Logistics Indicators Could Improve Logistics Performance of Hospitals

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Abstract. Hospitals are institutions in which numerous transactions take place. A significant amount of those transactions happen in the realm of logistics. Logistifics is one of the concern of the hospital's managing entities. Hospitals must provide a variety of logistics within a limited amount of time. The implementation of hospital logistics indicators were expected to assist the management in improving performance in the logistics units of hospitals in the Province of Jakarta. It was expected that by attending to a number of variables, namely information technology support, logistics management, logistics business intelligence, and logistics performance, such improvement could be achieved. The result of this study provided a description of major indicators that could improve the logistics performance in hospital industry located within the Province of Jakarta. Index Terms: hospital logistics indicator, information technology support, logistics business intelligence, logistic management, logistics performance.

1 Introduction

Globalization has resulted to many alterations within the practice of free trade which, consequently, brought about positive impacts for the international community and Indonesia. Those alterations, combined with the level of competitiveness of a country's industry, constitute a factor which can influence a country's trade position. Indonesia, considering its current context and situation, has seen its industry spending a lot more in terms of production of goods and services in comparison to other countries. One of the factor that underlies such phenomenon is the slow development of logistics performance or capacity that is implemented within the country [1].

Logistics Performance Index was introduced by World Bank through one of its study [2]. The study on logistics performance was explored further, by focusing on time, cost, and reliability of logistics [3].

Asian Development Bank (ADB) conducted a research on a macro level which reviewed a country's condition. On the other hand, a country's logistics activities could also be observed from many industries, such as logistics activities in hospital industry. An example for such observation is documented in a study of several hospitals in ASEAN countries which was conducted by Hoeur and Kritchanchai (2015) [4].

Hospital logistics cover a variety of activities, such as those related to medicine logistics, medical devices, food and beverage, consumable materials, office stationeries, and linen.
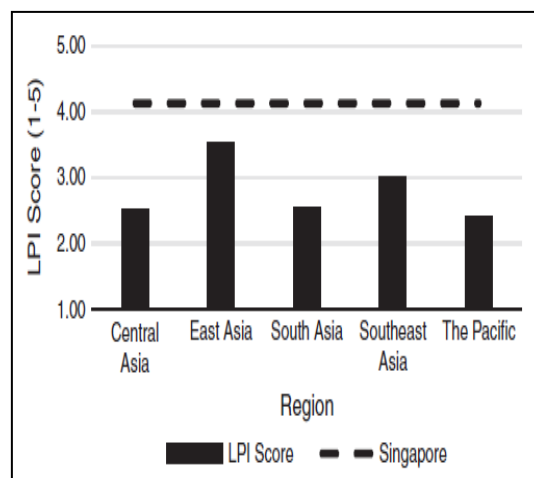

Figure 1. Logistics performance index of regions according to ADB [3]

Considering the fact that the majority of funding in a hospital is allocated to logistics, amounting to 46% of the total funding in a hospital [5], inefficient logistics activities would spike the cost charged to the patients, as well as making the hospital performance as a whole unsatisfactory. As a consequence, there might be a chance for a hospital to shut down due to the poor condition of its logistics financing.

Olaru (2014) mentioned that a factor which influences a hospital's logistics performance lies on its ability to implement a good business intelligence [6]. Meanwhile, Coyle, et al. (2013) [7] and Taylor (2007) [8] claimed that the implementation of a wholistic logistics management would enable the hospital to manage the total cost of logistics, therefore influencing the logistics performance

of hospitals. On the other hand, logistics management and business intelligence require support from information technology in order to make the existing data processible and meaningful for the managing entities of the hospital [9].

2 Problem formulation

The root of the problem in hospital logistics in particular stems from its procurement activities. This is due to the fact that purchasing department needs to be able to determine materials and products required by the hospital, as well as pointing suppliers who are able to fill those deficits, aside from purchasing activities conducted in relatively routine manner.

By taking into account the connection between IT Support, Logistics Management, Logistics Business Intelligence, and Logistics Performance, the aforementioned variables would be able to be observed through a correct and accurate operationalization of those variables.

