Mediation Effects of Logistics Performance on Collaboration and Firm Performance of Palm Oil Companies: PLS Path Modeling

Montree Piriyakul (Corresponding author)
Department of Statistics, Ramkhamhaeng University, Bangkok, Thailand
Tel: 66-08-1910-8012 E-mail: mpiriyakul@yahoo.com

Chayanan Kerdpitak
Ph.D. Candidate, Faculty of Business Administration, Ramkhamheang University, Bangkok, Thailand
Tel: 66-08-7028-7287 E-mail: ckerdpitak@gmail.com

Received: June 8, 2011 Accepted: July 4, 2011 doi:10.5539/jms.v1n1p90

Abstract

This research investigation is concerned with determining how well internal collaboration and external collaboration link through logistics performance to influence on marketing performance and competitive performance of the firm. With data collected from 104 general managers from 120 available palm oil companies in southern Thailand, findings indicate that marketing performance was affected by the influence of logistics performance and by the direct and indirect influence of internal collaboration. Competitive performance was affected by external collaboration. When taking into account the role of logistics performance as a mediator, it was found that logistics performance was affected only by internal collaboration and transmitted the effects to marketing performance.

Keywords: PLS-Path modeling, Logistics, Performance, Palm oil

1. Introduction

At present, logistics plays a very important role in organizations. Due to the highly competitive environment, organizations have tried with their utmost endeavor to deploy brand new strategic approach within their own organizations so as to generate a higher competitive edge. Logistics plays key role in supporting organizations as they strive for more efficient management systems (Sheridan, 1993; Wallenburg, 2005) as in the business practices, the inefficient logistics system together with the inefficient internal management would disable the organization to respond to the needs of customers with the lowest price at the shortest feasible time frame including the quality level which does not meet customer expectation and would lead the organizations to the competitive disadvantage situation against their rivals. With a broad range of manufacturers and distributors for our customers to choose from, they can choose to purchase the products from the manufacturers and distributors who capable to offer products which match their specified quality at the lowest prices and be delivered on time (Stalk and Hout, 1990; Azzone and Masella, 1991; Adobor & McMullen, 2007).

Palm oil is economic importance for both country and global level. The productivity of palm oil in Thailand ranks fourth in the world after Malaysia, Indonesia and Nigeria and currently the average productivity output is increasing and becoming close to become third rank of the world (Ministry of Agriculture, USA, July 2009). Furthermore, the palm oil is ranked as the second most important economic crops in Thailand after rice and hence the government focuses their attention to improve its specie, its productive yield and in expanding its agricultural area to other regions of the country, i.e. Eastern, Northeastern and Central Region (Department of Industrial Manufacturers, 2008; Department of Internal Trade, 2008). The expanding of such agricultural area has generated numerous arisen issues which are needed to be tackled and solved by various organizations. These farmer issues on the increasing volume of palm oil productivities in the near future as the consequence of the expanding agricultural area in various locations in Southern, Eastern and Northeastern Region of Thailand (Department of Agriculture, 2009) including the improvement of palm spicy for higher productivity yield by the Palm Oil Research Center at Suratthani Province in southern Thailand would means the increasing volume of palm oil in the market and lead to the increasing of production cost. For the production cost analysis reveals that production cost is higher than key competitors, i.e. Malaysia and Indonesia at approximately 10% of total

productivities (Department of Internal Trade, 2008; Department of Internal Trade, 2009) which is required managerial process in resolving such issues. With such prolong situation of industrial production cost increases over their competitors lead the palm oil industry to become competitive disadvantage against their competitors in the market.

