

IMPROVEMENT OF POSTCONSUMER FOOTWEAR SUPPLY CHAIN BY LEAN CONCEPT

Jureerut Somboon, Korrakot Yaibuathet Tippayawong*

*Excellence Center in Logistics and Supply Chain Management, Faculty of Engineering
Chiang Mai University, Chiang Mai, 50200 Thailand*

**korrakot@eng.cmu.ac.th*

1. Introduction

In any declining economy, consumers tend to spend more carefully. Second hand markets can be considered as the market of choice to save their money. Used goods are popular if they are generally in good quality and low price. In Thailand, there are many second hand markets, for example at Chatuchak, Wang Lang, Klong Thom, Srinakarin etc. One of the biggest second hand markets in Thailand is Rong Kluea Market located near Thai-Cambodia border approximately 360 km from Bangkok. This market is popular for Thai people, tourists and sellers.

There are several materials and processes involved which are driving the production process for sandals and specialized shoes. The footwear industry is growing and the demands of these products are increasing. The product cycle is relatively short. With the rapid changes in fashion, consumer trends could lead to a higher level of post-consumer waste. Worn and discarded (end-of-life) shoes are disposed of, despite their remaining market values.

In Thailand, there are imported used shoes from overseas through Laemchabang port located in Southern Bangkok which are then forwarded to Rong Kluea Market for reselling. The process flow of the selling chain is of great interest. The middlemen who import used shoes sell them to merchants in Dech Thai market (Sub-market of Rong Kluea market). The merchants are classified into 3 groups by grade and price of products they selected. Used shoes are put into the following processes: separating, selecting, washing, repairing and coloring. Subsequently, the shoes are resold with retail and wholesale price. Generally, all products in this chain are used shoes and consumers are interested in buying them, because they contain brand name shoes which have lower prices than new shoes.

This study focuses on reviewing the postconsumer footwear supply chain to analyze the value creation along the chain. The processes are analyzed and defined using Value Stream Mapping (VSM) to reduce unnecessary activities. Finally, improvements based on lean concept are suggested to reduce total time to finish the process.

2. Literature Review

There have been relatively few studies on the postconsumer footwear supply chain, hence the reason for this study. The scope of this paper is related to the review of the used shoes supply chain and to understand the value added in the chain by means of value chain analysis. Moreover, lean concept is applied to improve processes in the postconsumer footwear supply chain.

Previous studies carried out in this area are reviewed in 4 main categories, end-of-life strategy, value chain management, waste management in footwear industry, principal and generalization of lean concepts.

This section aims to describe some of the key concepts in understanding why the business organizations are interested in recovery products. How companies add value to their products. In addition, waste management in the footwear industry is analyzed. Finally, this research will illustrate and show some examples about an application of lean concept.

2.1 End-of-life Strategies

Previous studies reported that businesses attempt to create appropriate procedure to reduce waste at products' end-of-life cycle. Pigosso, et al. (2010) introduced eco-design concept which focused on remanufacturing. They concentrated on products' end-of-life as a part of product life cycle. The End-of-life strategy includes processes such as; reuse, repair, refurbishment/reconditioning, remanufacture and recycling. This concept tries to close the loop, minimizing environmental impact and cost of life cycle manufacturing processes.

Nowadays, numerous business organizations intend to follow up the end-of-life strategies, because they believe it can reduce the cost of their business and wastes produced in the process. Moreover, it can help to decrease environmental impact. Therefore, they try to add value to the recovery products and complete processes in short time. End-of-life strategies use in many businesses extensively especially in electronic equipment, automobile industries, mobile phone industries, returnable packaging etc. For example, Subramoniam et al., (2010) presented an aftermarket remanufacturing strategic planning decision-making framework where the surveys were conducted in 3 target groups of automotive aftermarket. End-of-life strategies of mobile phones are studied in many areas such as India, Hong Kong and United Kingdom (Rathore, et al., 2011; Chan and Chan, 2008; Canning, 2006; Geyer and Blass, 2010). During the research carried out on mobile phones reuse and recycling, the authors surveyed supply chain components, market structure and economy scale of these products. In addition, they focus on product life cycle of a typical mobile phone. Lastly, they show how mobile phones currently move through the value chain and the important of recovery markets.

