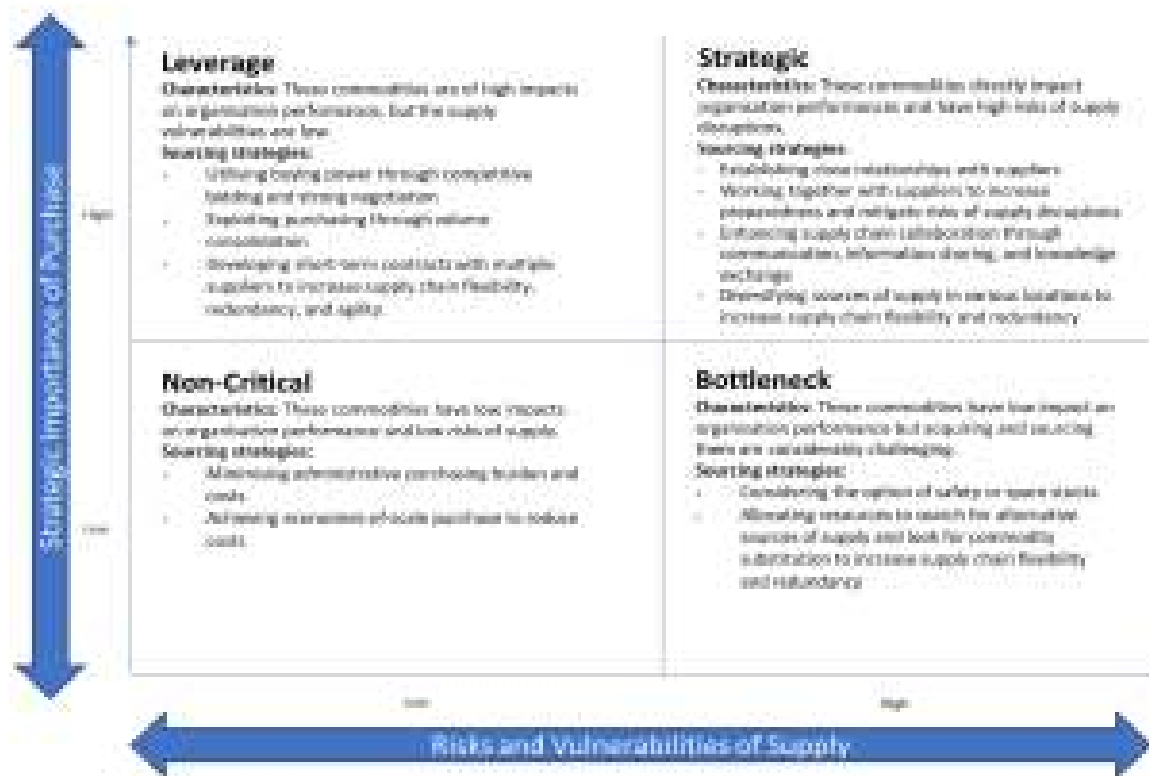


Figure 2: The purchasing portfolio segmentation for development aid agency
 Source: adapted from Bhusiri et al. (2021)