Eventually, the consequence issue from the increasing volume of productivity is the increase of inventory level which in turn is the key factor in increasing industrial production cost. The increase cost would then be passed on to the buyers of which is resulted in the continuing increase of palm oil prices in the country. For instance, the selling price of A grade palm oil was about 45 cents a kilogram. The average price of B grade palm oil was about 42 cents a kilogram and with the continue increasing trend (Department of Internal Trade, 2008; Office of Economic Agriculture, 2008).The issue of increasing of palm oil prices should be carefully studied and managed by both buyer and production parties in order to soothing the issue and to locate the effective solution The study of palm oil management revealed that many managerial issues of both internal organization and within the same supply chain. On the internal organization, it revealed the lack of effective collaboration in the management system even though the joint collaboration within and among the organizations was the key success factor of the organization (Porter, 1985; Fisher, 1997; Handfield and Nichols, 1999). Each function focused on their individual operations and responsibilities but less integration among them. On the internal supply chain, it revealed the lack of effective collaboration among trading parties. Each organization focused on their own buying and selling targets but still without the joint trading collaboration (Kerdpitak, et al, 2009). In addition, the study of supply chain efficiency revealed that there were still numerous non value added activities existed within the supply chain which needed the organization attention to be managed and resolved (Kerdpitak, et al, 2008, 2009).

The objectives of the research were to study the influence of factors affecting toward the marketing performance and the competitive performance with the following captive research questions:

1) Whether logistics performance transmits the effective collaboration roles within the internal and the external organization toward the competitive performance and marketing performance?
2) Whether the internal collaboration had directly and indirectly influences toward the marketing performance?
3) Whether the external collaboration had directly and indirectly influences toward the competitive performance?

2. Literature Review

2.1 Logistics Performance

The logistics performance is the managerial process of storage and transportation, in combination, of raw material/products in supply chain. The goals of logistics performance are cost efficiency, sales growth, profitability, job security and work condition, customer satisfaction, product availability, on-time delivery, CSR, keeping promises, less losses and damage, faire price and flexibility. (Chow, Heaver, Henrikson, 1994) To be successful organizations, the organizations must response the orders with responsive basis and shortest time delivery with the lowest cost (Sheridan, 1993; Moskal, 1995). In managing the supply chain, responsiveness was of the essence. What was required was speed, capacity to fill orders, delivery flexibility, and dependable delivery meeting the requirements of customers. On the other hand, as far as manufacturing was concerned, attention must be riveted on responding with alacrity to the changes in the needs of customers (Moskal, 1995; Willis, 1998).

Good performance is dependent upon the full array of organizational systems, capacities and processes. These include the logistics, the marketing system and production systems, production capacity, intra-organizational performance processes, internal communication, and attention being paid to customer satisfaction (Tracey, 1998; Kim, Cavasgil and Calantone, 2006). Tracy, Lim and Vonderembse (2005) found that the outcome of logistics performance had effect the marketing performance of the success organization and with the increase of competitive performance.

2.2 Internal Collaboration

Internal collaboration is the way to work together among different functions in the firm better than seamless practice. Workers in different departments may come to work together in same area or work in their place but with same disciplines or exposure to common problems and common pursuit of interests (Wang, 20002). Past findings indicated that collaboration in mutual performance was an important contributing factor to organizational success. In investigating supply chains, researchers had determined that both internal and external collaboration were essential to the efficient linking of business processes from commencement to termination. Effective collaboration linking supplier, manufacturer, distributor, retailer, and customer was in itself a generator of added value to participants in the supply chain and concomitant customer satisfaction. Irrespective of good internal performance, organizations could still not solve current or future issues without external collaboration (Lambert et al., 1998; Gimenez and Ventura, 2005). With the organization value the importance of these factors would had

both direct and indirect effects toward the organization performance, i.e. the organization with efficient logistics performance, marketing performance and competitive performance (Holmstrom, Smaros, Disney and Towill, 2003; Giminez and Ventura, 2005; Green, Whitten and Inman, 2008)

2.3 External Collaboration

External collaboration is new idea of today business to use what exist outside the wall of the firm. The most rationales offered from this idea are risk sharing, access to new market and technologies, coupling complementary skill, knowledge sharing, resources sharing, speed of development, reduction in product development (Lassen, Laugen and Middel, 2008) Good organizational performance might rely on external collaboration with business partners. (Quinn, 1998; Handfield and Nicholls, 1999; Gimenez and Ventura, 2005). In addition, internal operational problems must be continuously solved by any effective organization. Thus, internally, organizations must foster good principles of collaboration through informal teamwork, sharing of information, enhancing logistics performance, and engaging in mutual problem solving. Nonetheless, external collaboration not only fosters better logistics performance, it also enhanced competitive capacity.

