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Applying Lean Strategy by Establishing Logistics Service Providers to Material Supply and Product Delivery in a Fabric Supply Chain

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Abstract

This paper is to present the application of lean by establishing logistics service providers, and then consider its impact on the material supply and the product delivery in term of time and costs. Besides, the case study of a fabric manufacturer in Thailand is employed to illustrate the possible effect of lean by using logistics service providers to the material supply and the product delivery, and its expected outcome in terms of transport costs and time, is presented. Moreover, the multiple approaching methods coupled with the advanced statistical method (Cluster Analysis) are manipulated as the analytic tools. The findings have revealed the leanness techniques in the practical term including the location cluster and the transport route design coupled with purchasing the one way transport service, and lean by establishing logistics service providers subsequently takes place instead of the former logistics sections of fabric firm. Following this, transport costs and time have been significantly reduced, and customers' satisfaction has been extensively increased. Exceptionally, application of lean by establishing logistics service providers improves performance in time, cost and satisfaction.

Keywords: Lean strategy, logistics and supply chain, logistics services provider, material supply and product delivery.

Introduction

Clinical At the present time, the industrial firms face the problem of changing in the business environment. The performance dimensions comprising time, cost and reliability are needed to be enhanced in order to sustain their business operation [18]. This pressure put any firms or companies to continuously improve their practice in an assortment of ways, and application of lean for developing their process is essentially desired. Regarding lean strategy, the elimination of waste or muda out of manufacturing system and machinery is actually known as a lean strategy, which it's consequences is reduction in time and cost [5]-[15]. Accordingly, it might be stated that lean strategy is the enhancement for sustaining business.

Transportation is the essential key of firms for supporting producers and customers. It has the significant role to collect and deliver materials and products to clients, in order to turn the revenue back to the focal firms, and transportation is a key of the forward logistics activities, which carriers the materials and products to point of customers to construct the competitiveness in time and place utility [13]-14]-[16]. For example, if the materials and product cannot be transported to the destination on time, the utilization coupled with satisfaction at the next producers or customers will be fallen. Accordingly, it might be implied that transportation has a significant relationship with the customer satisfaction, and application of lean strategy into the material supply and the product delivery might help firms get a higher benefit in cost and time.

Nowadays, the transferring activities are widely allocated to logistics service providers. The industrial firms desire to focus on their core activity which is production, so the incompetent activities are increasingly outsourced for reducing their operation [1]-[28]. The significant intermediate player in logistics is transport service provider who consolidates materials and products, and then delivers to manufacturers and customers at the right time and the right place. Actually, if outsourcers or providers generate a lower cost or a higher benefit for clients, their services will be purchased [1]-[9]-[24]. So, it might be argued that the using the logistics service provider in transportation might facilitate clients a higher cost reduction and consist of lean strategy.

Recently, there was research articles had studied aspects of using logistics service providers. Initially, previous research article suggested that transport service providers carry out a higher reliability in the product distribution coupled with an excellent performance in cost and time [4]. Secondly, [8] reported on appraisement of logistics service providers in fuzzy environment by constructing the algorithm for making decision. Their findings indicated that the transport service providers assist their client achieving a higher service level coupled with a lower cost and a better customer satisfaction. Therefore, it can be stated that logistics service providers are widely employed because they maybe solve their client dilemmas in cost, time and reliability.

Thirdly, [1] reported on the opinion in using logistics service providers (LSPs). They found that there have a lot of criteria for appraisement; however, cost, delivery time and quality are dimensions to be highly important for using the logistics service providers. Following this, [22] and [26] reported on the view point clients of third-party logistics service providers in the context of industry, and their findings indicated that the technologies are the important factor, but the performance dimensions in cost, service quality and delivery are need to be basically measured before making the decision to employ logistics service providers in transportation. Hence, it can be implied that cost, time and reliability are the initial factor for using transport providers.

According to previous studies, it might be argued that establishing logistics service providers in transportation might consist in lean strategy because it helps reducing waste, cost and time. Moreover, the minimize organization and investment might be obtained in case of using transport service providers. As seen in prior research articles, logistics service provider might have an ability to be a tool of lean strategy for developing firms in a supply chain. A number of researchers study in the various view of user's opinion in using transport service providers, but evidence of actually applying lean by establishing logistics service providers to the material supply and the product delivery in a supply chain has not been investigated yet.

How does firm apply lean strategy by establishing logistics service providers to the material supply and the product delivery in a supply chain? The purposes of this study are two objects. Firstly, this paper is to present an application of "Lean strategy by establishing logistics services providers" to material supply and product delivery. Secondly, this paper has an aim to consider the impact of lean by establishing logistics service providers to material supply and product delivery in term of time and costs. In order to reveal the hidden techniques behind this application, this paper described a case study of a fabric firm that has applied lean by establishing logistics service providers, and then described the method of reducing cost and sustaining the ability to the material supply and the product delivery..

Theoretical framework

Lean strategy

Lean strategy is actually known as the elimination of waste out of the processes [29]. Leanness is defined as a value stream improvement to eliminate all waste and time coupling with shifting the level of scheduling [23]. Moreover, the inconsistency outputs are different from the acceptable condition, and the root causes and the variation reduction are required in action. In addition, "mudas" are identified as the non-value added concurrences which are required reducing out of the processes [2]-[17]-[29]. Consequently, it can be implied that lean strategy can be referred to as improvement of controlling the minimal resources for producing outputs, and a better reliability and a higher reduction in both cost and time are consequences when comparing with a previous operation.

As shown in table 1, Market knowledge using, virtual corporation, lead time compression, muda elimination and smooth scheduling are the necessary activities while rapid configuration and robustness are desirable and arbitrary term respectively [23]. As seen in figure 1, the key point of lean is to increase level of quality and service coupled with sustaining the acceptable lead time, which the resultant leanness is a lower level of the operation cost [21]. Moreover, leanness actions concentrate on minimizing the resources and the variation on processes. Therefore, it can be implied that lean strategy attempts to generate a lower cost reduction which is to create a higher profit for organization.

Table 1. The key ranking of leanness characters (Adapted from [23])

Keyword	The importance
Use of market knowledge	○○○
Virtual corporation/Value stream	○○○
Lead time compression	○○○
Eliminate muda	○○○
Rapid reconfiguration	○○
Robustness	○
Smooth demand/Level scheduling	○○○

Note: ○= arbitrary, ○○= desirable, ○○○= essential

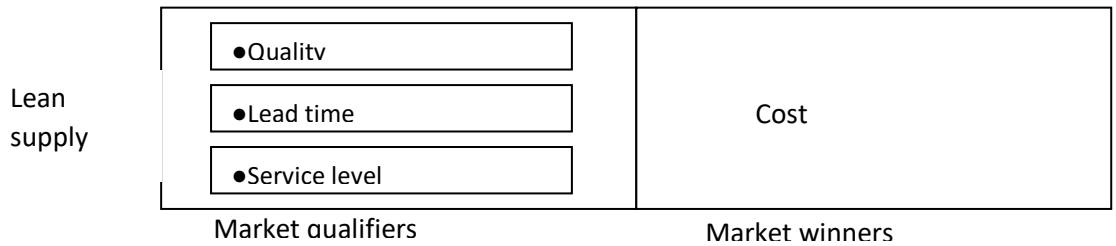

Figure 1. Market winners and qualifiers for lean

(Adapted from [21])

Logistics service provider in transportation in a supply chain

Logistics management is defined as that part of Supply Chain Management (SCM) that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and point of consumption in order to meet customer requirements [7]. Forward logistics, which is a forward flow in logistics, can be referred to as the transferring activity of physical resources and information from point of origin to point of consumption [3]-[27]. Beside, forward logistics is traditionally understood as the operation to collect the products, and then deliver to customers [13]-[20].