It can be seen that majority of previous studies focused on automotive or electronic industries which adopted concept of End-of-life strategies to their business. There is hardly any study, investigating in second hand textile or footwear products.

2.2 Value Chain Strategy

Generally, value chain is a strategy that they used for analyzing their chain from the beginning. Value Chain focuses on processes, and how inputs are changed into the outputs purchased by consumers (Porter, 1985). Elements in Porter's value chain are divided into primary and support activities. Primary activities are inbound logistics, operations, outbound logistics and marketing/sales. Support activities are served as major driven function for primary activities. There are procurement, human resource management, technological development and infrastructure. Walters and Lancaster (2000) reported that several businesses have value chain process in details more than Porter's model, such as The bluegum group, automotive industry, The Caterpillar, etc. Each of them has different value chain model. Customers today have more selection of products and services than ever before, but they are not entirely satisfied. The concept of co-creation is, therefore, presented to combine the firm, market and consumer together. Prahalad and Ramaswamy (2004) compared concept between no co-creation and co-creation. Co-creation increases interaction between the firm, the market and the consumer. For example, they are joint problem definition and problem solving. For this reason, this concept creates experience variety and then aggregate into one idea. Problems may be resolved directly according to the customers need. As a result, co-creation is an interesting practice in value creation. Value chain of fashion industry is likewise interesting because it has rapid change with demand driven. Fashion supply chain concerns on lead times, time to market, customer response. Today, fashion market is extremely competitive and need to modernize product all the times. If they shift into an agile supply chain and the demand can be accurately forecasted, their cost will reduce (Christopher, et al., 2004). This research analyzes the value chain of postconsumer footwear based on 5 primary and 4 supporting activities to outline how the used shoes create value.

2.3 Waste Management in the Footwear Industry

The footwear industry is a significant part of the fashion industry. In recent years, demands and competition in this industry has rapidly increased. Life cycle of footwear can be relatively short, leading to a higher level of waste towards their end-of-life. Despite this, very few studies have investigated the impact of waste produced from the footwear industry on the environment. Staikos and Rahimifard (2007) aimed to create an optimal method for waste management in footwear industry. They presented a decision-making model using analytic hierarchy process (AHP), which is a multi-criteria decision-making (MCDM) method. Normally, shoes waste management model consists of four options in end-of-life which are reuse, recycling, energy recovery and disposal. In addition, they try to use an associate software tool to support the decision-making model. The research provided optimal model for waste management process to represent responsibility for environmental and help the company to reduce cost in waste disposal process. However, this research focuses mainly on reuse, repair, recycle and refurbish of used shoes.

2.4 Lean Concept Application

Lean method is a concept which focuses on eliminating wastes in processes in order to increase efficiency and productivity. There are several tools and techniques in lean such as Value stream Mapping (VSM), Total Productive Maintenance (TPM), Kanban, Visual Management, and etc. (Kumer et al., 2006). Businesses adapt tools and techniques of lean in different ways.

VSM is considered as one of the most important tool of lean techniques in reviewing overall processes. The current state mapping of processes is initially generated then the processes are defined and classified into three categories; non-value adding (NVA), necessary but non-value adding (NNVA) and value-adding (VA). Subsequently, appropriate procedures are implemented to eliminate wastes in the system. The future state mapping is finally constructed to display process modification. The expected result includes minimizing time and cost in value chain (Hines and Rich, 1997). The VSM concept is considered as a significant tool in the improvement stage of this research.