Applications of research on external collaboration had proved beneficial to businesses. It was found that focus solely on raw material quality did not in itself ensure effective organizational effectiveness. Organizations must also paid strict heed to issues of external collaboration (Fisher, 1997), notably in regard to managing raw materials and dealing with the sellers of raw materials. The food industry in the USA paid attention to such matters and had allocated high budgets to deal with collaboration in these two respects. Consideration was given to quality of raw material, speed in placing orders, good mutual relationships, and being able to solve problems for the suppliers of raw materials (Kim, Cavasgil and Calantone, 2006). The major issue to keep in the forefront of attention was mutual planning followed by performance according to plans and improving work processes (Paulraj & Chen, 2007). Contemporary studies revealed that external collaboration laid strong effects on competitive performance on logistics performance, marketing performance and competitive performance. (Fawcett et al., 2005; Giminez and Ventura, 2005; Green, Whitten and Inman, 2008).

2.4 Marketing Performance

Marketing performance is indices used to indicate whether firm pass through short-run survival to long-run growth. There are many candidate indices, mostly multi-dimensional. Marketing performance of the firm can be some of these indicators, e.g. Return on Investment (ROI), Cash Flow, Customer Equity, Net Present Value, Customer Lifetime, Return on Customer (ROC) or Return on Expenditure (ROX) (Ambler and Roberts, 2005). In most commercial organizations, there was a concern to focus on what yields returns in the long run, in at least 3 years. In this connection, good organizational performance was depending upon above indices that could be group into 3 categories; they are increased market share, increased sales volume, and increased returns on sales (Koksal and Osgul, 2007). In general, successful organizations must take these principles into consideration for at least three years or even more (Tracy and Vonderembse, 2005). Accordingly, market performance would be good provided that internal management and logistic performance were good. All of these factors conduced to successful marketing performance. The marketing performance in good organizational performance was depend-ing on the external collaboration among organizations in bringing added value to their customers (Day, 1994; Narver and Slater, 1990).

2.5 Competitive Performance

An important issue was whether industrial organizations had the edge over competitors by being able to fill customer orders at short order in response to customer demands. In general, there were four aspects to measuring this capacity (Sheridan, 1993). These aspects were increase sales volume, increase market share, increase capital assets and high competition ability in general (Swafford, Ghosh and Murthy, 2006). The increase of competitive performance was also as the outcome of good logistics performance (Swafford, Ghosh and Murthy, 2006), e.g. the reliability of delivery process and the accuracy of informative data (Lages, Lages and Lages, 2005). Hence, organizations with good competitive performance relied on the organizational collaboration, the information exchange throughout the supply chain and the joint targets development (Cavusgil and zou, 1994; Lages, Lages and Lages, 2005; Hooper, 2006)

3. Research Methodology

The researchers employed a survey research method to investigate whether the conceptual framework could be validly extrapolated to the palm oil business. Using the conceptual framework adopted, the survey utilized a sample survey approach to gather necessary data from 104 of 120 general managers of available palm oil companies in southern Thailand. Scales used adapted from 2 sources; internal collaboration and external collaboration adapted

from Gimenez and Ventura (2005) and logistics performance, marketing performance, and competitive performance adapted from Green et al. (2008). All items measured in LIKERT scale with 1 to 5 values; 1 stands for least practice or the like and 5 stands for most practice and the like dependent upon construct contexts.

