An empirical analysis of the impact of information systems in logistics performance management of retail firms

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Abstract

The aim of this research is to analyze logistics performance management of retail firms in Thailand. We explore how the relationships between information systems usage and logistics performance management that are measured by logistics performance indicators. In addition, the study also examines correlation analysis to find what factors that have influence on logistics performance management. We conducted a survey of 103 retail firms in Thailand. The empirical results indicate that the information systems usage in logistics activities has a significant impact on the firm's logistics performance management.The implications and further exploration are discussed.

Introduction

Nowadays, logistics management is defined as a set of methods used to interconnect suppliers, warehouses and customers. Logistics management has been become the corporate strategy to generate cost reduction and create value for customers (BüYüKöZKAN et al., 2008). It will be trade-offs between total cost and service level that mean the firm achieves minimizing cost effective and maximizing customer's satisfaction level (Chow et al., 2005). Hence, itis concerned with achieving a more cost-effective satisfaction of end customer requirements through buyer-supplier integration by through the sharing of information (Murthy et al., 2004). Information technology (IT) applications can support logistics management in firms to improve logistics performance for better customer service levels (Ngai et al., 2008).Moreover, information systems (IS) have positively and significantly influences to performance of organizations (Bayraktar et al, 2009).

Therefore, we believe that LIS can provide a firm to manage logistics activities that a highly effectiveness and efficiency for gaining competitive advantage. Hence, it is necessary to identify the factors that affect logistics performance management. Online survey of local retail firms was conducted. The propose of this research is to explore the factors affect logistics performance management and also point out logistics performance indicators in retail firms for usage to improve their performance.

The remaining sections of this paper are organized as follows. Section 2 provides some influential prior works to this study. Section 3 describes the objectives and research methodology. Data analysis and findings are elucidated in Section 4. Section 5 displays result and discussion. Section 6 describes conclusion and future work.

Literature review

1 Logistics management

An effective logistics management will be provide the right product in the right place at the right time with minimize cost but maximize customer satisfaction (Çelebi et al., 2010). A thorough study from relevant literatures, the boundary of logistics activities in firms consist of customer service, order processing, demand forecasting, transportation, warehouse management, purchasing and procurement, packaging and reverse logistics (Lai et al., 2010; Wu and Huang, 2007; Aptel and Pourjalali, 2001; Ngai et al., 2008).Moreover, many researches (Ngai et al., 2008, Tilokavichai and Sophatsathit, 2011, Loukis et al., 2009) have indicated that Information Technology (IT) applications support logistics activities to obtain competitive advantage. Logistics information system (LIS) is defined as a management IS that provides the management of a firm with relevant and timely information related to its logistics functions. Today LIS play an important role in logistics management (Ngai et al., 2008). Operating managers need comprehensive information to manage the organization's operations and set strategy (Kaplan and Norton, 1996). Hence, there is an important necessary for the development of LIS that can provide quality logistics information to achieve better position in market from logistics management (Lai et al., 2010).

2 Logistics performance indicators

Normally logistics performances are evaluated under four perspectives which are cost, quality, service and flexibility such as delivery times, stock levels, costs, quality ,packaging, scrap management and environmental concerns through logistic activities integration by the sharing of information (Lai et al., 2010; Murthy et al., 2004; Kurata and Lui, 2007). For example, the integration model of inventory and transportation have objectives are minimum unsatisfied demands products, minimize vehicles costs, products flow costs, carrying costs and transfer costs (Ozdamr et al., 2004; Haghani and Oh, 1996). The associated flow of information in logistics activities is necessary elements for firms to manage the logistics workflow for customer responsiveness (Lee et al., 2011). Indicators are important to measuring logistics performance for benchmarking with best practice firm to find opportunities for improvement (Garcia et al., 2011). The

logistics performance measurement related to the firm's logistics management that includes a wide range of planning and control measurements (Andersson et al., 1989). Table 1 shows logistics performance indicators.