As seen in figure 2, regarding the discussion of forward logistics, it may be stated that forward logistics has increasingly played the important role for stakeholders. The forward logistics is the supporting activity which businesses have to operate and manage, since delivery and cost reduction ability will formulate the revenue and a more profit, and the customer satisfaction back to firms [1]-[28]. Especially, the main player in the forward logistics is transportation, since it handles and transfers the tangible things from point of origin to point of consumption. For example, the products will not be delivered to the place of customer without transportation.

Transport service providers are defined as third party companies which manage flows of information and physical goods, and their roles are to deliver the right materials to the right place at the right time [1]-[25]-[28]. In particular, if they cannot deliver the intermediate goods from suppliers to customers on time, manufacturing organizations might not produce their goods following the master production schedule. Following this, industrial goods might not deliver to the manufacturing chain, and the supply chain performance might be decrease. Thus, transport service providers are contributing important roles in the industrial sectors.

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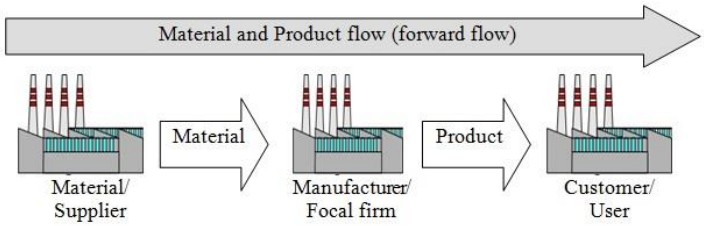

Figure 2. Simplify supply chain context: forward logistics channels

(Adapted from [19],[20])

The lean paradigm by using logistics service providers in a supply chain

The benefits of lean strategy by establishing transport service providers will facilitate reducing the overall cost and time of transport program both material supply and product distribution, and it will help increase the satisfaction of suppliers, manufacturer and customers. The measurement in time, cost and customer satisfaction is widely used in logistics performance [3]-[10]. It is expected that transport performance in the material supply and the product delivery such as operational time, transport cost and customer satisfaction will be improved through application of "lean strategy by using transport service providers".

The traditional lean, manufacturers have attempted to operate the whole operation by themselves for minimizing their cost [6]. For example, the transport and distribution center have been invented, and a centralized office have a responsibility to support the material supply and the product delivery. Nevertheless, the frequency cited problems with the centralized transportation are a poor service level and a high cost, which are illustrated in their customer satisfaction. Many firms have attempted to enhance the service level, but they always face problems of a higher cost and investment in return.

Figure 3 illustrates points of logistics service providers in the forward logistics structure. The application of a lean strategy by using logistics service provider means that lean will be used at the downstream of the transport points. This will eliminate wastes in the forward logistics process both the material supply and product distribution.

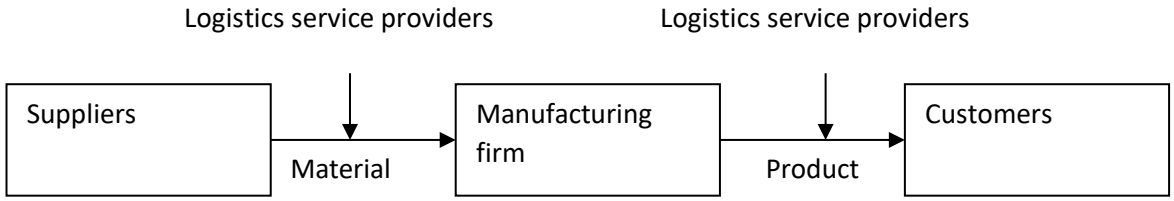

Figure 3. Forward logistics structure and point of logistics service providers in a supply chain.

Source: the Authors

Method

For this study, in order to explain the method of applying lean strategy by establishing logistics services providers in the material supply and the product delivery in a supply chain, a single case study method [11] was used. The case was identified as one of a lot of firms in a research project with aim of applying lean strategy to material supply and product delivery in a supply chain. Particularly, this firm had not initially collaborated with logistics providers, and the researchers subsequently chose to explore this topic.

Case selection

The case the study should be deep of complex phenomenon and interdependent in complex structure where researchers are allowed to deeply access the important data for study [11]. The short description of a selected case study is presented as below.

The focal firm is a fabric factory is based in Khon Kaen where its location is the central city of the northeastern of Thailand. Besides, this small business is an original equipment manufacturing (OEM) produces various cloths without branding for supporting their customers in Bangkok and several provinces in the central region of Thailand.

Suppliers of this focal firm are material providers. They have provided chemicals, cotton, plastic packaging and paper packaging, and they are located in nine different locations in northeastern of Thailand. They are not only small businesses, but they also do not have their delivery section. Furthermore, the frequency of the material transport is conditionally fixed both weekly and yearly following agreement between fabric firm and its suppliers.

Customers of this fabric firm are fourteen retailers in Bangkok and the central region of Thailand. Most customers are groceries, and they typically are the small business entrepreneurs. In addition, they do not have their own transport, so the fabric manufacturer has to take in charge in the activity of delivery products by itself. Moreover, the regularity of the product delivery is regularly indicated both weekly and yearly through the contract between fabric firm and its customers..

Data collection

Regarding all transferring activities both the material transport and the product transport were operated by the fabric manufacturer, so researchers were able to directly insight the whole essential data in this focal firm. All transport logistics data was collected and conducted during January 2022- December 2022.

Originally, the observation comprised of attaining the material transport, sitting with driver to deliver products, seeing the loading and unloading activities in the real locations in order to deeply understand phenomena in reality. Sometimes, researchers attained the shop meeting for understanding in the grounded operation.

Subsequently, the secondary data, such as transport cost report material supply and product delivery, the customer satisfaction and complaint were used. The annual report provided a deep understanding of this case study including the material transport cost, the distribution cost, the satisfaction coupled with complaints, and the problematic situation. According to observe the operation in the actual places and collect the secondary data, the operation activity, operating time in transportation, transport frequency, transport cost, customer satisfaction data were collected.

Finally, the whole collective data was sent to validate by the relevant managers in this fabric firm. This was to ensure the whole data was correct and \ aligned with the firm purpose, which made a strong point in this research's reliability.

Data analysis

The data analysis based on the grounded situation. The collected data were analyzed to identify the situations of this case study which extended the transferring process both the material supply and the product delivery. The data analysis in this research had been implemented as follows.

Firstly, the analysis of the empirical observation data was conducted into three parts. The transferring activities both the material supply and the product distribution were written in form of process mapping (PM) for making an initial understanding in the overall process in this supply chain. Besides, the geographical mapping was manipulated to construct a clearer understanding in the actual locations of suppliers, focal firm and customers. Moreover, material and product flows presented linkages of suppliers, a focal firm and customer in this supply chain.

Secondly, the analysis of the secondary data was conducted into three sections. The process activity mapping (PAM) was employed to exhibit the waste operation and time in both the material supply and product delivery. Then, the full truck load, transport frequency and transport operation (distance and time) were reorganized into the transport structure. Afterward, the cost structures were calculated, which exhibited consequences from the transport activities and structure. Accordingly, the analysis of the observation data and the secondary data assisted identifying waste and its impacts on the transferring processes in term cost and time.

Thirdly, to answer the first research question, the identified wastes were considerably eliminated or reduced. Besides, wastes in the transportation processes were needed to be eliminated or reduced, and process mapping and process activity mapping were rewritten. Moreover, the advanced statistical technique, Hierarchical Cluster Analysis was manipulated as the analytic tool for reducing the fluctuation of transportation. Afterward, this step is to apply lean by establishing logistics service providers to material supply and product delivery in this supply chain.

