THE IMPACT OF INFORMATION INTEGRATION IN THE SUPPLY CHAIN ON FINANCIAL PERFORMANCE

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Abstract

Companies in Indonesia are still struggling to improve their intra- and inter-firm integration, and are still in the early stages of such integration. Therefore, this study is to measure and confirm the relation of horizontal information integration within a company's cross functional integration to vertical information integration of the company with their customers and suppliers, and how that affects customer satisfaction and financial performance. We used structural equation modeling (SEM) to investigate supplier and customer integration strategies using a sample of 90 manufacturing, distribution, and retail companies in Indonesia. The respondents from each company were limited to senior managers with functional areas of expertise and responsibility. The research was conducted through a survey questionnaire. The results of the study show 1) a positive direct relationship between integrated information and customer satisfaction, 2) a positive relationship between customer satisfaction and financial performance, and 3) a positive relationship from integrated information through to financial performance. The holistic implementation of information integration strategies in other developing countries can help companies to excel and gain measurable financial performances.
Keywords: Supply Chain Management; Supply Chain Integration; Customer Service Performance; Financial Performance; Structural Equation Modeling.

Abstrak

Perusahaan - perusahaan Indonesia tengah berupaya untuk meningkatkan integrasi *intra-* dan *inter*-perusahaan, dimana kebanyakan dari mereka masih berada pada tingkatan awal dari keseluruhan proses integrasi tersebut. Oleh karenanya, penelitian ini bertujuan untuk mengukur serta mengkonfirmasi hubungan integrasi informasi horisontal lintas departemen dalam perusahaan dengan integrasi informasi vertikal antara perusahaan dengan pelanggan dan pemasok, dan bagaimana hal tersebut mempengaruhi tingkat kepuasan pelanggan serta kinerja finansial. Peneliti mempergunakan metode *Structural Equation Modeling* (SEM) untuk menginvestigasi strategi integrasi antara pemasok dan pelanggan dengan mempergunakan sampel sebesar 90 perusahaan yang terdiri dari perusahaan manufaktur, distribusi, dan *retail* di Indonesia. Responden yang terpilih dari setiap perusahaan dibatasi pada tingkat *Senior Manager* dari berbagai bidang fungsional. Pengumpulan data dilakukan lewat metode survei dengan mempergunakan kuesioner. Hasil dari penelitian menunjukkan: 1) terdapat hubungan positif langsung antara integrasi informasi dan kepuasan pelanggan, 2) terdapat hubungan positif antara kepuasan pelanggan dan kinerja finansial, dan 3) terdapat hubungan positif dari integrasi informasi hingga kinerja finansial. Implementasi menyeluruh dari strategi integrasi informasi pada negara berkembang dapat membantu perusahaan untuk mengungguli pesaing dan memperoleh kinerja finansial yang terukur.

Kata Kunci: Manajemen Rantai Suplai; Integrasi Rantai Suplai; Kinerja Pelayanan Pelanggan; Kinerja Finansial; *Structural Equation Modeling*.

1. Introduction

Supply chain covers from suppliers, manufacturers, distributors, wholesalers, down to retailers before the products or services reach the intended customers. Information in the form of "orders" is transferred along the supply chain and tends to be distorted and can misguide upstream members in their inventory and production decisions. Distortion may arise as a result of local-optimizing behaviors by players in the supply chain. As a result, the upstream channel will experience larger variance of the "order" than that of "sales" and this phenomenon is also known as "bullwhip effect" (Lee et al.,, 1997). Many researchers suggest that the higher the level of integration with suppliers and customers in the supply chain the greater the potential benefits (Stevens, 1989; Lee et al.,, 1997; Metters, 1997; Narasimhan and Jayaram, 1998; Lumnus et al.,, 1998). There was consistent evidence that the widest degree of integration with both suppliers and customers had the strongest association with performance improvement (Frohlich and Westbrook, 2001). The experimental results indicate a 47.58% cost reduction moving from a traditional supply chain to a fully integrated system (Sahin and Robinson, 2005).

This paper empirically analyzed supply chain integration. The paper used evidence from Indonesia companies in Jabotabek area and tested the relationship between supply chain integration and performance.

2. Literature Review
2.1. Intra-firm Information Integration

Intra-firm information integration starts from good cross-functional communication among individuals, both formal and non-formal. The use of information technology will help the communication more efficient. To make the intra-firm integration more powerful, the quality of information is required and it supported by reliable information technology. Intra-firm integration is important prior to further integrates it with customers and suppliers.

Some researchers suggest that successful inter-departmental integration is primarily achieved through the encouragement of information sharing activities among functional departments (Dougherty, 1992; Griffind and Hauser, 1992; Ruekert and Walker, 1987). This involves formal and informal communications. Functional areas within a firm must effectively interact and work together to plan, coordinate, and implement strategic initiatives. Inter-functional integration is believed to be directly related to a firm's competitiveness and profitability. Cross-functional integration refers to lateral communication within a firm and signifies the level of coordination among different work units (Galbraith, 1994; Ruekert and Walker, 1987). Effective lateral communication, prerequisite for the integration of functional activities, is one goal of cross-functional teams and cross-functional liaison personnel (Germain et al.,, 2008). Informally working together; sharing ideas, information, and/or resources; and working together as a team are the types of behaviors to have meaningful collaborative interaction and cooperation between functional areas (Stank et al.,, 1999). Effective information sharing enhances effective supply chain practices, such as supply chain planning, JIT production and delivery practices. As a result, supply chain transparency may be enhanced and forecast errors may be reduced (Zhou and Benton, 2007).