Table 1: Logistics performance indicators

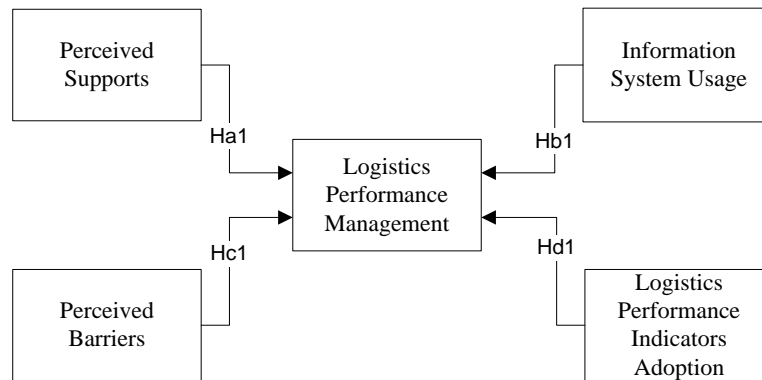| Example of Logistics performance indicators	Related literatures
Inventory turnover	
Customer service cost per sales	Andersson et al., 1989;
Customer satisfaction Index	Laitinen, 2002;
No. of new customers	Murthy et al., 2004;
% of product returned	Kurata and Lui, 2007;
Average waiting time	Quezada et al., 2009;
Number of complaints	Lai et al., 2010;
Lead times	Garcia et al., 2011
On time delivery	
Forecast accuracy rate	
Stock days	
Order processing cycle time	
Transportation cost per sales	
Transportation per trip	
Warehouse cost per sales	
Rate of return goods	
Procurement cost per sales	
Value damage per sales	

Figure 1: Research framework of the study.

Therefore, the following research framework and hypotheses as shown in Figure 1 established and elucidated in subsequent sections.

Ha1: The support factors have an effect on logistics performance management.
Hb2: IS adoption has an effect on logistics performance management.
Hc1: The barrier factors have an effect on logistics performance management.
Hd1: Adopting logistics performance indicators have an effect on logistics performance management.

Research objectives and methodology

We derive a survey questionnaire, consist of four topics, namely, (1) performance in logistics activities, (2) support factors that influent the logistics performance, (3) barriers in logistics management and (4) the analyze current of logistics information usage and logistics performance indicators. The questionnaire uses a 5-point Likert's scale with 1 being "Strongly disagree" and 5 being "Strongly agree" to logistics management in retail firms. The research methodology was based on empirical data collected through questionnaire surveys of retail firms in Thailand. To ensure content validity of the measure is systematically accounted for in this study, a thorough study from relevant literatures and consult academics, and pilot tested with logistics managers were carried out during the development of the questionnaire.

A preliminary study was conducted to test the viability of the questionnaire with subjects in companies. From the preliminary 300 questionnaires, 103 were returned and used in the analysis. The overall response feedback was 34%. Table 2 summarizes the respondents' company profile. The respondents included operation personnel, first-line managers, middle managers and top executives. The respondents clearly have considerable experience with logistics activities, thus they are well-qualified to response in this research. Table 3 shows IS adoption in logistics activities. Adopting logistics performance indicators as shown in Table 4.

Table 2: Profile of respondent firms (103 total).

	Frequency	Percent
Operation (Yrs)		
1-3 Yrs	24	23.3
4-6 Yrs	30	29.1
> 10 Yrs	49	47.6
Number of Employee		
< 50	62	60.2
51 – 200	4	3.9
201 - 350	3	2.9
> 350	34	33
Revenue (Baht)		
< 30,000,000	57	55.3
30,000,001 – 50,000,000	10	9.7
50,000,001 – 100,000,000	6	5.8
100,000,001 - 200,000,000	4	3.9
> 200,000,001	26	25.2

Table 3: Information system adoption in logistics activities (103 totals).

Logistics Activities	IS adopt		IS not adopt	
	Frequency	Percentage	Frequency	Percentage
A	80	77.7	23	22.3
B	82	79.6	21	20.4
C	88	85.4	15	14.6
D	78	75.7	25	24.3
E	84	81.6	19	18.5
F	88	85.4	15	14.6
G	66	64.1	37	35.9
H	19	18.4	84	81.6
I	36	35	67	65

A: Customer Service, B:Order Processing, C:Purchasing & Procurement, D:Transportation, E:Warehouse Management, F:Inventory Management, G:Demand & Forecasting, H:Packaging, I:Reverse Logistics

Table 4 :Adopting logistics performance indicators (103 totals).