Data were analyzed through structural equation modeling (SEM) to determine model causality using PLS-Graph 3.0 software (Chin, 2001).The SEM consisted of the following structural equation linking latent variables:

$$\eta = \mathbf{B}\eta + \Gamma\xi + \zeta$$

where η is the endogenous variable and ξ is the exogenous variable. ζ signifies the margin of error.

The measurement model for the exogenous variable in each block was

$$\mathbf{X} = \Lambda_x\xi + \delta_x \text{ or } E(\mathbf{X}|\xi) = \Lambda_x\xi$$

X was the indicator of ξ and Λ_x was the loading factor indicating the influence of latent variable ξ on indicator **X**.

The measurement model for the endogenous variable was

$$\mathbf{Y} = \Lambda_y\eta + \varepsilon_y \text{ or } E(\mathbf{Y}|\eta) = \Lambda_y\eta$$

Y was the indicator of η and Λ_y was the loading factor indicating the influence of latent variable η on indicator **Y**.

In model analysis, the researcher used the following algorithm:

1) Estimated the value of the latent variable using the value of the indicators i.e. $\hat{V}_i \ \alpha \ \sum P_{ij} w_{ij}$ where α means $\hat{V}_i$ derived from the standardized value of weighted sum of indicator P_{ij} with w_{ij} being assigned arbitrarily, but recommended range is -1 to 1, i = 1, 2, …, K; j =1, 2, …, M_i.
2) Estimated the value of the dependent variable in SEM by $Z_i \ \alpha \ \sum c_j \hat{V}_j$ which meant the latent variables in SEM came from the weighted aggregate of the standardized estimated value of the latent variables in each path or the adjacent. c_j was an appropriate weight, but correlation is recommended.
3) Updated w_{ij} in 1 through correlation between Z_i and its standardized P_{ji}.
4) Go to 2.
5) Applied number 2 through 4 until the coefficient of all paths showed convergence.

4. Findings

As exhibited in Table 4, it revealed that palm oil companies exercised high level of external and internal collaboration which result very high level of logistics performance in turn. However, it was shown that there marketing performance and competitive performance were not much appreciable. In Figure 1, Table 1 and Table 2, it is seen that internal collaboration influenced marketing performance and logistics performance. External collaboration was also seen to influence competitive performance. This means that if the organization has good levels of internal collaboration and external collaboration, logistics performance will be enhanced. Moreover, the findings show that good logistics performance brings about good marketing performance. It was also found that internal collaboration displayed both direct and indirect influence on marketing performance. At the same time, good external collaboration only directly affected quality competitive performance, but did not affect marketing performance (see figure 1).

When considering only latent variables, it was found that the marketing performance variable was controlled by the influence of the internal collaboration and the logistics performance variables. It was found that external collaboration had the highest influence. The logistics performance variable was only affected by the internal collaboration, while it was also found that competitive performance influenced the growth of sales. Assets, market share, and overall growth were affected only by external performance. External collaboration means collaboration in working as a team by information sharing, determining methods for performance, formulating goals, deter-mining decision-making methods, and building understanding.

Logistics performance functions as a good mediator only in respect to internal collaboration and marketing performance. That is, logistics performance was influenced by internal collaboration and influenced marketing performance, but was not influenced by external collaboration. Moreover, it did not influence competitive performance, but was influenced by internal collaboration. However, it did influence competitive performance. This indicates that the role of logistics performance is that of partial mediation, a role which permitted some antecedents passed their influence directly to outcome constructs.