Lean thinking is not only suitable for production industries but also found to be used in other types of industries. The hospitals are interested in lean to solve their problems. On the other hand, lean can apply to eliminate waste in communication process such as waiting time, critical path related queues and erroneous data or information (Gifu and Teodorescu, 2014).

This research applies main concept of lean using VSM to analyze the current and future state of post-consumer footwear business.

3. Research Methodology

A review on the postconsumer footwear supply chain was conducted from secondary databases and documented for understanding this chain briefly. Survey of the chain and interview of stakeholders in the chain were then performed. Value chain analysis starts from analyzing primary activities and support activities. Finally, value added of the used shoes has focused by looking at value changed in each step in the chain.

VSM is later used to define and analyze processes. Processes are classified into three categories; value added activities (VA), necessary but non-value added activities (NNVA) and non-value added activities (NVA). Wastes in these processes were identified. Suggestion and concepts were proposed to help improving the process, after implementation and reporting.

4. Results

4.1 Overview of The Post Consumer Footwear Supply Chain

Rong Kluea market is located in Sakaeo, near Aranyaprathet border. There are 6 sub-markets including Old Rong Kluea market, Golden Gate market, Dech Thai market, Thesaban II (New- Rong Kluea market), Benjawan market and Indochina market. Each market can be divided into specialty markets. For example, Golden gate market sells new and second hands items; Benjawan market sells second hands clothes and accessories, and Dech Thai market is specific to used shoes.

The used shoes supply chain starts from middleman in Dech Thai market who import used shoes from other countries such as Korea, Hong Kong, China through Laemchabang port in approximately 45 containers per month. The middleman sells used shoes to 4 groups of merchants at Dech Thai market. After reconditioning processes, used shoes are resold to tourists and provincial merchants in order to distribute to other second hand markets in Thailand. The overview of the used shoes supply chain is exhibited in Figure1.

Used shoes supply chain can be identified into 3 stages; inbound logistics, internal logistics and outbound logistics. This can be an initial idea to analyze value chain of the used shoes supply chain in the next stage.

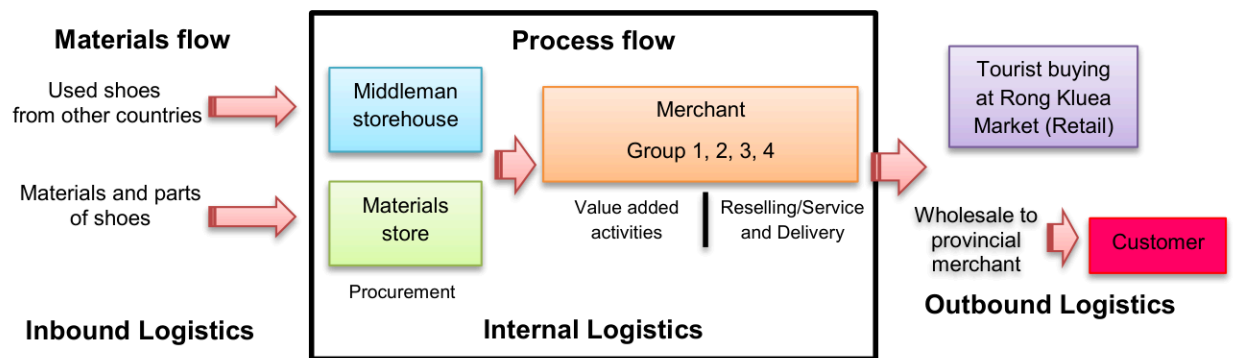


Figure1. Postconsumer footwear Supply Chain

4.2 Value Chain Analysis

Value chain analysis aimed at finding value added activities in supply chain for understanding current business process. Nowadays, stakeholders try to create several activities for supporting their business. Table1 illustrate the post-consumer footwear value chain analysis. The result here specifies what activities stakeholders currently perform in order to add value to the chain.