Figure 2 provides an explanation regarding literature study and theories which are used, as well as setting the foundation and framework in giving recommendations of solutions for existing problems.

3 Literature review

3.1 Information system

According to O'Brien and Marakas (2013), a system is a set of related components with clear distinctions which aim to reach a desired goal by gaining inputs and providing outputs in a process of transformation.

Processed data and data which are meaningful to humans are referred to as information [9]. According to O'Brien and Marakas (2013), information is data which has become a useful context for the end users of the system. According to Stair and Reynolds (2012), information is a collection of facts with added values to them [10].

According to several definitions regarding information system, it can be inferred that information system comprise of several components, such as software, hardware, human, communication network as well as coordinated data to conduct information gathering, processing, and storing in order to support decision-making process, control activities, conduct coordination, analyze problem, and conduct visualization inside an organization.

3.2 Hospital information system

Information system inside hospitals are specific developments of information system which are implemented within the hospital industry. This system will gather, process, store, and spread real-time information according to the data entered by every operator within the hospital's information system, specifically the hospital's supporting department which is

responsible in managing patients' medical data. These medical data will then be used in the process of making coordinated decision regarding a patient's health. Currently, many hospitals are willing to move from paper-based information systems to electronic information systems in order to support patients' care [11].
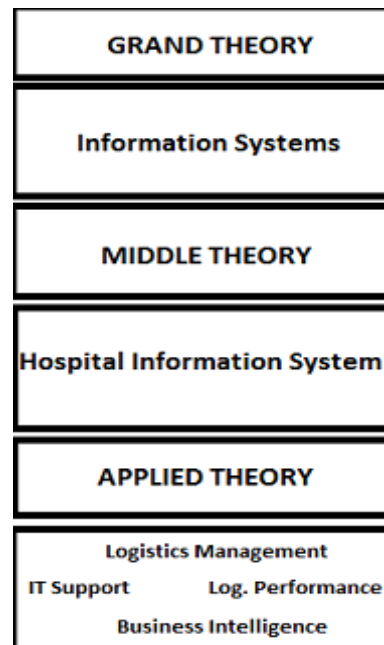
Figure 2. Theoretical foundations of the study

Hospital information system has a significant potential in reducing the cost of patient's care, as well as providing a satisfactory end result [12]. It is also predicted to provide similar positive outcomes for the logistics department of the hospital.

3.3 Logistics performance

Gil-Saura, et al. (2010) claimed that logistics performance is not merely about logistics operational activities, but that it serves as a main factor and strategic variable in fulfilling consumers' satisfaction [13]. The fact is that if a consumer's needs is not fulfilled, the result of that dissatisfaction will lead the consumers to search for other service providers which will be able to provide for their needs, due to the negative experience that the consumers felt with the initial service provider [14].

Logistics performance is a result of a good logistics activities aimed at optimizing quality, cost, and time.

3.4 Logistics management

It is a field of science concerning the process behind planning and conducting needs assesment for procurement, distribution, maintenance, and storage, as well as rescission of materials/instruments from the logbook. Therefore, logistics management will be able to explain the means to achieve the goal of procurement of materials/products when they are needed and can be used optimumly [15].

Logistics management is a logistics activity such as planning, executing, and monitoring of incoming and exiting items in order to create an organization that runs optimally.

3.5 Business intelligence

It is a means to gather, store, organize, reshape, and summarize data, as well as providing information, be it company's internal business activities, or its external activities, including the business activities of its competitors which are easy to access and analyze for many managerial activities [16].

Business Intelligence is an analytical instrument used to consolidate, analyze, store, and access data in order to assist the decision making process, akin to a software for query database and reporting, multidimensional data analysis tool and data mining [9].

Logistics business intelligence is an activity of collecting, storing, and analyzing logistics data in hospitals as well granting access to user for the sake of a better decision-making process within a certain period.

3.6 Information technology support

According to Raymond McLeod, IT Support is a collection of data which can be processed in order to provide a certain meaning as well as values [17]. Meanwhile, according to James O'Brien, it is a form of data existing within a context, which indicates that it has meaning and is useful for end user [18]. According to Laudon, it is a form of data which has been processed and the outcome is a meaningful and useful data for human lives [9].

