Industrial Logistic Performance Evaluation: A Case of Printing and Packaging Company in Thailand

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***Abstract*— Thailand is a leader of printing and packaging industry in the Association of Southeast Asian Nations (ASEAN). It generates the highest exported value along with obtains the well government support. In order to maintain the position of leader, the printing and packaging industry, especially companies require continuous improvements. They are quantitatively evaluated in three dimensions (i.e. cost, time, and reliability) which cover nine logistic performance indicators (9 LPIs) developed by Banomyong and Supatn [3] as the paper aim. In addition, this paper proposes guidelines to improve the poor LPIs.**

Keywords— industrial logistic performance; performance evaluation; printing and packaging industry

I. Introduction

Thailand has been the biggest exporter of printing and packaging products in the Association of Southeast Asian Nations (ASEAN). They were more exported than Singaporean in 2014 [1]. Hence the printing and packaging industry in Thailand has been supported by government to build a cluster. It aims to motivate stakeholders developing printing and packaging products along their supply chain. However, the printing and packaging industry confronts of increasingly fierce competition. It forces stakeholders continuously improving oneself. The improved issues are assessed and pointed out by appropriate performance measures. One of them broadly applied is logistics performance indicators (LPIs) of the World Bank [2]. They are analyzed in six components including customs, infrastructure, services quality, international shipments, tracking and tracing, and timeliness. These components are mapped into two main categories comprising of areas for policy regulations as inputs, and service delivery performance (i.e. cost, time, reliability) as outcomes shown in Fig. 1 [2]. They are used for globally ranking; in other words, evaluating and comparing one country to others

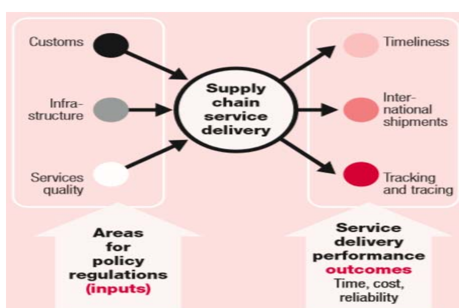

Figure 1. Global LPIs framework

Thailand was ranked at 35 (of 160 countries) in 2014 and 2010, but inferior in 2007. Comparably in 2014, Thailand was poorer than Singapore (ranked at 5) and Malaysia (ranked at 25) for all of the six component as shown in Fig. 2 [2]. Such the rankings imply that Thailand requires more improvement of logistic performance in order to enhance the industrial competitiveness. However, LPIs of the World Bank do not suit with industry because measured as global. They are also vague due to qualitative survey which rely on the subjective judgement of decision makers. Consequently, industrial LPIs were developed for industrial and quantitative evaluation [3].

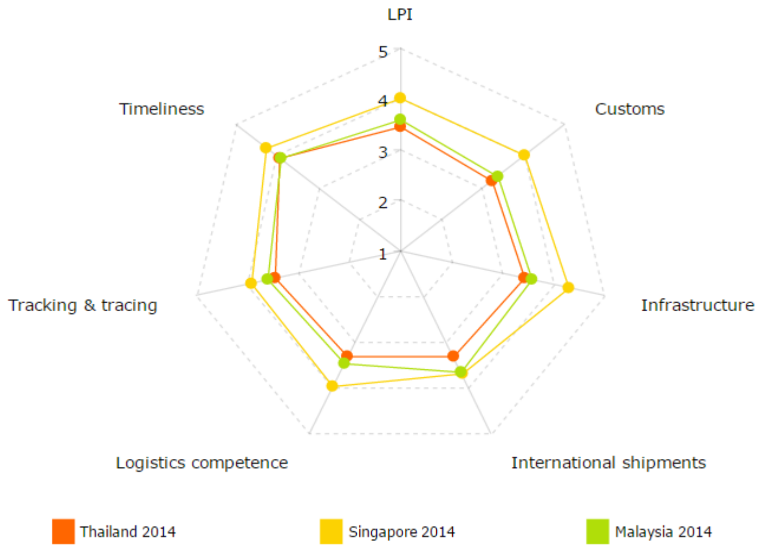

Figure 2. Global LPIs in 2014

The development of industrial LPIs primarily emphasizes the cost dimension [4][5] along with the time dimension [6][7] or the reliability dimension [8]. All of the three dimensions are measured for nine logistics activities of Grant [9]. They include customer service and support, purchasing and procurement, logistics communication, order processing, transportation, facilities site selection, warehousing and storage, demand forecasting and planning, inventory management, material handling and packaging, and return goods handling and reverse logistics. This development generates totally 27 LPIs whose 9 LPIs are considered as primary. They cover more than 80% of cost, time, and reliability along the logistics activities as highlighted in Table I [3]. Accordingly, this paper aims to quantitatively evaluate logistics performance with 9 primary indicators for a case of printing and packaging company in Thailand.