4.3 Value Creation in Postconsumer Footwear Supply Chain

Used shoes are imported from other countries at a price by container. Total cost of achieving 1 container of shoes including used shoes price, imported tax, shipping cost, warehouse rental, and labor cost is approximate 27,000 USD. Each container contains 48,000 pair of shoes, which cost about 0.56 USD/ pair. The middleman sells them to 4 groups of buyers in Dech Thai market at different

Table1. Value Chain Analysis of Post-Consumer Footwear

Support Activities	Procurement: - Middleman contacts with suppliers on aboard by email - Each group of merchant supplies materials and parts of shoes from material store	Margin
	Human Resource Management: - Employ flexible labors and hire them fairly - Teach technique and skill to laborers	

Firm infrastructure: - Business model of middleman and merchants				
Inbound Logistics	Operations	Outbound Logistics	Marketing and Sales	Services
- Used shoes from other countries - Materials and parts of shoes from store	- Selecting by each merchant - Value added activities such as; Soles repairing, Washing, Repairing and Ornamenting heeled shoes & Painting	- Reselling by retail and wholesale	- Select used shoes in good quality for customers when they can't come to select by themself - Delivery for province customers	- Compensate to customers in case deliver incomplete quantity
Primary Activity				

prices. Subsequently, each buyer put their shoes in different reconditioning process (wash, repaint sole repair etc.) depending on shoe conditions. The reconditioned shoes are then resold to different second hand shoe market. Trading of the used shoes in this case study is approximately 20% to retail market (tourist group) and 80% to wholesale market (provincial merchants) depending on quantity requested by customers. Each stakeholder benefits differently. Details of value creation in of the used shoes supply chain and selling margin of each stakeholder is exhibited in Table 2.

Table2. Margin of Each Stakeholder in Post-Consumer Footwear Supply Chain

Stakeholders	Cost (in USD) ^{*1}			Selling price (Avg.)	Margin (%)	
	Used shoe cost	Reconditioning cost (Ave)	Total cost			
Middleman/ Importer	0.56	0.00	0.56	3.48	520.17	
Merchants Group 1	11.43	0.16	11.59	14.57	25.71	
Merchants Group 2	2.1	5.71	0.19	5.90	8.69	39.98
	2.2	5.14	0.21	5.36	7.71	
	2.3	4.29	0.24	4.53	5.83	
Merchants Group 3	3.1	1.94	0.27	2.21	3.71	66.82
	3.2	1.29	0.32	1.60	2.97	
	3.3	1.14	0.37	1.51	2.46	
	3.4	0.71	0.42	1.13	1.71	
Merchants Group 4	0.09	0.52	0.61	1.14	87.79	

^{*1} 1USD = 35 THB (As of 28 Aug, 2015)

4.4 Processes Analysis by Value Stream Mapping

Value stream mapping is used to understand the current processes in the used shoes supply chain. The chain starts from a middleman in Dech Thai market who imports used shoes from oversea suppliers through Laemchabang port, approximately 45 containers per month. After paying the import duty, the used shoes are forward to warehouses in Dech Thai market. The middleman sells the used shoes to merchants in Dech Thai market who can freely select used shoes with grade and price as they need. These merchants are separated into 4 groups; Merchants in group 1 and 2 are among the first selectors. They can select whole goods in container; normally, they always select brand name grade as good quality. Group 3 selects goods which merchants group 1 and 2 did not select. Finally, group 4 buy used shoes in bulk. The used shoes are selected for reconditioning before reselling.

The VSM was applied in this process to identify current stage of activities in post-consumer footwear supply chain. Those activities can be classified into three categories; value added activities (VA), necessary but non-value added activities (NNVA) and non-value added activities (NVA). Table 3 shows the grouping of activities which were investigated by Value Stream Management (VSM) concept.