Finally, to answer the second research question, after applying lean by establishing logistics service providers to material supply and product delivery in this supply chain, the transport and cost structures both the material supply and the product delivery were collected again, and then compared with the former relevant structures. Moreover, the impacts of applying a lean strategy by establishing logistics service providers are appraised.

Results

The empirical observation data

As seen in figure 4, to begin with material resources, chemical, ingredients, packaging materials were supplied from the suppliers, and then directly consolidated, handled and transported by the incoming transport section. After receiving materials, the incoming materials were collected in the acceptable before feeding to production line. Subsequently, ingredients and chemicals were blended, and then generated to be the different fabric types following the selling orders. Afterward, the fabric items were assembled with packaging to be the finished goods.

Figure 4. Process mapping in forward flow of a fabric supply chain.

Source: The Authors

Figure. 5. The geographical mapping of incoming materials and product delivery.

Source: The Authors

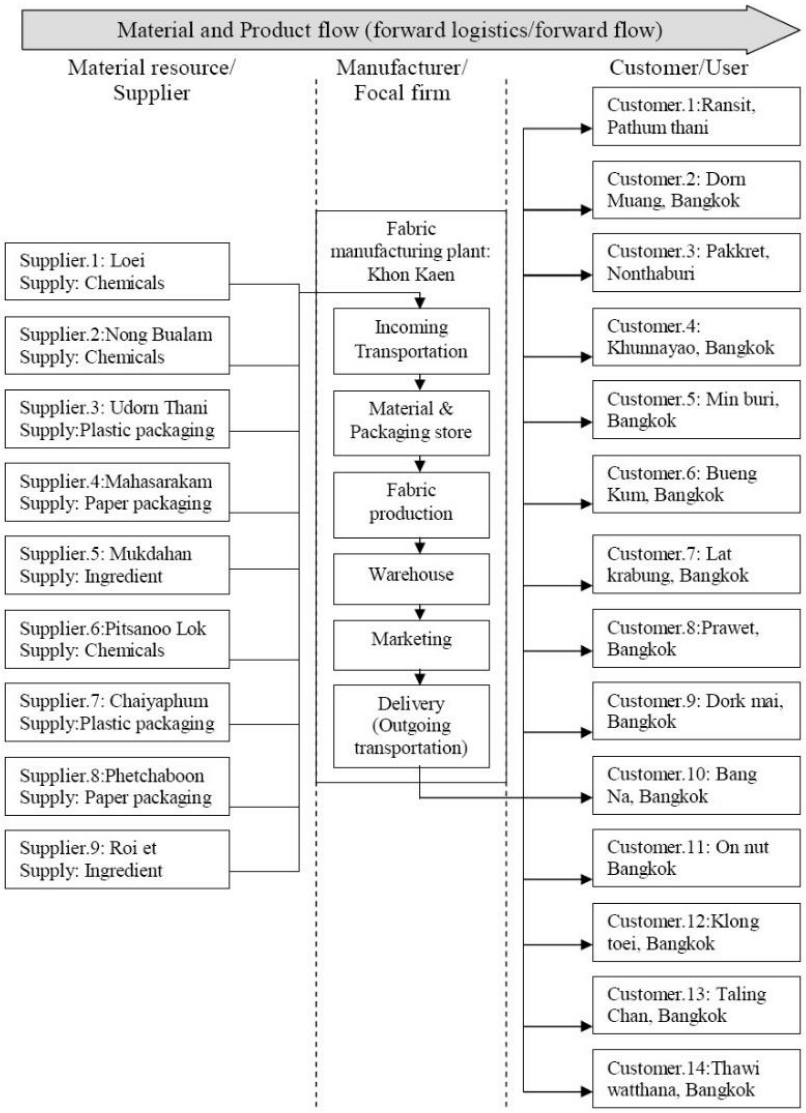

Figure 6. Material and Product flow (forward logistics) in a fabric supply chain.

Source: The Authors

After labeling, the products were lastly checked by the inspectors, and then approved by the responsible marketer before storage in warehouse. Following this, the marketing officer issued invoices and the relative document in order to pull the product for delivery. Moreover, the warehouse operator section consolidated the set of the specific fabric products, and the delivery officer loaded the products into container. Finally, the truck drivers received the invoice and documents, and the products were distributed to different customer locations in Bangkok and central area.

The geographical mapping in figure 5 was drawn to explain the location linkages of both the incoming material and the product delivery. Explicitly, the incoming materials were located in nine different locations in the northeast region and the northern area of Thailand while the destinations of product delivery are positioned in 14 places in Bangkok and the central region. Moreover, the whole transportation of materials and products were totally operated by the incoming transport section and the delivery (outgoing transport section) of the fabric firm. As shown in figure 6, the process mapping in figure 4 and the location linkages in figure 5 were rewritten for making a clearer understanding the material and product flow of this case study.

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The secondary data

As illustrated in table 2, the process activity mapping for incoming transportation had a necessary-non value added activity in each trip. Regarding the incoming transportation operated by fabric firm, the drivers had to drive the trucks with empty containers from factory to the supplier locations, and they had to drive the trucks with material back to factory after loading. Explicitly, the first waste or muda in this process is the driving the truck with empty container from factory or office to the supplier locations which needs to be eliminated out.

Table 2 As is: Process Activity Mapping for incoming transportation per a round trip.

Source: The Authors

No.	Description	Time (hrs)	Operator (person)	Symbol	Activity		
					VA	NVA	NNVA
1	Driving the truck with empty container from factory to suppliers	See table 3	1				√
2	Loading the materials into container of truck	1	1		√		
3	Driving the truck with the loaded container from supplier to factory	See table 3	1		√		
	Total	See table 3	3		2		1

Note: VA= Value added, NVA= Non Value Added, NNVA= Necessary but Non Value Added

As demonstrated in table 3, the utilization of loading material is situated at a low level, for the almost full truck load is less than 35%. This is a reflection from a high transport frequency which subsequently affects and generates a massive transport distance coupled with a long duration. This is an example of an effort of the incoming transport section to enlarge a higher service in material supply to fabric factory, but it confronts problem of many wastes in return. Obviously, the third waste is a high transport frequency in material supply which is needed to be reduced.

Table 3. The structure of incoming transport operated by fabric firm.

Source: The Authors

Supplier	AVG full truck load (%)	Round trip (fabric factory to supplier ,and then supplier back to fabric factory)				Frequency		Annual Transport operation	
		Distance (Kms)	Duration			Week (times)	Year (times)	Distance (Kms)	Duration (hrs)
			Driving (hrs)	Loading (hrs)	Total (hrs)				
1.Loei	35	250	4.2	1	5.2	4	192	48,000	998
2.Nong Bualamphu	32	222	3.8	1	4.8	4	192	42,624	915
3.Udorn Thani	31	230	3.7	1	4.7	4	192	44,160	896
4.Mahasara kam	32	300	4.5	1	5.5	4	192	57,600	1,056
5.Mukdahan	33	336	5.7	1	6.7	4	192	64,512	1,280
6.Phitsanoo Lok	33	642	9.7	1	10.7	4	192	123,264	2,048
7.Chaiya phum	34	500	7,5	1	8,5	4	192	96,000	1,632
8.Phetcha boon	30	512	7.6	1	8.6	4	192	98,304	1,651
9.Roi et	32	328	4.7	1	5.7	4	192	62,976	1,094
Total	32					36	1,728	637,440	11,571

As shown in table 4, the process activity mapping for outgoing transportation has a necessary-non value added activity in each trip. Regarding the outgoing transportation operated by fabric firm, the drivers have to drive trucks with products from factory to the customer places, and they have to drive the trucks with empty container back to factory after delivery. Explicitly, the second waste or muda in this process is the driving the truck with empty container back to offices which needs to be eliminated out.