Logistic Activities	Logistic Performance Indicators	Adopt		Not Adopt	
		Freq	Percentage	Freq	Percentage
1.Customer Service	Customer service cost per sales	62	60.2	41	39.8
	Customer satisfaction Index	99	96.1	4	3.9
	Number of new customers	74	71.8	29	28.2
	Number of complaints	64	62.1	39	37.9
	Average waiting time	46	44.7	57	55.3
2.Order Processing	Average response time from sale order	66	64.1	37	35.9
3.Purchasing& Procurement	Procurement cost per sales	58	56.3	45	43.7
4. Transportation	Average delivery time	92	89.3	11	10.7
	On time delivery	86	83.5	17	16.5
	Transportation cost per trip	74	71.8	29	28.2
	Transportation cost per sales	58	56.3	45	43.7
5.Warehouse Management	Warehouse Management cost per sales	91	88.3	12	11.7
6.Inventory Management	Inventory carrying cost per sales	70	68.0	33	32
	Average stock days	94	91.3	9	8.7

7.Demand & Forecasting	Forecast accuracy rate	76	73.8	27	26.2
8.Packaging	Packaging cost per sales	66	64.1	37	35.9
9. Reverse Logistics	Goods return rate	77	74.8	26	25.2
	Damage value per sales	61	59.2	42	40.8

Data analysis and finding

In this research applied exploratory factor analysis (EFA) to examine the underlying dimension that reduced the items of the barriers, the supports and logistics information system usage. Principal component analysis (PCA) was used to extract the factors loading with varimax rotation method. The eigenvalue of any factor should be greater than one (Hair et al., 1998). The Kaiser-Meyer-Olkin (KMO) was used to detect whether or not the data were properly factored. The KMO measure the minimum acceptable value of 0.5 (Kaiser, 1974) satisfies the prerequisite of a good factor analysis. Factor validation is accomplished using convention advocated by Nunnally (1967) on items having factor loadings of exceeding 0.4. Data reliability and validity are carried out by Cronbach's alpha that measures the internal consistency of multi-item scales as low as 0.6 (Nunnally, 1967) for each construct. The results of EFA can be summarized as shown in Table 5. Correlation analysis was tested between barriers factors and logistics performance management of firms. Pearson correlation coefficient, found that all of support factors have associated with logistics performance management at the significant value of 0.05.In additional, we employed independent sample t-test forcomparisons between two groups and statistical significance is tested by t-test statistic.

Table 5: Results of EFA for all items.

Subject	Factors
Support Cronbach's á=0.883, KMO=0.791, Cumulative of Variance = 79.634%	Internal Support: % variance = 62.747, Eigenvalue = 4.392 -Internal Cooperation -Vendor's Cooperation -Customer's Cooperation -IT system Application -Executive's Support -Staff's skill and knowledge
	External Support: % variance = 16.888, Eigenvalue = 1.182 -From Government
Barrier Cronbach's á=0.901, KMO=0.777	Barrier: % variance = 68.263,Eigenvalue = 4.096

Subject	Factors
Cumulative of Variance = 68.263%	-Internal Communication -External Communication -IT System has not user friendly -Insufficient Knowledge
Logistics Performance Management Cronbach's á=0.510, KMO=0.777 Cumulative of Variance = 73.484%	Forward logistics activity management: % variance = 50.341,Eigenvalue = 4.531 - Customer Service - Order Processing - Purchasing & Procurement - Transportation - Warehouse Management - Inventory Management - Demand & Forecasting - Packaging
	Backward logistics activity management: % variance = 23.143,Eigenvalue = 2.083 - Reverse Logistics

The associations among these factors in accordance with the model framework hypotheses established earlier are given in Table 6. It shows the significance of correlating factors among logistics management factors, support factors and barrier factor. Three implementation categories are compared since they exhibit significant interrelationship.

Table 6: Summary of association.

Association	Forward Management	Backward Management	Barrier
Internal Support	Associated(+0.464)	Associated(-0.302)	Associated(-0.813)
External Support	Associate(+498)	No Associated	No Associated
Barrier	Associated(-0.281)	Associate(+0.306)	

Table 7 shows comparative results of IS adoption and logistics performance management from all respondents and Table 8 shows comparative results of logistics performance management and adopting logistics performance indicators. This confirms that firms have adopted IS in logistics management has better logistics performance.