Table 3. The current state analysis of activities in postconsumer footwear supply chain by VSM

No.	Activities	Activity Time Estimate (T _e)- (hours)	VSM
1	Middleman order used shoes from oversea supplier	1.66	VA
2	Shipping	372	NNVA
3	Pay import duty at Laemchabang Port	1.35	NNVA
4	Transport to middleman storehouse at Dech Thai market	4.70	VA
5	Move product from container and stacking in 1 ton bulk	3.5	NNVA
6	Merchant gr.1&2 selected	5.04	VA
7	Separating	4.01	NNVA
8	Storage (waiting for merchant gr.3 selected)	15.0	NVA
9	Stacking in 16 piles	2.89	NVA
10	Select by Merchant gr.3	4.42	VA
11	Buy the remaining shoes in bulk by Merchant gr.4	2.0	VA
12	Selected used shoes are moved to merchant's shop at Dech Thai Market	0.25	NNVA
13	Separate shoes needed for sole repairing	1.25	NVA
14	Sole Repairing	4.07	VA
15	Washing	7.43	VA
16	Drying	26.58	VA
17	Repair and recondition shoes' heels	12.0	VA
18	Color repainting	8.55	VA
19	Prepare used shoes for wholesaler	3.75	NNVA
20	Transport to wholesalers in provinces	24.83	NNVA
21	Repackage at each merchant (wholesaler) shop	6.27	VA
Total		511.55	

There are 21 activities in total, 11 of VA (52.38%), 7 of NNVA (33.33%) and 3 of NVA (14.29%). Activities no.1-11 were undertaken at the middleman storehouse and no.13-19 were carried out at merchant's shop in Dech Thai Market. Time in each activity was determined from observations and interviewing with stakeholders in the chain. Processes time is uncertainly. Therefore, activity time estimate; T_e (equation 1) is suitable.

$$T_e = \frac{a+4m+b}{6} \quad (1)$$

where; a = optimistic time estimate, m = most likely time estimate, b = pessimistic time estimate

The overall processing time from placing used shoes order from overseas to reselling to the end customer was approximately 512 hours. The most time consuming activity was shipping, occupy more than 70% of total time.

4.5 Processes Improvement

This process improvement focused on middleman storehouse and merchant's shop at Dech Thai market. Most activities at these parts are operations and value added activities. Therefore, reducing number of processes and shortening process time involved in supply

chain were recommended. ECRS and lean concepts were applied in this stage to identify improvement solutions.

4.5.1 Processes Improvement at middleman storehouse

At middleman storehouse, total operating time before improving was 37.11 hours. The most time consuming activity was storage (15 hrs.), which was classified NVA. This location we applied "Rearrange", "Combine" and "Elimination" concepts as in the following detail.

For rearrangement and combine, separating process (no.7) will be operated immediately after used shoes are shifted from container. At this station, shoes will be separated and arranged in 16 piles (3,000 pairs each), then merchants group 1 and 2 are consequently allowed to select shoes. By doing this, merchants group 3 are permitted to enter the selecting process soon after group 1 and 2 finish each pile selection. This could eliminate storage time (no.8). After rearrange, combine and eliminate processes, total time at middleman storehouse reduced from 37.11 to 17.51 hrs.

4.5.2 Process Improvement at merchants' shop in Dech Thai market

Elimination of NVA activities, combine and rearrange processes are techniques used in merchant station. Separating shoes needed for sole repairing (no.13) is removed from the processes. The shoe reconditioning process include sole repairing (no.14), shoe and heel repair (no.17) and color repainting (no.18) are combined at one working station. The washing and drying processes are rearranged after finishing all fixing processes. After process modification, operating time at merchant's shop reduced from 88.46 to 86.31 hrs.

The activities highlighted in Table 3 are modified as previously explained. The summary of postconsumer footwear supply chain improvements in each location are again concluded in Table 4.