5. The Quality of Model and Measures

5.1 The Overall Quality of the Model

On the basis of Table 4, it can be seen that the model displayed a value of R^2 between 0.186 and 0.338. The mean was 0.251, which was higher than 0.20. This means that the structural equation had predictive quality at an acceptable level. The structural equation satisfied the fit index; that is, Goodness of Fit (GoF) was equal to 0.411 (GoF $=\sqrt{0.251*0.672}$ = 0.411). This indicates that the model displayed predictability at a moderate level. The value of Average Communality was equal to 0.672. This means that the construct, on average, reflected their nature through their indicators at a rather good level. The model displayed an Average Redundant value equal to 0.180. This means that independent variables (construct) in each structural equation could portray their sound influence through their dependent variable to indicators of that block. In summary, the quality of the model was at a rather good level.

5.2 Convergent Validity

On the basis of Table 3, it was found that loading was greater than 0.707 thresholds for all values. This means that indicators in all blocks could be accurately measured. From Table 4, all constructs displayed a composite reliability (CR) at a high level, *viz.,* between 0.887 and 0.930, which was higher than 0.60. The average variance extracted (AVE) was between 0.569 and 0.793 which was higher than 0.50 thresholds. This means that each construct has very well reflective indicators and could be used for accurate measurement in its own domain.

5.3 Discriminate Validity

As displayed in Table 4, it was found that $\sqrt{\text{AVE}}$ was the value of a number in the diagonal line (see Table 3) and had a greater value than the number in the same column. The value in any column (called column variable) showed cross construct correlation. This correlation was a relationship between latent variables. This means that measurements for each construct can measure the variation in its own without having to measure the variation in other constructs as well.

6. Discussion and Implications

Findings indicate that logistics performance in palm oil companies plays a partial mediation role in linking collaboration in an organization's functional areas to efficient marketing performance. However, empirical data do not support the conclusion that logistics performance is affected by external collaboration because the path coefficient did not exhibit statistical significance and thus does not affect marketing performance. However, internal collaboration affects marketing performance while external collaboration affects competitive performance directly, a finding that is congruent with the hypotheses framed for this investigation.

This study indicates that any operation of palm oil companies that purports to lead to efficient competition resulting in the growth of sales volume, assets and market share requires external collaboration involving informal teamwork, mutual goals and strategies setup, building understanding and innovations in all parties exhibiting efficient management. At the same time, in order to have quality marketing performance involving increased sales volume, increased value of sales, larger market share, palm oil companies must develop good internal collaboration and exhibit good logistics performance responsive to customers when taking orders, communicating with customers, and being efficient in making deliveries.

However, research findings show that empirical data are not supportive of there being actual links between external collaboration and logistics performance and between logistics performance and competitive performance. Nonetheless, this conclusion needs to be reevaluated in the light of additional sets of data which will be collected in the future

References

Adobor, H., and McMullen, R. (2007). Supplier diversity and supply chain management: A strategy approach, *Horizons,* Vol. 50: 219-229. doi:10.1016/j.bushor.2006.10.003, http://dx.doi.org/10.1016/j.bushor.2006.10.003

Ambler, T., and Roberts, J. (2005). Beware the Silver Metric: Marketing Performance Measurement has to be Multidimensional. London Business School, Center for Marketing.

Azzone, G., and Masellam, C. (1991). Design of performance measures for time-based companies. *International journal of Operations and Production Management*, Vol. 11, No. 3. doi:10.1108/01443579110143412, http://dx.doi.org/10.1108/01443579110143412

Cavusgil, S.T., and Zou, S. (1994). Marketing strategy-performance relationship: An investigation of the empirical link in export market ventures. *Journal of Marketing*, Vol. 1, No. 58: 1-21. doi:10.2307/1252247, http://dx.doi.org/10.2307/1252247

Chayanan Kerdpitak, Montree Piriyakul, Supasit Jarupathiran, Paopak Sirisuk (2009).Competitive Advantage of Thai Palm Oil Industries Through Logistics Strategies. *9th Conference on Logistics and Supply Chain*, 35-40.

Chayanan Kerdpitak, Supasit Jarupathiran, Paopak Sirisuk (2008). Improvement of Logistics and Supply Chain Efficiency for Palm Oil Industries. *Thai VCML*, 25-30.