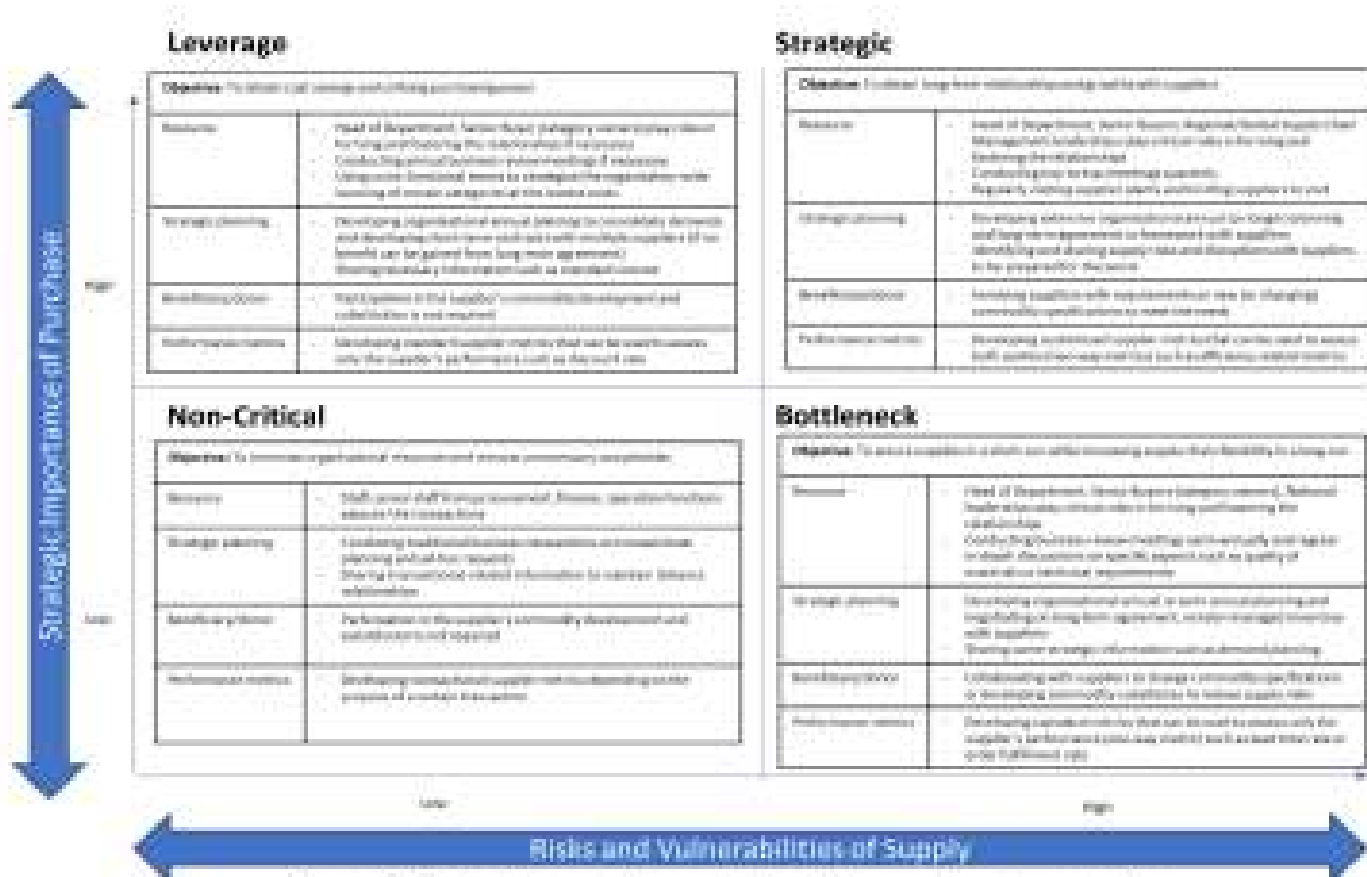


Figure 3: Relationship implication guidelines for humanitarian organisations

Source: adapted from Banomyong et al. (2022)

In the leverage category, the organisation can consider having short-term contracts with multiple (approved) suppliers. More business and transaction information such as annual volume (or a part of it), preferred prices and payment terms, preferred qualities, supplier code of conduct, compliance, and other requirements can be shared to the supplier (Keith et al., 2016). The PSA according to above-mentioned information can be developed for suppliers to follow. Long-term contracts with suppliers can be options if cost reduction or risk reduction can be achieved. In this case, developing relationships with suppliers with minimum resource allocation is required. Similarly, the transaction model is still the traditional one. Since level of relationship is formed, additional performance metrics can also be defined such as discount rate and satisfaction level. A supplier scorecard can be developed (de Sousa et al., 2020).

In the bottleneck category, for some types of commodities that are very complicated to be sourced, a performance-based (or output-based) business model suggested by Keith et al. (2016) can be applied. This is the model that supplier performances are measured by outputs or targets. In our case, the humanitarian organisations target to achieve the supply consistency (without large investment as these are low important commodities). The organisations can set the level of performances (or targets such as 95% order fulfillment rate) in the long-term agreement or the PSA for suppliers to work out. Also, the organisations and suppliers can agree to work on the collaborative projects such as vendor-managed inventory (VMI). Strong relationships might be required as the suppliers need to allocate budgets for investment. Strategic information to influence the target achievement such as demand & procurement planning, detailed process and activities, beneficiary & donor requirements, commodity specifications, and common operational risks needs to be shared with suppliers. Supplier performance metrics include order fulfillment rate, lead time rate, safety stock level over time spanning, and occurrence of stockouts. Payment method can be similar

to the traditional transactions with additional penalties applied when the targets are not met. Also, payment can be made with proportional to the success rate.

In strategic category, the business models can be either the output-based model to ensure supply consistency or the outcome-based model to fulfil missions, objectives, and goals of projects/programmes/operations/organisations. These models seek strong collaboration between humanitarian organisations and suppliers. Detailed operations, projects, programmes, and organisations must be shared with suppliers along with demand projections, beneficiary & donor requirements, and supply risk identifications. Large (and long-term) investments on strengthening relationships, information sharing, and perhaps humanitarian supply chain preparedness from both parties are required. Strong collaboration can lead to innovative solutions from suppliers (Keith *et al.*, 2016) such as optimising and designing their processes and plans for cost-efficiency, effectiveness, and responsiveness, extending their supply network to mitigate supply risks, and commodity substitution to increase quality. Both parties need to develop (and agree) the customised performance metrics that can be used to assess supplier performances such as maintaining (or having better) order fulfilment rate at a lower cost, improving responsiveness, and reducing lead times and the metrics that can assess both parties such as return on investment (ROI). Payment method can be similar to the traditional transactions with additional incentives applied when the targets or outcomes are met. Or payment can be made with proportional to the success rate.

Conclusions

Humanitarian supply chain operations have been operated with low upstream resiliency. These have led to interrupted humanitarian supply chains and ultimately more suffering and decease of beneficiaries. These have been due to a lack of the comprehensive SRM framework with a set of paramount strategic processes. This paper adapted the SRM strategic processes from the well-known SRM approaches in the commercial supply chain perspective and formed the SRM framework for humanitarian organisations to use as guidelines to streamline and implement humanitarian sourcing strategies, action plans, processes, and metrics for better relationship management with suppliers and more resilient upstream supply chain.

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