Hypothesis 1: Intra-firm information integration is positively associated on information quality

Information systems play an important in supply chain integration, including information sharing capabilities, to firm performance (Dedrick et al.,, 2003). Malone et al., (1987) develop an important model which describes how it is pivotal to share information across the boundaries of the firm as a way to facilitate improvements in communication, coordination, and collaboration. In fact, firms are paying significant attention to the information sharing benefits provided by technological advancements such as ERP systems, RFID technology, and GPS

systems. Investments in these devices are enabling firms to collect, store, and analyze vast amounts of system-wide information which can lead to enhancements in supply chain performance. These technologies enable supply chain members to make real-time decisions which could impact the cost structure and ultimately the competitive position of the firm (Sambamurthy *et al.,*, 2003). Using advanced IT systems, supply chain partners are able to improve their production planning, inventory management, distribution, and safety management decisions because of the information sharing capabilities provided by information technology investments (Sanders, 2007). If a company can provide complete information availability, the impact of both types of problem solving approaches (abstract problem solving approach and concrete problem solving approach) on performance becomes negligible (Cantor and Macdonald, 2009). The extent use of IT is meaningless unless it tells accurately the levels of inventory, status of orders, and delivery. It must come with information quality in which it measures the degree to which the information exchanged between organizations meets the needs of the organizations (Petersen, 1999). In this study we measure nine aspects of information quality: accuracy, availability, timeliness; internal connectivity; external connectivity; completeness; relevance; accessibility; and frequently updated information (Zhou and Benton, 2007).

Hypothesis 2: Intra-firm information integration is positively associated on information technology support

Some preceding researches suggest that successful inter-departmental integration is primarily achieved through the encouragement of information sharing activities among functional departments. Which could involves formal and informal communications (Dougherty, 1992; Griffind and Hauser, 1992; Ruekert and Walker, 1987).

Hypothesis 3: Intra-firm information integration is positively associated on cross functional integration

2.2. Inter-firm Information Integration
Frohlich and Westbrook (2001) studied five arcs of integration: inward-, periphery-, supplier-, customer-, and outward-facing groups and reported that companies with the greatest arcs of supplier and customer integration would have the largest rates of performance improvement. Information sharing, specifically information sharing about consumer needs and store-level inventory, is related to a positive change in profit margin (Kulp *et al.,*, 2004).

Hypothesis 4: Supplier information integration is positively associated on intra-firm information integration

Hypothesis 5: Customer information integration is positively associated on intra-firm information integration

2.3. Information Integration and Organizational Performance
Customer service is an important factor, particularly delivery performance and product support, to justify that supply chain system is good or not. Information quality and delivery practice have significant positive influence on delivery performance (Zhou and Benton, 2007). Vickery *et al.,* (2003) reported that there is a positive relationship between customer service and financial performance in first tier automotive suppliers and we used this finding to generate a more general hypothesis, not only to manufacturers, but also to distributors. We also test if there is a positive relationship from intra-firm information integration directly to customer service. In

addition, as reported by Michael E. Porter, the cost or performance of direct activities is improved by greater efforts in indirect activities (Porter, 1982).

Hypothesis 6: There is a direct positive relationship between customer service and financial performance

Hypothesis 7: There is a direct positive relationship between intra-firm information integration and customer service.

3. Research Methods
3.1. Data Collection Procedure

For this study, we surveyed using a questionnaire method. Respondents were asked to complete a questionnaire. Samples received notification by email which required them to take the on line survey. The survey was conducted from 9 to 27 February 2009, and covered supply chain companies in manufacturing, distribution, and retail within the Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek) areas.

The sample sectors are taken from manufacturing sectors ranging from, consumer packaged goods, automotive, electronic equipment and supplies, pharmaceuticals, food, and distributors and retailers. The survey participants are senior managers ranging from managers through vice presidents and directors with functional areas of expertise in operations, and production. The number of participants was based on 300 contacts with only 90 samples being useful. Thus resulting in a 33.3% of response rate.

The questionnaire design contains questions about intra-firm integration, customer integration, supplier integration, supply chain integration, customer service, and financial performance measured by a seven-point Likert scale to address participants' opinions. It is acknowledged that some bias may have occurred in the distribution of the questionnaires, i.e. it may be that only the "best" managers were sent questionnaires.

The research considers two purposes, first to test the fit between the theoretical model and the empirical findings. Secondly to test and measure the supply chain performance indicators from within Indonesian companies and find out points of improvements.