Table 4 As is: Process Activity Mapping for outgoing transport per a round trip.

Source: The Authors

No.	Description	Time (hrs)	Operator (person)	Symbol	Activity		
					VA	NVA	NNVA
1	Driving the truck with loaded container from factory to customers	See table 5	1				√
2	Unloading the products out of container, and bring into customer sites	1	1		√		
3	Driving the truck with empty container from customers to factory	See table 5	1		√		
	Total	See table 5	3		2		1

Note: VA= Value added, NVA= Non Value Added, NNVA= Necessary but Non Value Added

As seen in table 5, the utilization of loading products is positioned at a low level, for the almost full truck load is less than 50%. This reflection comes from a high transport frequency which consequently creates a massive transport distance coupled with a long duration. This is an example of an attempt to enhance a greater service in product delivery, but a number of wastes are retuned. Apparently, the forth waste or muda in this process is a high transport frequency in delivery which is needed to be reduced in order to eliminate the relative wastes from this operation.

According to the results of attempting to increasingly support the internal production and its customers, there had reflection on the annual transport operation in return both incoming and outgoing. The cost structure of incoming transport operated by fabric firm is presented in table 6 while the cost structure of outgoing transport operated by fabric firm is presented in table 7. In case of transferring materials, the annual frequency was totally 1,728 times coupled with generating a huge cost at 312,798 USD/year. On the other hand, the annual frequency of delivery products was 1,152 times coupled with creating a cost at 452,041 USD/year.

Table 5. The structure of outgoing transport operated by fabric firm.

Source: The Authors

Customer	AVG full truck load (%)	Round trip (fabric factory to customer ,and then customer back to fabric factory)				Frequency		Annual Transport operation	
		Distance (Kms)	Duration			Week (times)	Year (times)	Distance (Kms)	Duration (hrs)
			Driving (hrs)	Loading (hrs)	Total (hrs)				
1.Ransit, Pathum thani	62	834	9.7	3	12.7	1	48	40,032	661
2.Dorn Muang, Bangkok	32	840	9.7	3	12.7	2	96	80,640	1,216
3.Pakkret, Nonthaburi	36	842	9.9	3	12.9	2	96	80,832	1,235
4.Khunnayao, Bangkok	30	878	10.1	3	13.1	1	48	42,144	629
5.Min buri, Bangkok	36	880	10.3	3	13.3	1	48	42,240	637
6.Bueng Kum ,Bangkok	31	878	10.1	3	13.1	1	48	42,144	630
7.Lat krabung ,Bangkok	38	906	10.5	3	13.5	2	96	86,976	1,299
8.Prawet, Bangkok	31	908	10.6	3	13.6	2	96	87,168	1,302
9.Dork mai, Bangkok	30	904	10.3	3	13.3	2	96	86,784	1,280
10.Bang Na, Bangkok	40	917	10.5	3	13.5	2	96	88,032	1,299
11.On nut, Bangkok	32	918	10.4	3	13.4	2	96	88,128	1,286
12.Klong toei, Bangkok	27	920	10.5	3	13.5	2	96	89,280	1,293
13.Taling Chan, Bangkok	48	930	10.6	3	13.6	2	96	89,472	1,309
14.Thawi watthana, Bangkok	46	932	10.9	3	13.9	2	96	87,552	1,331
Total	37					24	1,152	1,032,192	15,358

Table 6. The cost structure of incoming transport operated by fabric firm.

Source: The Authors

No.	Description	Unit	Unit cost	Quantity	Annual operation	
					Frequency (times/year)	Transport cost (USD/year)
1	Average direct transport cost					
	1.1 Fuel cost (Round trip: fabric factory to supplier, and then supplier to fabric factory)					
	1.1.1 Loei	USD/round	73	1 round	192	13,920
	1.1.2 Nong Bualamphu	USD/round	64	1 round	192	12,361
	1.1.3 Udorn Thani	USD/round	67	1 round	192	12,806
	1.1.4 Mahasarakam	USD/round	87	1 round	192	16,704
	1.1.5 Mukdahan	USD/round	97	1 round	192	19,708
	1.1.6 Phitsanoo Lok	USD/round	186	1 round	192	35,747
	1.1.7 Chaiyaphum	USD/round	145	1 round	192	27,840
	1.1.8 Phetchaboon	USD/round	148	1 round	192	28,508
	1.1.9 Roi et	USD/round	95	1 round	192	18,263
	1.2 Allowance cost (3 operators/truck)					
	1.2.1 Major driver (forward driving)	USD/round	10	1 person	1,728	16,457
	1.2.2 Minor driver (backward driving)	USD/round	7	1 person	1,728	11,520
	1.2.3 Sorter	USD/round	4	1 person	1,728	6,583
	1.3 Employment cost					
	1.3.1 Major driver (forward driving)	USD/round	13	1 person	1,728	22,217
	1.3.2 Minor driver (backward driving)	USD/round	10	1 person	1,728	17,280
	1.3.3 Sorter	USD/round	9	1 person	1,728	15,799
2	Average maintenance cost of truck					
	2.1 Changing the tires (4 wheels)	USD/year	1,143	6 Trucks		6,857
	2.2 Changing the lubricant	USD/year	571	6 Trucks		3,429
	2.3 Changing the filer (oil, air, lubricant)	USD/year	86	6 Trucks		514
3	Average Insurance cost					
	3.1 Vehicle insurance	USD/year	1,429	6 Trucks		8,571
	3.2 Personal insurance	USD/year	571	18 prs.		571
	3.3 Product insurance	USD/year	2,857	6 Trucks		17,143
	Total cost					312,798

Table 7. The cost structure of outgoing transport operated by fabric firm.

Source: The Authors

No.	Description	Unit	Unit cost	Quantity	Annual operation	
					Frequency (times/year)	Transport cost (USD/year)
1	Average direct transport cost					
	1.1 Fuel cost (Round trip: fabric factory to customer, and then customer to fabric factory)	USD/round	257	1 round	1,152	296,229
	1.2 Allowance cost (3 operators/truck)					
	1.2.1 Major driver (forward driving)	USD/round	29	1 person	1,152	32,914
	1.2.2 Minor driver (backward driving)	USD/round	20	1 person	1,152	23,040
	1.2.3 Sorter	USD/round	11	1 person	1,152	13,166
	1.3 Employment cost					
	1.3.1 Major driver (forward driving)	USD/round	13	1 person	1,152	14,811
	1.3.2 Minor driver (backward driving)	USD/round	10	1 person	1,152	11,520
	1.3.3 Sorter	USD/round	9	1 person	1,152	10,533
2	Average maintenance cost of truck					
	2.1 Changing the tires (4 wheels)	USD/year	1,143	8 Trucks		9,143
	2.2 Changing the lubricant	USD/year	571	8 Trucks		4,571
	2.3 Changing the filer (oil, air, lubricant)	USD/year	86	8 Trucks		686
3	Average Insurance cost					
	3.1 Vehicle insurance	USD/year	1,429	8 Trucks		11,429
	3.2 Personal accidental insurance	USD/year	571	24 prs.		1,143
	3.3 Product insurance	USD/year	2,857	8 Trucks		22,857
	Total cost					452,041

Based on above information of this case study, it can be stated that the transportation is very importance for transferring materials and products, but it created the muda at the same time. Driving truck with the empty containers and a number of transport frequencies, which created a low level of truck load and a long driving period, were the initial problems which have effects on pulling the relevant resources. Consequently, these wastes are necessarily required to be eliminated, and cost, time and reliability in transportation will be improved.