Chin, W.W. (2001). PLS Graph User's Guide Version 3.0. [Online] Available: http://www.pubinfo.vcu.edu/carma/Documents/OCT1405/PLSGRAPH3.0Manual (March 15, 2008)

Chow, G., Heaver, T. D., and Henrikson, L. E. (1994). Logistics Performance: Definition and Measurement. *International Journal of Physical Distribution & Logistics Management*, Vol. 24, No. 1: 17-28. doi:10.1108/09600039410055981, http://dx.doi.org/10.1108/09600039410055981

Day, G.S. (1994). The capabilities of market-driven organizations. *Journal of Marketing*, Vol. 58, 37-52. doi:10.2307/1251915, http://dx.doi.org/10.2307/1251915

Fawcett, S. E., Osterhaus, P., Magnan, G. M., Brau, J. C., and McCarter, M. W. (2005). Information sharing and supply chain performance: The role of connectivity and willingness. *Supply Chain Management*: *An International Journal*, 12(5): 358-368.

Fisher, L. M. (1997). What is the right supply chain for your product. *Harvard Business Review*, March-April.

Gimenez, C., and Ventura, E. (2005). Logistics-production, logistics-marketing and external integration. *International Journal of Operation & Production Management,* 25(1), pp. 20-38.

Green, K.W., Whitten, D. W., and Inman, R. A, (2008). The impact of logistics performance on organizational performance in a supply chain context. *Supply Chain Management: An International Journal*, Vol. 13, Iss 4, pp. 317–327.

Handfield, R. B., Nichols JR, E. L. (1999). *Introduction to Supply chain Management.* Prentice Hall.

Holmstrom, J., Smaros, J., Disney, S. M., and Towill, D. R. (2003). Collaborative supply chain configurations: The Implications for supplier performance in production and Inventory control, paper presented at the 8th International Symposium on Logistics, Sevill, Spain July 6th-8th.

Hooper, V. A. (2006). *The Impact of the Alignment between Information System Improvement,* Victoria, University of Wellington, Australia.

Kim, D., Cavasgil, S. T., and Calantone, R. J. (2006). Information System Innovations and Supply Chain Management: Channel Relationship and Firm Performance. *Journal of the Economy of Marketing Science*, 34(1): 409-54.

Koksal, M. H., and Osgul, E. (2007). The Relationship between Marketing Strategies and Performance in an Econo-mics Crisis. *Marketing Intelligence & Planning*, Vol. 25 No. 4: 326-342. doi:10.1108/02634500710754574, http://dx.doi.org/10.1108/02634500710754574

Lages, L. F., Lages, C., and Lages, C. R. (2005). Bringing export performance metrics into annual reports: The PERFEX scorecard, FEUNL Working Paper No.469. [Online] Available: http://ssrn.com/abstract=882472 (March 2, 2008).

Lambert, D. M., Cooper, M.vC., and Pagh, J. D. (1998). Supply Chain management: implementation issues and research opportunities. *International Journal of Logistics Management,* Vol. 9, No. 2: 1-19. doi:10.1108/09574099810805807, http://dx.doi.org/10.1108/09574099810805807

Lassen, A. H., Laugen, B., and Middel, R. (2008). Collaborative Entrepreneurship: On the Influence of Internal and External Collaboration on Corporate Entrepreneurial Innovation, Aalborg University, Denmark.

Moskal, B.S. (1995). Son of agile. *Industrial week*, Vol.15: May 1995.

Paulraj, A., and Chen, I. J. (2007). Strategic Buyer-Supplier Relationships, Information Technology and External Logistics Integration. *The Journal of Supply Chain Management,* Vol.43, No.2, Spring 2007: 2-14. doi:10.1111/j.1745-493X.2007.00027.x, http://dx.doi.org/10.1111/j.1745-493X.2007.00027.x

Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance.* New York: The Free Press.