Information Technology Support is every kind of technology implemented to process, form, shape, and spread information electronically.

4 Methodology

4.1 Framework

Inferring from the literature review conducted in this study, there several gaps that serves as grounds for furthere research. These gaps include variables of information technology support, logistics management, logistics business intelligence and logistics performance. The discussion within each reviewed article only touched one or two of the aforementioned variables. In this article, however, the discussion of all four variables will be advanced.

Logistics performance is a logistics activity aimed to optimize quality, cost, and time in order to ensure that patient's needs are fulfilled through the existence of logistics management which consist of logistics activities such as planning, executing, and monitoring the movement of incoming and exiting logistics supply in order to ensure a more optimum service for the patients. Due to the variety and large amount of logistics activities data, an implementation of logistics business intelligence

is needed, namely an activity of collecting, storing, and analyzing logistics data as well as granting access to user in order to create a good decision-making process, which will certainly require an IT support which is every kind of technology implemented to process, form, shape, and spread information electronically.

4.2 Model Analysis

Data collected from 45 hospitals located in the Province of Jakarta by simple random sampling from the population of 81 hospitals, ranging from those of class A, B or C, were processed using SmartPLS 2.0. After running the application all the indicators were valid (loading factor > 0,5 and t-statistics >2,0.
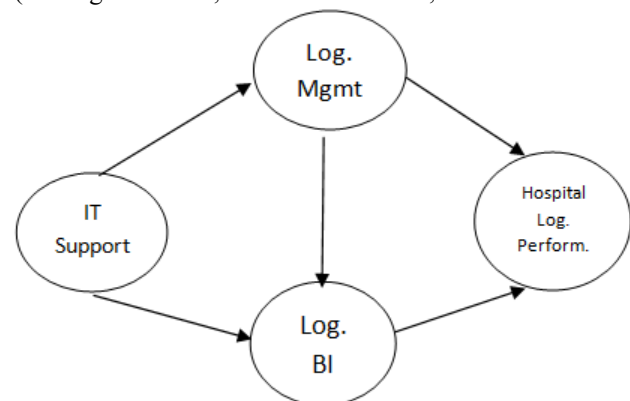

Figure 3. Theoretical framework

After checking the loading factor, the next process is the resampling process using bootstrapping with 1000 samples.

From the evaluation of convergent validity through the states of evaluation, validity indicator and reliability construct (variables) that indicates condition of available data from variable information technology support has the biggest impact, variable logistics management does not have much influence in this research, variable logistics intelligence with indicator adding service value has the biggest impact in the model and indicator regularly is the biggest impact for logistics performance variable (Table 1).

5. Conclusion

The study has identified three major indicators that could significantly affect the performance of logistics, including reliability tracking which will greatly assist the hospital in the process of tracking, in order to find an item / product that is needed by patients, to determine the existence. And indicator adding service value could be considered as an important factor in creating customer satisfaction (patients and families) in Jakarta. In additioin to that, the quality of information provided on a regular basis to solve the problem together with third parties.

By implementing those indicators (Table 1), it is expected that hospitals will be able to have references in calculating their logistics performance, because previously, the system which is used in hospitals have yet to have a standard of reference in terms of logistics. Yet by identifying and defining the dominant indicator that