Applying a lean strategy to material supply and product delivery in a supply chain

As previous information, the wastes of transport frequency in material supply and product delivery were needed to be technically reduced while the wastes of the driving the trucks with empty containers are need to be exactly eliminated. To begin with reducing the transport frequencies of incoming materials, the various destinations were strongly required categorizing in groups. In the material supply, as shown in figure 7 and table 8, nine suppliers were arranged into three clusters according to nearby area, and the geographical cluster of the fabric material suppliers is illustrated as figure 8. Besides, in order to decrease the delivery frequency of the products, as illustrated in figure 9 and table 9, fourteen destinations were considered into five factions, and the geographical cluster of the fabric customers is illustrated as figure 10.

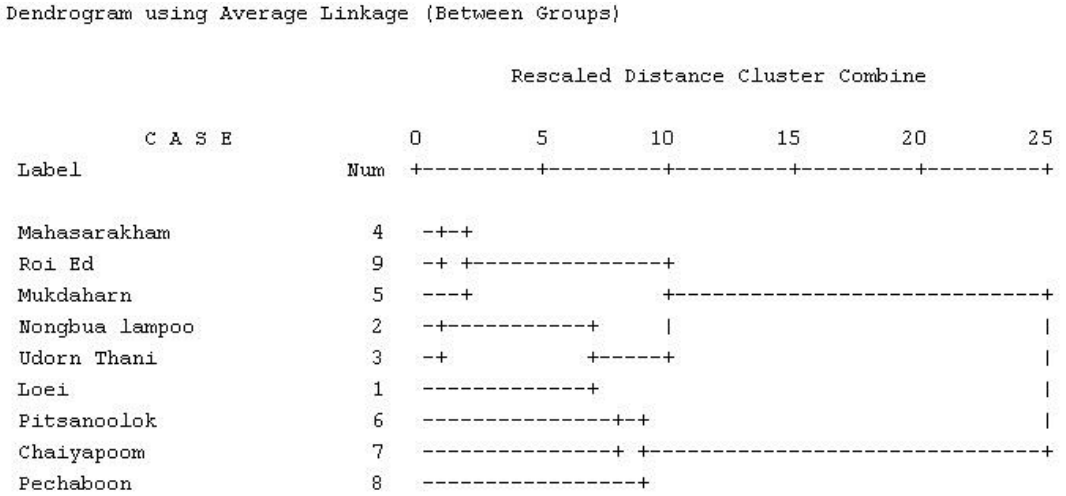

Figure.7. Dendrogram (by SPSS) of the fabric material suppliers.

Source: The Authors

Table 8. Cluster membership (by SPSS) of the fabric material suppliers.

Source: The Authors

Case	3 Clusters
1:Loei	1
2:Nongbua lampoo	1
3:Udorn Thani	1
4:Mahasarakham	2
5:Mukdaharn	2
6:Pitsanoolok	3
7:Chaiyapoom	3
8:Pechaboon	3
9:Roi Ed	2

Figure 8. Geographical Cluster of the fabric material suppliers.

Source: The Authors

To eliminate the occurrence of driving the trucks with empty containers in material supply and product delivery, the prospective transport service providers need to have few criteria as follows. Firstly, the fabric factory required purchasing a one way of transport service. Following this, five transport service providers are founded, and then qualified. After negotiated with five transportation service providers, they have accepted the condition of one way delivery.

In order to improve the efficiency of transportation in the material supply and the product delivery, a lean strategy is applied by using the transport providers which were established in incoming material and product delivery. Figure 11 presents new lean forward logistics channel in the fabric supply chain. The transport logistics providers are ideally employed to replace the incoming transport section and the outgoing transport section of the fabric manufacturing firm.

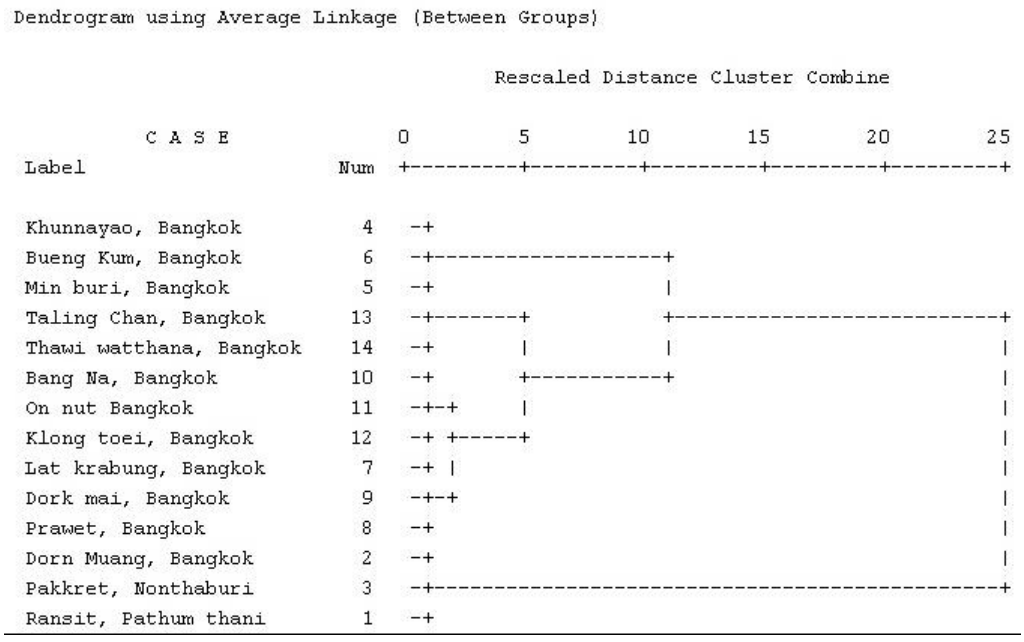

Figure 9. Dendrogram (by SPSS) of fabric customers.

Source: The Authors

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Table 9. Cluster membership (by SPSS) of fabric customers.

Source: The Authors

Case	5 Clusters
1:Ransit, Pathum thani	1
2:Dorn Muang, Bangkok	1
3:Pakkret, Nonthaburi	1
4:Khunnayao, Bangkok	2
5:Min buri, Bangkok	2
6:Bueng Kum, Bangkok	2
7:Lat krabung, Bangkok	3
8:Prawet, Bangkok	3
9:Dork mai, Bangkok	3
10:Bang Na, Bangkok	4
11:On nut Bangkok	4
12:Klong toei, Bangkok	4
13:Taling Chan, Bangkok	5
14:Thawi watthana, Bangkok	5

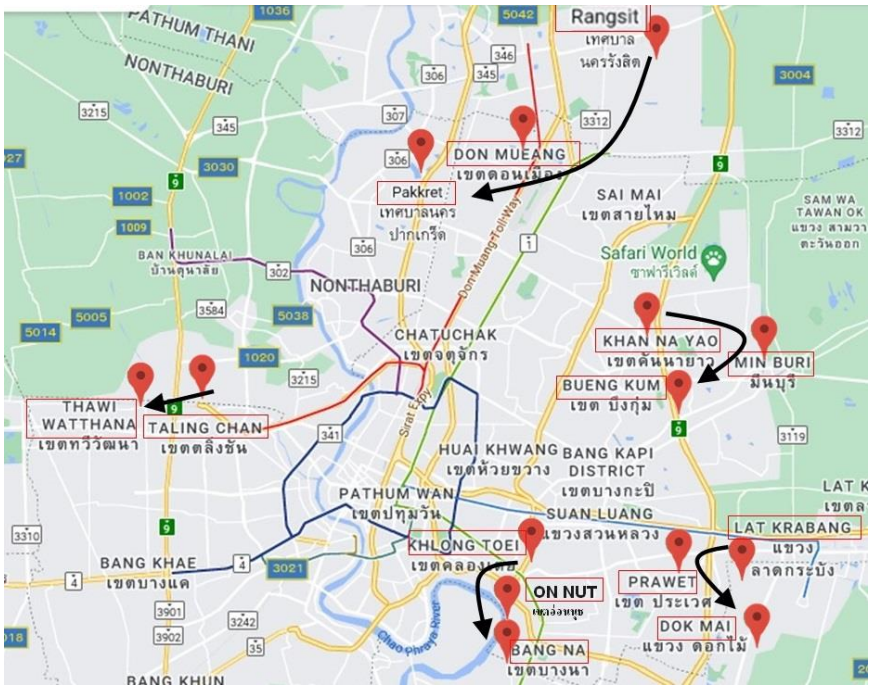

Figure 10. Geographical Cluster of fabric customers.