Table 7: Comparative results of IS adoption and logistics performance management.

Logistics Activities	Equal Variances	Sig. (2-tailed)/2	Mean Difference	Result
1. Customer Service	No	0.105	0.223	Not Diff
2. Order Processing	No	0.000	0.600	Diff
3. Purchasing & Procurement	Yes	0.437	0.027	Not Diff
4. Transportation	No	0.000	0.833	Diff
5. Warehouse Management	No	0.0005	0.627	Diff
6. Inventory Management	No	0.238	-0.113	Not Diff
7. Demand & Forecasting	No	0.008	0.269	Diff
8. Packaging	Yes	0.2035	0.407	Not Diff
9. Reverse Logistics	No	0.000	0.637	Diff

Table 8 : Comparative results of logistics performance management and adopting logistics performance indicators.

Logistic Activities	Logistic Performance Indicators	Equal Variances	Sig.(2-ailed)/2	Mean Diff	Result
1.Customer Service	Customer service cost per sales	No	0.000	-0.777	Diff
	Customer satisfaction Index	No	0.005	-0.182	Diff
	Number of new customers	No	0.000	0.867	Diff
	Number of complaints	No	0.404	-0.034	No Diff
	Average waiting time	Yes	0.000	-0.706	Diff
2.Order Processing	Average response time from sale order	No	0.000	-0.414	Diff
3.Purchasing & Procurement	Procurement cost per sales	No	0.002	-0.315	Diff
4. Transportation	Average delivery time	No	0.000	0.653	Diff
	On time delivery	No	0.054	0.302	No Diff
	Transportation cost per trip	Yes	0.046	0.288	Diff
	Transportation cost per sales	Yes	0.000	-0.514	Diff

5.Warehouse Management	Warehouse Management cost per sales	Yes	0.000	1.001	Diff
6.Inventory Management	Inventory carrying cost per sales	Yes	0.344	0.063	No Diff
	Average stock days	Yes	0.083	0.357	No Diff
7.Demand & Forecasting	Forecast accuracy rate	No	0.000	0.476	Diff
8.Packaging	Packaging cost per sales	No	0.000	0.876	Diff
9.Reverse Logistics	Goods return rate	No	0.000	-0.383	Diff
	Damage value per sales	No	0.008	0.225	Diff

Discussion

This paper has empirically tested a framework identifying the relationships among adopting IS, support factors, barrier factors and logistics performance management drawing on a sample of 103 retail firms in Thailand. Exploratory factor analysis was employed to identify the underlying dimensions of IS adoption and logistics performance management. Barriers factor, internal support factor and external support factorhave an effect on forward logistics activity management factor. IS adoption has not an effect on performance management in customer service, purchasing and procurement and inventory management because it is standard functions in retail firm that they think it is not necessary to use IS. Adopting logistics performance indicators have an effect on logistics performance management except indicators in number of complaints, on time delivery, inventory carrying cost and average stock days that they are indicators in flexibility perspective. Hence, the retail firms can use other indicator for logistics performance measurement (Lai et al., 2010; Murthy et al., 2004; Kurata and Lui, 2007).

Conclusion and future work

The contribution of this paper is an empirical analysis An empirical analysis of the impact of information systems in logistics performance management of retail firms. We have investigated factors that influent logistics performance management with IS adoption, support factors, barrier factor and logistics performance indicator adoption. The results of association encompass support factors, barrier factor and logistics performance management factors. Moreover, recognition of barrier factor that effect logistics performance management.

This study sets the stage for future research on logistics performance management. However, this research was conducted in Thailand may limit the generalizability of the results. There are ample opportunities to extent to firm size segment. Moreover, it would be interesting to compare in the context of another country.

References

ANDERSSON, P., ARONSSON, H. & STORHAGEN, N. G. 1989.Measuring logistics performance.*Engineering Costs and Production Economics, 17*, 253-262.

APTEL, O. & POURJALALI, H. 2001. Improving activities and decreasing costs of logistics in hospitals: a comparison of U.S. and French hospitals. *The International Journal of Accounting,* 36, 65-90.