affects the dimensions and variables could increase the performance of logistic. As a consequence, hospitals will be able to monitor and control the logistics performance in order to reach an improved optimum level. On a macro level, Indonesian government will be able to have an higher LPI in contrast to other countries within the same region.
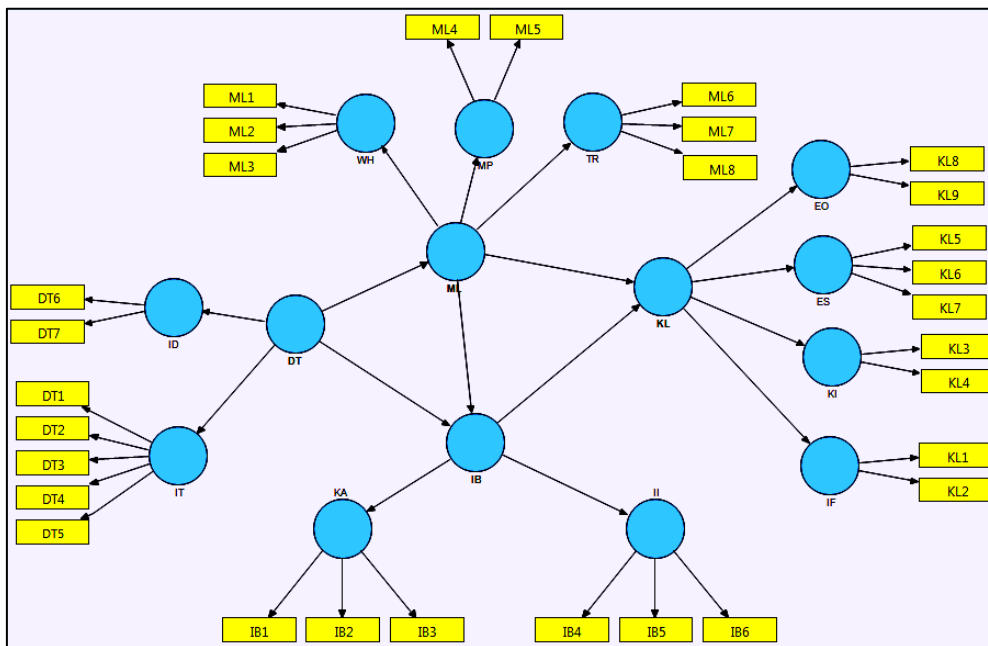

Figure 4. Path Diagram

Table 1. Variables operationalization

Variable	Concept	Dimension	Indicator	Measurement	Loading Factor	T-Statistics
Information technology support (DT)	Every kind of technology implemented to process, form, shape, and spread information electronically	-. Information and technology management (IT)	DT1 - Use of technology	Level of use of technology	0,599	4,612
			DT2 - Product identification	Identification level	0,647	6,523
			DT3 - Tracking accuracy	Accuracy level	0,860	22,992
			DT4 - Reliability tracking	Reliability level	0,871	21,798
			DT5 - Information availability	Information availability level	0,773	10,968
		-. Data integration (ID)	DT6 - Condition of available data	Data condition level	0,897	33,226
			DT7 - Consistency of data source	Data source level	0,851	15,221
Logistics management (ML)	logistics activities such as planning, executing, and monitoring the movement of incoming and exitting logistics supply in order to ensure a more optimum service for the patients	-. Storage (WH)	ML1 - Spatial utilization	Utilization level	0,513	2,209
			ML2 - Categoriztn	Categorization level	0,695	6,997
			ML3 - Acceptance note	Acceptance level	0,869	21,024
		-. Supply management (MP)	ML4 - Inventory visibility	Visibility level	0,738	3,963
			ML5 - Inventory availability	Availability level	0,771	3,673
		-Transportation and distribution (TR)	ML6 - Product condition	Product condition level	0,653	3,383
			ML7 - Delivery order	Order level	0,815	14,302
			ML8 - Received	Date level	0,583	2,896

				date		
Logistics business intelligence (IB)	An activity of collecting, storing, and analyzing logistics data as well as granting access to user in order to create a good decision-making processwithin a certain period	-. Analytical skills (KA)	IB1 - Interactive report	Interactive report level	0,735	4,647
			IB2 - Analytical application	Analytical application level	0,824	8,191
			IB3 - Dashboard	Dashboard level	0,773	9,836
		-. Information implementation (II)	IB4 - Building innovation	Innovation level	0,617	5,343
			IB5 - Altering strategies	Strategic alterations level	0,772	6,132
			IB6 - Adding service value	Service level	0,824	10,952
Logistics performance (KL)	A result of a good logistics activities aimed at optimizing quality, cost, and time.	-. Level of information which will be given (IF)	KL1 - Notification of information	Notification level	0,850	14,116
			KL2 - Increasing coordination	Coordination level	0,837	11,379
		-. Quality of information (KI)	KL3 - Complete information	Information completeness level	0,844	11,452
			KL4 - Regularly	Degree of order	0,886	31,460
		-. System effectivity (ES)	KL5 - Increasing response	Response level	0,849	21,003
			KL6 - Increasing productivity	Productivity level	0,817	12,579
			KL7 - Decrease time of delivery	Time delivery level	0,883	20,013
		-. Organizatinl effectivity (EO)	KL8 - Target market	Target market level	0,805	6,999
			KL9 - Innovation	Innovation level	0,888	19,001