Source: The Authors

Finally, the fabric firm has applied the lean strategy by establishing logistics service providers to incoming material supply and product delivery. As seen in figure 12, after implementing lean strategy by using the logistics

service provider in the forward logistics channel, the incoming transport and the outgoing transport section of the fabric manufacturing firm can be eliminated out.

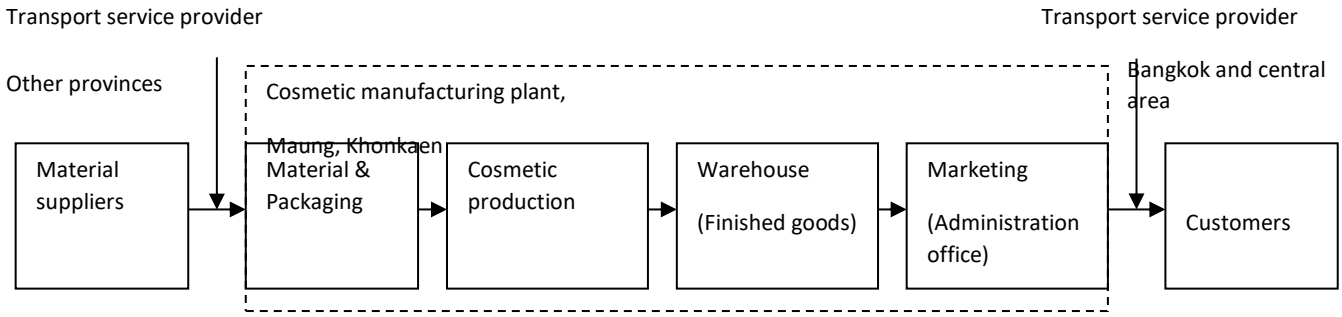

Figure 11. New process mapping after applying leanness by establishing logistics service providers.

Source: The Authors

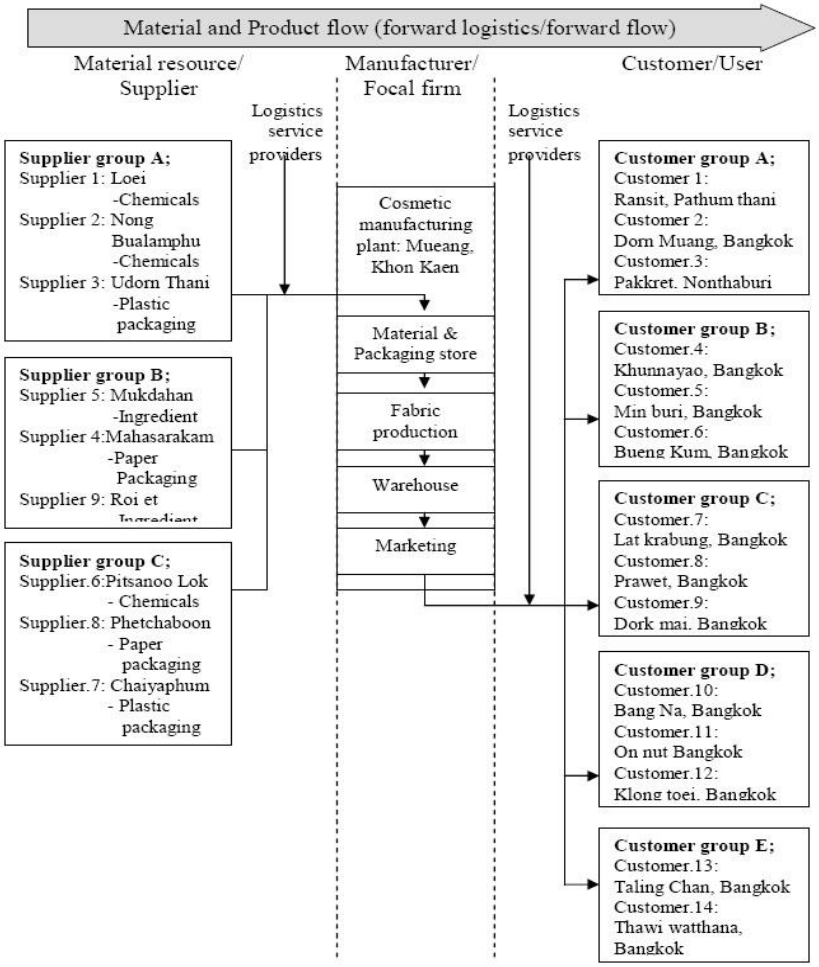

Figure 12. New material and Product flow after applying lean by establishing logistics service providers in a fabric supply chain.

Source: The Authors.

Results after implementing a lean strategy to material supply and product delivery

The new process activity mapping for incoming materials is presented in table 10. It has shown that necessary-non value added activity, which is the driving trucks with empty containers from factory to suppliers, has been

eliminated out. Thus, there remain only two value added activities which are the activity of loading materials and transferring materials to factory. Besides, the incoming transport section, which is formerly operated by fabric firm, is closed down after implementing lean strategy by using logistics service providers.

Table 10 New Process Activity Mapping for incoming transportation per times.

Source: The Authors

No.	Description	Time (hrs)	Operator (person)	Symbol	Activity		
					VA	NVA	NNVA
1	Loading the materials into container of truck, and then consolidate other materials following the designed route	1	Performed by transport service providers		√		
2	Driving the truck with the loaded container from suppliers back to factory	See table 9	Performed by transport service providers		√		
	Total	See table 9			2		

Note: VA= Value added, NVA= Non Value Added, NNVA= Necessary but Non Value Added

Table 11. The new structure of incoming transport.

Source: The Authors

Supplier	AVG full truck load (%)	One way (supplier to fabric factory)				Frequency		Annual operation	
		Distance (Kms)	Duration			Weekly (times)	Yearly (times)	Distance (Kms)	Transport duration (hrs)
			Driving (hrs)	Loading (hrs)	Total (hrs)				
Group A; 1.Loei 2.Nong Bualamphu 3.Udorn Thani	98	270	4.4	3	7.4	4	192	51,840	1,424
Group B; 5.Mukdahan 4:Mahasarakam 9: Roi et	98	292	4.4	3	7.4	4	192	56,064	1,418
Group C; 6.Pitsanoo Lok 8.Phetchaboon 7:Chaiyaphum	96	492	7.7	3	10.7	4	192	94,464	2,054
Total	97					12	576	202,368	4,896

New structure of incoming transportation, which is now performed by logistics service providers, is presented in table 11. In overview, the average full truck load is enhanced to 97% which is a higher ability than the previous operation approximately 65%. Besides, the frequency of transportation is reduced to be 12 times a week or 576 times a year which is a lower incidence than the earlier procedure roughly 67%. In addition, the annual transport distance and the annual transport duration are fallen down to be 202,368 kilometers and 4,896 hours, which are a lesser value than the former structure about 66% and 55% respectively.