Quinn, F. J. (1998). Building a world class supply chain, Logistics online. [Online] Available: http:// www. manufacturing.net/magazine/ archives/1998/scmr/05brave.html.

Sheridan, J. H. (1993). Agile manufacturing: stepping beyond lean production. *Industrial week*, Vol.19.

Stalk, G., and Hout, T. M. (1990). *Competing Against Time: How Time-Based Competition Is Reshaping Goal Markets.* Free Press, New York.

Tracey, M. (1998). The Importance of Logistics Efficiency to Customer Service and Firm Performance. *The International Journal of Logistics Management,* 9(2): 65-81. doi:10.1108/09574099810805843, http://dx.doi.org/10.1108/09574099810805843

Tracy, M., Lim, J., and Vonderembse, M. A. (2005). The Impacts of Supply Chain Management Capabilities on Business Performance.*Supply Chain Management: An International Journal*, 10/3: 179-185.

Wallenburg, C. M., and Weber, J. (2005). Structural Equation Modeling as a Basis for Theory Development Within Logistics and Supply Chain Management Research. [Online] Available: http:// www.springerlink. com/ content/ n3m60u77vl711518/ (Jan 25,2010)

Wang, E. A. (2002). RX for pharmaceutical Company: Internal Collaboration is the key to improve Innovation. *Internal Collaboration.* IBM Institute for Business Value.

Willis, T. H. (1998). Operational competitive requirements for the twenty-first century. *Industrial Management & Data Systems*, Vol. 98 Iss 2: 83–86. doi:10.1108/02635579810207717, http://dx.doi.org/10.1108/02635579810207717

Table 1. Results from hypothesis testing

Hypothesis (path)	Path coefficient	T-stat.	Result
H1:Internal Collaboration has positive effect on Marketing Performance	0.222	1.861[a]	support
H2: Internal Collaboration has positive effect on Logistics Performance	0.457	4.895**	support
H3: External Collaboration has positive effect on Logistics Performance	0.176	1.324	not support
H4: External Collaboration has positive effect on Competitive Performance	0.384	2.526**	support
H5: Logistics Performance has positive effect on Marketing Performance	0.267	2.050*	support
H6: Logistics Performance has positive effect on Competitive Performance	0.161	1.126	not support

[a] $p \leq 0.10$ * $p \leq 0.05$ ** $p \leq 0.01$

Table 2. Effect of antecedents on dependent variables

Dependent variable	R^2	Contribution	Antecedents		
			Internal Collaboration	External Collaboration	Logistics Performance
Marketing Performance	0.186	Direct Effect	0.220	0.000	0.263
		Indirect Effect	0.122	0.047	0.000
		Total Effect	0.342	0.047	0.263
Competitive Performance	0.230	Direct Effect	0.000	0.384	0.161
		Indirect Effect	0.074	0.028	0.000
		Total Effect	0.074	0.412	0.161
Logistics Performance	0.338	Direct Effect	0.457	0.176	N/A
		Indirect Effect	0.000	0.000	N/A
		Total Effect	0.457	0.176	N/A

Table 3. Cross construct correlation and performance indices

Construct	LV 1	LV 2	LV 3	LV 4	LV 5	R^2	Average Communality	Average Redundancy
LV 1	0.750					0.000	0.569	0.000
LV 2	0.616	0.791				0.000	0.625	0.000
LV 3	0.565	0.457	0.841			0.338	0.708	0.239
LV 4	0.371	0.421	0.391	0.891		0.186	0.793	0.148
LV 5	0.394	0.458	0.337	0.536	0.814	0.230	0.663	0.153
Average						0.251	0.672	0.180

LV1 = Internal Collaboration, LV 2 = External Collaboration, LV 3 = Logistics Performance, LV 4 = Marketing Performance, LV 5 = Competitive Performance

Table 4. Loading factor, composite reliability (cr) and average variance extracted (AVE)