TABLE I INDUSTRIAL LPIS

	Logistics activities	**Dimension**		
		Cost	***Time***	***Reliability***
1	Customer Service & Support	Ratio of customer service cost per sale	Average order cycle time	Delivered in-full, on-Time
2	Purchasing & Procurement	Ratio of procurement cost per sale	Average procurement cycle time	Supplier in full, on-time
3	Logistics communication & order processing	Ratio of information processing cost per sale	Average order processing cycle time	Order Accuracy Rate
4	Transportation	Ratio of transportation cost per sale	Average delivery cycle time	Transportation in full, on-time
5	Facilities site selection, warehousing & storage	Ratio of warehousing cost per sale	Average inventory cycle time	Inventory Accuracy
6	Demand forecasting & planning	Ratio of forecasting cost per sale	Average forecast period	Forecast Accuracy Rate
7	Inventory management	Ratio of inventory carrying cost per sale	Average inventory day	Inventory out of stock rate
8	Material handling & packaging	Ratio of value damaged per sale	Average material handling and packaging	Damage rate
9	Return goods handling & reverse logistics	Ratio of returned goods value per sale	Average cycle time for customer return	Rate of returned goods

II. METHODOLOGY

In order to evaluate logistics performance with 9 primary indicators for a case of printing and packaging company in Thailand, its methodology undergoes four steps as follows (Fig. 4). Firstly, the industrial LPIs is understood clearly before formulated into mathematical equations as the second step. Their data is thirdly collected from the printing and packaging company to input into http://lpi.dpim.go.th/frontend/ [10]. It is a mathematical equation-embedded website for returning industrial LPI outputs. They are eventually resulted and discussed.

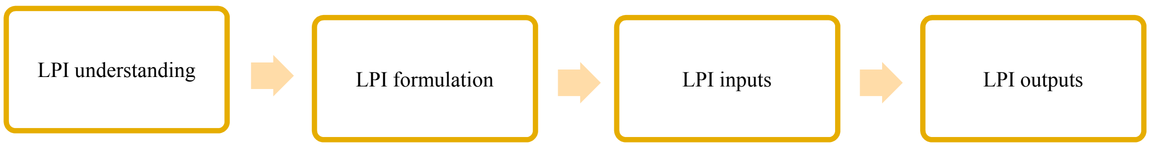

Figure 4. Four-step methodology

A. LPI Understanding and Formulation

In order to understand the 9 LPIs, their individuals are clarified in terms of definitions. They support to formulate the 9 LPIs into mathematical equations as shown in Table II [3].

TABLE II DEFINITIONS AND EQUATIONS OF INDUSTRIAL LPIS

Industrial LPI		Unit	Equation
1	Ratio of transportation cost per sales Definition: cost of transporting raw materials and/or goods from one place to another place	%	(Salary of transportation workers + Fuel expense for transporting raw materials and / or goods + Vehicle maintenance + Other expenses + Inbound shipping cost + Outbound shipping cost) / Sales
2	Ratio of warehousing cost per sales Definition: cost of managing warehouse	%	(Warehouse depreciation + Warehouse insurance + Wage of warehousing workers + Warehouse rental + Depreciation of warehousing conveyors + Maintenance of warehousing conveyors + Warehousing conveyor rental + Fuel or electricity cost of warehousing conveyor + WMS depeciation + WMS maintenance + WMS license or rental) / Sales
3	Ratio of inventory carrying cost per sales Definition: cost of holding raw materials, work in process and finished goods at a period of time	%	(Inventory carrying cost + Inventory insurance)*(1 + MRR) / Sales
4	Average order cycle time Definition: a period of time that counts from a customer sends an order until receiving that order	Day	Constant
5	Average delivery cycle time Definition: a period of time that counts from an order is loaded until arrived to customer	Day	Constant
6	Average inventory day Definition: a period of time that counts from an item that is stocked in the warehouse until left from the warehouse	Day	365 / (Sales / Inventory Cost)
7	Transportation DIFOT rate Definition: percentage of items that have been delivered in full and on time to the customer	%	(Number of orders delivered the full amount to main customers / Number of orders delivered to main customers) * (Number of orders delivered on time to main customers / Number of orders delivered to main customers)
8	Forecast accuracy rate Definition: an accuracy of forecasting customer orders	%	1- | Number of actual order - Number of forecasted order | / Number of actual order
9	Rate of return goods Definition: a proportion of poor-quality goods incurred by damaged, misplaced, broken, expired items, etc.	%	Number of return goods / Number of delivery goods