New process activity mapping for product delivery is presented in table 12. It has shown that necessary-non value added activity, which is the driving trucks with empty containers from customer back to factory, has been eliminated out. New structure of the outgoing transport, which is currently occupied by transport service providers, is illustrated in table 13. In overview, the average full truck load is improved to be 98% which is a greater

capability than the prior action around 61%. Furthermore, the frequency of transportation is reduced to be 9 times a week or 432 times a year which is a lower occurrence than the past procedure nearly 63%. Moreover, the annual transport distance and the annual transport duration are collapsed down to be 201,312 kilometers and 4,138 hours, which are a lesser value than the former structure about 80% and 73% respectively.

Table 12 New Process Activity Mapping for outgoing transportation per times.

The Authors

No.	Description	Time (hrs)	Operator (person)	Symbol	Activity		
					VA	NVA	NNVA
1	Driving the truck with loaded container from factory to customer locations	See table 11	Performed by transport providers		√		
2	Unloading the products out of container, and bring into customer places following the designed route	1	Performed by transport service providers		√		
	Total	See table 11			2		

Note: VA= Value added, NVA= Non Value Added, NNVA= Necessary but Non Value Added

Table 13. New structure of outgoing transport.

The Authors

Customer	AVG full truck load (%)	One way (fabric factory to customer)				Frequency		Annual operation	
		Distance (Kms)	Duration			Weekly (times)	Yearly (times)	Distance (Kms)	Transport duration (hrs)
			Driving (hrs)	Loading (hrs)	Total (hrs)				
Group A; 1.Ransit, 2.Dorn Muang, 3.Pakkret,	99	447	6.3	3	9.3	2	96	42,912	894
Group B; 4.Khunnayao, 5.Min buri, 6.Bueng Kum,	97	458	6.5	3	9.5	1	48	21,984	454
Group C; 7.Lat krabung, 8.Prawet, 9.Dork mai,	99	474	6.7	3	9.7	2	96	45,504	930
Group D; 10.Bang Na, 11.On nut 12.Klong toei,	99	484	7.0	3	10.0	2	96	46,464	955
Group E; 13.Taling Chan, 14.Thawi watthana,	94	463	6.4	2	8.4	2	96	44,448	904
Total	98					9	432	201,312	4,138

Table 14. New cost structure of incoming transport operated by logistics service providers.

The Authors

No.	Description	Unit	Unit cost	Quantity	Annual operation	
					Frequency (times/year)	Transport cost (USD/year)
	Transport cost Cover: the direct transport cost, the vehicle maintenance cost, Insurances, GPS tracking system and etc. (one way: suppliers to fabric factory)					
1	**Supplier group A;** Loei, Nong Bualamphu, Udorn Thani	USD/one way	124	1 times	192	23,879
2	**Supplier group B;** Mukdahan, Mahasarakam, Roi et	USD/one way	135	1 times	192	25,825
3	**Supplier group C;** Phitsanoo Lok, Phetchaboon, Chaiyaphum	USD/one way	227	1 times	192	43,513
	Total cost					93,217

As seen in table 6 and table 14, the total cost of transferring materials from suppliers to the fabric factory is dramatically reduced. Evidently, the transport cost of material supply is decreased approximately 69% from 312,798 USD per annum to 93,217 USD per annum. Besides, 18 former operators (6 major drivers, 6 minor drivers and 6 sorters) in the incoming transport section are relocated to work in the fabric production lines for supporting the transformational processes, and the earlier 6 trucks are totally sold out approximately 85,714 USD for changing the asset to become the capital.

As shown in table 7 and table 15, the total cost of product distribution from the fabric plant to customers is extremely reduced. Obviously, the transferring cost of product delivery is diminished roughly 80% from 452,041 USD per year to 92,571 USD per year. Besides, 24 former operators in the incoming transport section are repositioned to work in the fabric assembly line for supporting the manufacturing processes, and the earlier 8 trucks are completely sold out approximately 114,286 USD for changing the asset to become the capital.

Table 15. New cost structure of outgoing transport operated by logistics service providers.

The Authors

No.	Description	Unit	Unit cost	Quantity	Annual operation	
					Frequency (times/year)	Transport cost (USD/year)
	Transport cost Cover: direct transport cost, vehicle maintenance cost, Insurances, GPS tracking system and etc. (one way: fabric factory to customers)					
1	**Customer group A;** Loei, Nong Bualamphu, Udorn Thani	USD/one way	214	1 times	96	20,571
2	**Customer group B;** Mukdahan, Mahasarakam, Roi et	USD/one way	214	1 times	48	10,286
3	**Customer group C;** Phitsanoo Lok, Phetchaboon, Chaiyaphum	USD/one way	214	1 times	96	20,571
4	**Customer group D;** Mukdahan, Mahasarakam, Roi et	USD/one way	214	1 times	96	20,571
5	**Customer group E;** Phitsanoo Lok, Phetchaboon, Chaiyaphum	USD/one way	214	1 times	96	20,571
	Total cost					92,571

Table 16. Comparison of overall impacts of applying lean by using logistics service providers to material supply and product delivery in a fabric supply chain.

The Authors

Description	Previous forward logistics structure	Leanness forward logistics structure
1.Average full truck load		
1.1 Material transportation	32%	97%
1.2 Product distribution	37%	98%
2.Transportation frequency		
2.1 Material transportation	1,728 times/year	576 times/year
2.2 Product distribution	1,152 times/year	432 times/year
3.Annual operational distance		
3.1 Material transportation	637,440 Kms./year	202,368 Kms./year
3.2 Product distribution	1,032,192 Kms./year	201,312 kms./year
4.Anual operational duration		
4.1 Material transportation	11,571 hours/year	4,896 hours/year
4.2 Product distribution	15,358 hours/year	4,138 hours/year
5.Annual transportation cost		
5.1 Material transportation	312,798 USD/year	93,217 USD/year
5.2 Product distribution	452,041 USD/year	92,571 USD/year
Total	764,839 USD/year	185,788 USD/year
6.Satisfaction level		
6.1 Material suppliers	Low	High
6.2 Fabric factory	Low	High
6.3 Customers	Low	High

Discussion

This study was to apply lean strategy by establishing logistics service providers, and evalua

te its impacts in a fabric supply chain. To attain this target, concept of lean strategy was introduced as an idea that a focal firm should apply to achieve an improbable results in time, cost and reliability. Besides, the analytic results also exhibited application of lean strategy by establishing logistics service providers to material supply and product delivery was very important for improving efficiency in transferring processes of a fabric supply chain. Afterward, the impact of applying lean strategy to material supply and product delivery showed a concurrence with former literature and provided the new contribution to enhance the supply chain operation as follows.

Research implication

This study attempted to answer how firm implement lean strategy by using logistics service provider to material supply and product delivery in a supply chain by using a case study of a fabric firm. In addition, it has been revealed the hidden leanness techniques in the grounded working which are the location cluster and the transport route design coupled with purchasing the one way transport service, which is the first purpose of this study. As seen in table 16, its impact extremely assists improving the material supply and the product delivery in dimensions of time, cost and reliability, which is the second purpose of this study. Consequently, this result contributes to the literature in improving a supply chain.

Practical implications

Table 16 obviously illustrates the impact of implementing a lean strategy by using logistics service providers to material supply and product delivery in a fabric supply chain of. Firstly, businesses and suppliers possibly use the leanness technique: the location cluster for reducing the transport frequency and distance, and the full truck load can be improved at the same time. Secondly, firms maybe use the technique of the transport route design coupled with purchasing the one way transport service in order to gaining a half price of the transport service.