Table4. Summary of used shoes supply chain improvement

Stage	Estimate operating time at current state (Hrs.)	Estimate operating time at future state (Hrs.)	Reducing time (Hrs.)	Percentage of reducing time (Hrs.)
Middleman storehouse	37.11	17.51	19.6	52.82%
Merchants's shop at Dech Thai Market	88.46	86.31	2.15	2.43%
Total operating time in supply chain	511.55	489.8	21.75	4.25%

5. Summary and Discussions

Used shoes are imported in approximately 45 containers per month (16 tons per container). Processes before reselling are sorting and reconditioning. Nowadays, there are no definite patterns within the supply chain. Some activities take a long time to process. Moreover, there are many wastes from the imported goods that could cause significant damage. For sellers, each pair of shoes has different prices which depending on merchantability and brands of products. Each stakeholder has similar processes but they do not get benefit equally. The highest margin appeared among middleman producing 520.17% and the lowest margin was 25.71% in merchant group 1. Last section, processes in the supply chain was defined into 3 categories; non-value adding (NVA), necessary but non-value adding (NNVA) and value adding (VA). Process improvements by ECRS and Lean concept were implemented to eliminate non-value adding processes and shortening processes time. As a result, it can decrease 21.75 hours of total operating time resulting in better time to market and cost

saving. However, the most time consuming activity (shipping) is excluded from improvement consideration since it related to external uncontrollable factor.

6. Acknowledgements

This work was supported by the Excellence Center in Logistics and Supply Chain Management (E-LSCM), Chiang Mai University, Thailand.

7. References

- Canning, L. (2006), "Rethinking market connections: mobile phone recovery, reuse and recycling in the UK", *Journal of Business & Industrial Marketing*, Vol.21 No.5, pp. 320-329.
- Chan, F.T. S. and Chan, H. K. (2008) "A survey on reverse logistics system of mobile phone industry in Hong Kong" *Management Decision*, Vol.46 No.5, pp. 702-708.
- Cristopher, M., Lowson, R. and Peck, H. (2004) "Creating agile supply chains in the fashion industry", *International Journal of Retail & Distribution Management*, Vol.32 No.8, pp. 367-376.
- Geyer, R. and Blass, V. D. (2010) "The economics of cell phone reuse and recycling", *International Journal Advanced Manufacturing Technology*, Vol.47, pp. 515-525.
- Hines, P. and Rich, N. 1997. The seven value stream mapping tool. *International Journal of Operations & Production Management*, 17(1), pp. 46-64.
- Kumar, M., Antony, J., Singhs, R.K., Tiwar, M.K. and Perry, D. (2006) "Implementing the Lean Sigma framework in an Indian SME: a case study", *Production Planning & Control*, Vol.17 No.4, pp. 407-423.
- Pigosso, D. C. A., Zanette, E. T., Filho, A. G., Ometto, A. R. and Rozenfeld, H. (2010) "Ecodesign methods focused on remanufacturing", *Journal of Cleaner Production*, Vol.18, pp. 21-31.
- Porter, M. E. (1985). *Competitive Advantage*, John Wiley & Sons Pte Ltd.
- Prahalad, C.K. and Ramaswamy, V. (2004), "Co-Creation Experiences: The Next Practice in Value Creation", *Journal of Interactive Marketing*, Vol.18 No.3, pp.275-284.
- Rathore, P., Kota, S. and Chakrabari, A. (2011), "Sustainable through remanufacturing in India: a case study on mobile handsets" *Journal of Cleaner Production* Vol.19, pp. 1709-1722.
- Staikos, T. and Rahimifard, S. (2007), "An End-of-Life Decision Support Tool for Product Recovery Considerations in the footwear Industry" *International Journal of Computer Intergrated Manufacturing*, Vol. 20, pp. 602-615.
- Subramoniam, R. and Huisingh, D. and Chinnam, R. B. 2010. Aftermarket remanufacturing strategic planning decision-making framework: theory & practice. *Journal of Cleaner Production* 18, pp. 1575-1586.
- Walters, D. and Lancaster, G. (2000) "Implementing value strategy through the value chain" *Management Decision*, Vol.38 No.3, pp. 160-178.