B. LPI inputs and outputs

According to the mathematical equations of 9 LPIs, their related parameters are collected from a case of printing and packaging company in Thailand. The collected parameters are input into http://lpi.dpim.go.th/frontend/ [10] which embeds the mathematical equations of 9 LPIs. The mathematical equation-embedded website returns a spider chart and nine bar charts as outputs. The spider chart contains the scores of individual 9 LPIs. They are scaled from 1 (poor) to 5 (excellent) by benchmarks among other companies having the same international standard industrial classification of all economic activities (ISIC) as shown in Fig. 5. The nine bar charts illustrate the values of individual 9 LPIs as shown in Fig.6 and Fig.7.

III. Result & Discussion

A case of printing and packaging company in Thailand is studied as a small-sized production business. It initially registered capital of 1 million Thai Baht (THB), and currently manufactures printing products which are coded with ISIC of 1811. Benchmarked among other companies having the same ISIC in year 2014, the case study is more competitive. It is because almost all of the 9 LPIs are excellent as shown in Fig. 5. However, the case study confronts of poor average delivery cycle time (LPI 5) and forecast accuracy rate (LPI 8) which are scored at 1. Such the poor LPIs absolutely require urgent improvements.

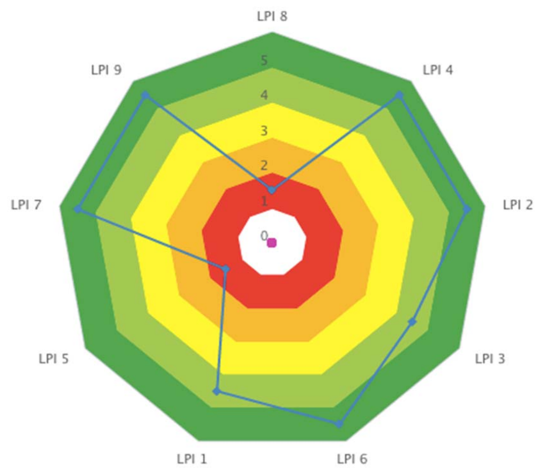

Figure 5. LPI results

According to LPI 5, the case study spends longer cycle time for delivering printing products to customers (2 days on average), whereas the best case takes less than 0.4 days as shown in Fig. 6. The poor delivery cycle time can be improved by adopting a transportation management system (TMS). It supports transportation planning and decision making, execution, follow-up, and measurement. The optimal transport solutions (i.e. either in-house or outsource) are eventually proposed by TMS.

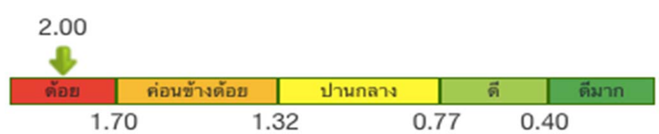

Figure 6. Average delivery cycle time (LPI 5)

According to LPI 8, the case study is incapable of accurately forecasting customer orders (82.76%), whereas the best case forecasts customer orders with accuracy of more than 98.72% as shown in Fig. 7. The poor forecast accuracy rate can be improved by adopting enterprise resource planning (ERP). It connects all of front-end, engine, and back-end and enables to demand-driven planning and control. Interestingly, the more forecast accuracy rate contributes the shorter average delivery cycle time (LPI 5) and others.

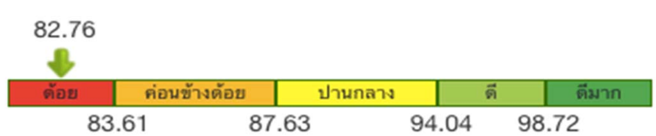

Figure 7. Forecast accuracy rate (LPI 8)

IV. CONCLUSION

This paper proposes the nine logistic performance indicators (9 LPIs) developed by Banomyong and Supatn [3]. They are superior to the LPIs of the World Bank organization [2] in terms of industrial and quantitative evaluation. The 9 LPIs are hence adopted for continuous improvements in a case of printing and packaging company in Thailand. It is found that the individual LPIs are interrelated. In other words, a change of one LPI has effects on other LPIs. The effects can be positive and negative, direct and indirect. However, the 9 LPIs of Banomyong and Supatn [3] are incapable of indicating such the LPI interrelations. This is recommended as a future study.

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