Limitation and future directions

It must be noted that the application of lean strategy by using transportation service providers in different supply chain contexts or other businesses might have the different results. Besides, a single case study is appropriate for presenting the phenomenon or testing a well formulated theory [12], so a single case study will not confirm that these strategies will have the positive impacts on other situation because of different from variables and factors.

conclusion

In this study, applying lean by establishing logistics service providers to material supply and product delivery in a supply chain was examined. Despite increased interest in understanding the lean strategy and logistics service providers in various views in supply chain, evidence of actually applying lean strategy by establishing logistics service provider to material supply and product delivery in a supply chain has not been investigated yet. Therefore, this study attempted to answer question as to how to implement lean strategy by using logistics service providers to material supply and product delivery in a supply chain.

To address this question, the paradigm of applying lean strategy by using logistics service providers to material supply and product delivery in a supply chain was developed by the evidence in the relevant literature. Afterward, a lean strategy by establishing logistics service providers was applied to material supply and product delivery, and its impacts were subsequently appraised in term of cost, time and reliability (customer satisfaction). Overall, the findings demonstrated that applying a lean strategy by establishing logistics service providers had the positive effects on reducing cost and time coupled with increasing reliability in a supply chain. The main findings of this study are presented as follows.

Firstly, two hidden leanness techniques in the practical term, which are the location cluster and the transport route design coupled with purchasing the one way transport service, can be usefully apply before subsequently implementing of a lean strategy by using logistics service providers to material supply and product delivery in a supply chain in order to gain a successful operation in reality.

Secondly, companies should implement a lean strategy by using logistics service providers to material supply and product delivery in a supply chain in order to gain a more benefit, since it has a massive return in reducing both costs and time coupled with shifting the customer satisfaction.

References

1. S. F. Alkhatib, R. Darlington, and T. T. Nguyen, “Logistics Service Providers (LSPs) evaluation and selection: Literature review and framework development,” Strategic Outsourcing: An International Journal, Vol. 8 no.1, pp.102-134, 2015
2. R. Banomyong and N. Supatn, “Supply chain assessment tool development in Thailand: an SME perspective,” International Journal of Procurement Management, Vol.4 no.3, pp.244-258, 2011.
3. R. Banomyong, V. Veerakachen,and N. Supatn, “Implementing leagility in reverse logistics channels,”. International Journal of Logistics: Research and Applications, Vol.11 no.1, pp.31-47, 2008.
4. R.S. Bhatti, P. Kumar and D. Kumar, “Analytical modeling of third party service provider selection in lead logistics provider environments,” Journal of Modelling in Management, Vol.5 no.3, pp.276-286, 2010.
5. C. Carvalho, D. Carvalho and M. Silva, “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, Vol.7 no.1, pp.1-12, 2019.
6. M.A. Chen and V. Agrawal, “After-sales service supply chains: a benchmark update,” available at: http://grace.wharton.upenn.edu (accessed 14 July 2022). 1999.
7. CSCMP, “Definitions of Supply Chain Management,”. available at: https://cscmp.org/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx (accessed 20 October 2022), 2013.
8. S. Datta, C. Samantra, S.S. Mahapatra, G.,l Manda and G. Majumdar, “Appraisement and selection of third party logistics service providers in fuzzy environment,” Benchmarking: An International Journal, Vol.20 no.4, pp.537-548, 2013.
9. F. Du, S. Ang, F. Yang and C. Yang, “Price and distribution range of logistics service providers considering market competition,: Asia Pacific Journal of Marketing and Logistics, Vol.30 no.4, pp.762-778, 2018..
10. P.J. Daugherty, M.B. Myers and R.G. Richey, “Information support for reverse logistics: the influence of relationship commitment,” International Journal of Business Logistics, Vol.23, 85–106, 2002.
11. W.G. Dyer and A.L. Wilkins, “Better stories, not better constructs, to generate better theory: a rejoinder to Eisenhardt,” Academy of Management Review, Vol.16 no.3, pp.613-619, 1991.

12. L.M. Ellram and O. Edis, "A Case Study of Successful Partnering Implementation," International Journal of Purchasing and Materials Management, Vol.32, pp.20-28, 1996.
13. B. Grant, M. Lambert, R. Stock and M. Ellram, "Fundamentals of Logistics Management," McGraw-Hill, Maidenhead, 2006.
14. S.J. Grawe and P.M. Ralston, "Intra-organizational communication, understanding, and process diffusion in logistics service providers," International Journal of Physical Distribution & Logistics, Vol.49 no.6, pp.662-678, 2019.
15. S. Gupta and S.K. Jain, "A literature review of lean manufacturing," International Journal of Management Science and Engineering Management, Vol.8 no..4,pp. 241-249, 2013.
16. A. Gupta and R.K. Sing, "Study of sustainability issues in an Indian logistics service provider: SAP-LAP approach," Qualitative Research in Organizations and Management: An International Journal, Vol.16 no.3/4, pp.530-549, 2021.
17. R.H. Hayes and G.P. Pisano, "Beyond World-Class:The New Manufacturing Strategy," Harvard Business Review, Vol.January-February , pp.77-86, 1994.
18. R. Henao, W. Sarache, and I. Gomez, "Lean manufacturing and sustainable performance: trends and future challenges," Journal of Cleaner Production, Vol.208, pp. 99-116, 2019.
19. S. Hoekstra and J. Romme, "Integral Logistics Structures: Developing Customer Oriented Goods Flow," McGraw-Hill, London, 1992.
20. D.M. Lambert, M.C. Cooper and J.D. Pagh, "Supply chain management: implementation issues and research opportunities," The International Journal of Logistics Management, Vol.9 no.2, pp.1-19, 1998.
21. R. Mason-Jones, J.B. Naylor and D.R. Towill, "Engineering the leagile supply chain," International Journal of Agile Management System, Vol.2 no.1, pp.54–61, (2000.
22. B.E. Narkhede, R. Rut, B. Gardas, H.T. Luong and M. Jha, "Selection and evaluation of third party logistics service provider (3PLSP) by using an interpretive ranking process (IRP)," Benchmarking: An International Journal, Vol.24 no.6, pp.1597-1648, 2017.
23. J.B. Naylor, M.M. Naim and D. Berry, "Leagility: Integrating the lean and agile manufacturing paradigms in the total supply chain," International Journal of Production Economics, Vol.62, pp.107-118, 1999.
24. G. Oeser, "Segmenting logistics service users based on their provider selection criteria to succeed in outsourcing," International Journal of Retail & Distribution Management, Vol.48 no.9, pp.963-984, 2020.
25. K. Selviaridis and A. Norrman, "Performance-based contracting for advanced logistics services: challenges in its adoption, design and management," International Journal of Physical Distribution & Logistics Management, Vol.45 no.6, 592-617, 2015.
26. S.K. Sharma and V. Kumar, "Optimal selection of third-party logistics service providers using quality function deployment and Taguchi loss function," Benchmarking. An International Journal, Vol.22 no.7, pp.1281-1300, 2015.
27. J. R. Stock and S. L. Boyer, "Developing a consensus definition of supply chain management: a qualitative study," International Journal of Physical Distribution & Logistics Management, Vol.39 no.8, pp.690-711, 2009.
28. C. M. Wallenburg and P. Lukassen, " Proactive improvement of logistics service providers as driver of customer loyalty," European Journal of Marketing, Vol.45 no.3, pp.438-454, 2011.
29. J.P. Womack, D.T. Jones and D. Roos, "The machine that changed the world," Rawson Associates. NewYork. NY,1990.