BAYRAKTAR, E., DEMIRBAG, M., KOH, S. C. L., TATOGLU, E. & ZAIM, H. 2009. A causal analysis of the impact of information systems and supply chain management practices on operational performance: Evidence from manufacturing SMEs in Turkey. *International Journal of Production Economics, 122*, 133-149.

BüYüKöZKAN, G., FEYZIOGLU, O. & NEBOL, E. 2008.Selection of the strategic alliance partner in logistics value chain.*International Journal of Production Economics, 113*, 148-158 .

ÇELEBI, D., BAYRAKTAR, D. &BINGöL, L. 2010. Analytical Network Process for logistics management: A case study in a small electronic appliances manufacturer. *Computers & Industrial Engineering, 58*, 432-441.

CHOW, H. K. H., CHOY, K. L., LEE, W. B. & CHAN, F. T. S. 2005. Design of a knowledge-based logistics strategy system.*Expert Systems with Applications, 29*, 272-290.

GARCIA, F. A., MARCHETTA, M. G., CAMARGO, M., MOREL, L. & FORRADELLAS, R. Q. 2011.A framework for measuring logistics performance in the wine industry.*International Journal of Production Economics, 135*, 284-298.

HAGHANI, A. & OH, S., 1996. Formulation and solution of a multi-commodity, multi-modal network flow model for disaster relief operations. *Transportation Research A*, 30, 231–250.

HAIR, J.F., ANDERSON, R.E., TATHAM, R.L., BLACK, W.C., 1998.Multivariate Data Analysis.Prentice-Hall, Englewood Cliffs, NJ.

KAISER, H.F. 1974. An index of factorial simplicity.Psychometrika 39, 31–36.

KAPLAN, R. S. & NORTON, D. S. 1996. Using the scorecard as a strategic management system.*Harvard Business Review*, 75–85.

KURATA, H. & LIU, J. J. 2007.Optimal promotion planning--depth and frequency--for a two-stage supply chain under Markov switching demand.*European Journal of Operational Research, 177*, 1026-1043.

LAI, K.-H., WONG, C. W. Y. & CHENG, T. C. E. 2010. Bundling digitized logistics activities and its performance implications. *Industrial Marketing Management, 39*, 273-286.

LAITINEN, E. K. 2002. A dynamic performance measurement system: evidence from small Finnish technology companies. *Scandinavian Journal of Management, 18*, 65-99.

LEE, C. K. M., HO, W., HO, G. T. S. & LAU, H. C. W. 2010. Design and development of logistics workflow systems for demand management with RFID.*Expert Systems with Applications,* doi:10.1016/j.eswa.2010.10.012

LOUKIS, E. N., SAPOUNAS, I. A. & MILIONIS, A. E. 2009. The effect of hard and soft information and communication technologies investment on manufacturing business performance in Greece - A preliminary econometric study.*Telematics and Informatics, 26*, 193-210.

MURTHY, D. N. P., SOLEM, O. & ROREN, T. 2004. Product warranty logistics: Issues and challenges. *European Journal of Operational Research, 156*, 110-126.

NGAI, E. W. T., LAI, K.-H.& CHENG, T. C. E. 2008. Logistics information systems: The Hong Kong experience. *International Journal of Production Economics, 113*, 223-234.

NUNNALLY, J.C. 1967. Psychometric Theory. McGraw-Hill, N.Y.

O¨ ZDAMAR, L., EKINCI, E., KU¨C¸U¨KYAZACI, B., 2004. Emergency logistics planning in natural disasters.*Annals of Operations Research*, 129, 217–245.

QUEZADA, L. E., CORDOVA, F. M., PALOMINOS, P., GODOY, K. & ROSS, J. 2009. Method for identifying strategic objectives in strategy maps. *International Journal of Production Economics,* 122**,** 492-500

TILOKAVICHAI, V. & SOPHATSATHIT, P. 2011. An Organization-Wide Analysis of ERP and Information Systems Interrelationship for Logistics Support. *Journal of System and Management Sciences*, 1, 59-68.

WU, Y.-C.J. & HUANG, I. C. 2007. Operations research practice on logistics management in Taiwan: An academic view. *European Journal of Operational Research,* 182**,** 428-435.