Indicator	Mean	Loading	T-stat.	CR	AVE
Internal Collaboration	3.79				
Int1: informal collaboration	3.80	0.512	3.923	0.901	0.569
Int2: exchange of ideas, data, information, knowledge	3.75	0.826	16.832		
Int3: development of teamwork	3.72	0.719	10.895		
Int4: mutual planning to solve operational problems	3.85	0.786	13.089		
Int5: determining mutual objectives/goals	3.81	0.808	18.081		
Int6:developing methods for building understanding in mission of one another	3.82	0.770	14.641		
Int7: mutual decision in selecting ways for making worthwhile outlays	3.78	0.813	18.152		
External Collaboration	3.73				
ex1: informal collaboration	3.72	0.718	11.618	0.930	0.625
ex2: share information, sales forecasts, sales volume, level of inventory	3.67	0.789	15.404		
ex3: collaborate in the development of logistics process	3.71	0.756	13.156		
ex4: developing teamwork to foster and use CRP/ECR together	3.72	0.786	13.895		
ex5: mutual planning to prevent and solve operational problems	3.73	0.784	15.430		
ex6: mutual determination of objectives	3.75	0.785	16.347		
ex7: develop methods for building mutual understanding	3.75	0.892	33.726		
ex8: mutual decision to select ways of making worthwhile outlays	3.79	0.802	12.776		
Logistics Performance	4.09				
lp1: delivery speed	4.13	0.811	17.025	0.924	0.708
lp2: delivery dependability	4.02	0.871	25.706		
lp3: responsiveness	4.10	0.836	20.032		
lp4: delivery flexibility	4.09	0.849	22.916		
lp5: order filling capacity	4.11	0.839	17.897		
Marketing Performance	3.27				
Mk1: increased market share on average in the past 3 years	3.23	0.878	22.064	0.920	0.793
Mk2: average increased sales volume in the past 3 years	3.28	0.882	22.282		
Mk3: average increased sales value in the past 3 years	3.31	0.913	23.324		
Competitive Performance	3.29				
cp1: sales growth in the last three years	3.32	0.794	15.691	0.887	0.663
cp2: market share growth in the last three years	3.25	0.859	22.236		
cp3: growth of assets in the last three years	3.31	0.811	16.600		
cp4: overall competitive capacity	3.30	0.791	16.553		

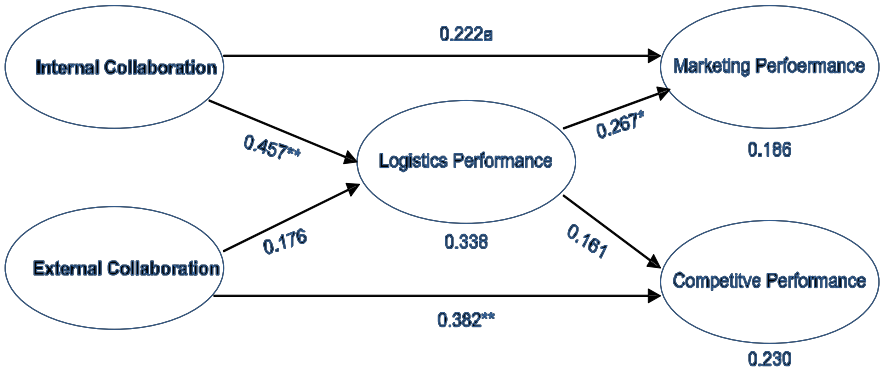

Figure 1. Final PLS Path Model

Remark: the number marking path between constructs display the path coefficient indicate how much influence the independent variables of each path left on its dependent variable. The numbers under ovals which are endogenous constructs are R^2 indicate proportion explained made by antecedents of that path. Symbols ** symbol * and symbol [a] adjacent to path coefficients mean statistical significant at 0.01, 0.05.and 0.10 level respectively.