References

1. Dedi Mulyadi, "Pengembangan sistem logistik yang efisien dan efektif dengan pendekatan supply chain management, (*Development of logistics system efficient and effective approach with supply chain management*)," Jurnal Riset Industri, **vol. 5**, no. 3, pp 275 – 282 (2011)
2. J.F. Arvis, Y. Duval, B. Shepherd, and C. Utoktham, "Trade cost in the developing world 1995-2010," World Bank Policy Research Working Paper No. 6309, World Bank. Washington, DC. (2013)
3. Ben Shepherd, and Shintaro Hamanaka, "Overcoming trade logistics challenges: Asia-Pacific experiences," Asia Pacific Journal of Marketing and Logistics (Emerald), **vol. 27**, Iss 3, pp. 444 – 466, Des (2015)
4. Soriya Hoeur, and Duangpun Kritchanchai, "Key performance indicator framework for measuring healthcare logistics in ASEAN," Toward Sustainable Operations of Supply Chain and Logistics Systems, p. 37 – 50 (2015)
5. Sylvain Landry, and Richard Philippe, "How logistics can service healthcare," Supply Chain Forum, an International Journal **vol. 5**, no 2 (2004)
6. C. Olaru, "Business intelligence in telecommunications industry," International Journal of Economic Practices and Theories, **vol. 4** no.1, pp 89-100 (2014)
7. J.J Coyle, C.J. Langley, R.A. Novack, and B.J. Gibson, *Supply chain management: a logistics perspective*, 9th edition. South-Western / Cengage Learning, Mason, Ohio (2013)
8. GD. Taylor, "*Logistics engineering handbook*," CRC Press, Boca Raton, Florida (2007)
9. Kenneth C. Laudon, and Jane P. Laudon, "*Management information systems*," Pearson Prentice Hall, 13th edition (2014)
10. Ralph M. Stair, and George W. Reynolds, "*Fundamentals of information systems*," Course Technology - Cengage Learning, 6th edition (2012)
11. Hesamaddin K. Takhti, Azizah A. Rahman, Samireh Abedeni, and Sadigheh Abedeni, "Impact of hospital information systems on patient care: Nurses's perception," International article (2010)
12. Robert G. Fichman, Rajiv Kohli, and Ranjani Krishnan, "The role of information systems in healthcare: Current research and future trends," Information Systems Research, **vol. 22**, no 3, pp 419 – 428 (2011)
13. I. Gil-Saura, D. Servera-Frances, and M. Fuentes-Blasco, "Antecedents & consequences of logistics value: & empirical investigation in the Spanish market," Industrial Marketing Management, **vol. 39** No. 3, pp. 493-506 (2010)

14. O. Bouzaabia, A.C.R. Van Riel, and J. Semeijn, "Managing in-store logistics: a fresh perspective on retail service," Journal of Service Management, **Vol. 24** No. 2, pp. 112-129 (2013)

15. Gianpaolo Ghiani, Gilbert Laporte, and Roberto Musmanno, "*Introduction to logistics systems management*," John Wiley & Sons, Ltd, second edition (2013)

16. Edward David Moreno, Marina L. Gavrilova, and C. J. Tan, Kenneth, "Transactions on computational science XI," Special Issue on Security in Computing (Part 2) (2013)

17. Raymond McLeod, and George Schell, "*Management information systems*," Pearson Int'l Edition (2007)

18. James A. O'Brien, and George M. Marakas, "*Introduction to information systems*," McGraw-Hill/Irwin, 16th edition (2013)