3.2. The Survey Instruments

The questionnaire is based on 7 separate dimensions associated with information quality, information system support, cross-functional integration, supplier integration, customer integration, customer service quality, and financial performance. Each dimension is represented by several indicators as described in Table 1.

Table 1. Construct and Indicators

Construct	Indicators (Likert scale 1-7)	Code
Information Quality (Zhou and Benton, 2007)	1. Information accuracy 2. Relevant Information 3. Provided real-time 4. Completeness	ki1 ki2 ki3 ki4
Information System Support (Zhou and Benton, 2007)	1. Electronic document exchanges (doc, xls, pdf) 2. ERP usage 3. Barcoding/RFID 4. IT department role in information system	tsp1 tsp2 tsp3 tsp4

Table 1., Continued...

Cross functional integration (Zhou and Benton, 2007)	1. Ability to cooperate informally 2. Resource sharing. 3. Work together to achieve corporate goal 4. Coordinate to solve operational issue	cfi1 cfi2 cfi3 cfi4
Supplier Integration (Zhou and Benton, 2007)	1. Information sharing through electronic network (e-procurement) 2. Inventory level information sharing 3. Shipment schedule information sharing 4. Sales forecast information sharing	is1 is2 is3 is4
Customer Integration (Zhou and Benton, 2007)	1. Information sharing through electronic network (EDI) 2. Inventory level information sharing 3. Shipment schedule information sharing 4. Sales forecast information sharing	ik1 ik2 ik3 ik4
Customer Service Quality (Vickery *et al.,*, 2003)	1. On-time delivery 2. Order to shipment ratio 3. Delivery reliability 4. Order-to-delivery lead time 5. Ability to accommodate changes in delivery schedule without using safety stock	cs1 cs2 cs3 cs4 cs5
Financial Performance	1. Inventory turnover [COGS/Ag Inventory] 2. Days of Inventory [365 x Inventory/Cost of Sales]	fp1 fp2

4. Results and Discussions

Target respondent for the study is senior managers (vice presidents, manager, or director) of Indonesian manufacturing industries, with personal functional area of expertise (operation, production, or manufacturing). The sampling procedure is following one of non-probability sampling method which is convenience sampling. From the overall responses, 43 participants stated their company size in terms of number of employees as less than 250 (47.78%), 10 participants stated their company size between 250-500 employees (11.11%), and 30 participants answered more than 500 employees (33.33%). In regard to their supply chain role, 28 participants are manufacturers (31.11%), 32 participants are distributors (35.56%), and 8 resellers (8.89%).

According to target market, 75.56% target the Java Island market, 80% target outside Java Island, and 57.78% target the international market. Java Island is the island with the most population density, and is considered to be the prime market in Indonesia.

Industry sectors are represented by 14 from the food sector (15.56%), 16 consumer goods non-food (17.78%), 5 chemicals (5.56%), 11 computers/communications (12.22%), 8 pharmaceuticals (8.89%), 8 automotive (8.89%), and 1 paper/packaging (1.11%).

The participants' titles were given as Staff (12.22%), Manager (32.22%), Senior Manager (28.89%), Deputy Director (3.33%), and Director (8.89%), with roles in General Administration (15.56%), Operations (33.33%), Production/Manufacturing (14.44%), Sales/Marketing (15.56%), Human Resources (3.33%), and Information Technology (7.78%). Finally, with experience levels of 0 - 2 Years (6.67%), 2 – 5 Years (37.78%), 5 - 10 Years (22.22%), 10 – 15 Years (15.56%), and more than 15 Years (8.89%).

4.1. Goodness-of-fit Measures

The data was measured using Structural Equation Modeling as originally proposed by Nunnally (1967). The criteria and measurement for the model is shown in Table 2. The goodness-of-fit index (GFI) values are less than 0.9, and the RMSR values are above 0.1,

suggesting the implied covariance in the model and the observed covariance from the data did not fit well. The following result assumed due to one of the research limitations, where valid responses for the study did not reach more than a hundred responses in total for the whole model, thus diminishing the overall model fit quality. Comparative fit indices such as ECVI, CFI, and AGFI are not used because we did not compare to another model. The RMSR, GFI indices suggest that the measurement model did not have a satisfactory model fit.

Table 2. The goodness-of-fit indices

GOF Measures	Criteria	Measurement
Samples	-	90
Degrees of freedom	-	311
Chi-Square		888.87
P	$p<0.05$	$p=0.00$
Absolute fit index		
Chi-square/degrees of freedom	$x\leq 3.0$	2.85
RMSR	$RMR\leq 0.05$	$RMR = 0.28$
GFI	$GFI\geq 0.90$	$GFI = 0.57$

4.2. Reliability and Validity of Measures

Convergent validity relates to the degree to which different measures of the same construct are highly correlated and hence yield the same result (Hensley, 1999). Discriminant validity is the degree to which measures of different latent construct are unique enough to be distinguished from another construct (O'Leary-Kelly andVokurka, 1998). Generally a construct with a reliability value of at least 0.50 and a significant t-value for loadings $t\geq 1.96$ is considered to be convergent valid (Chau, 1997). As seen on Table 3, the path model H1, H2, H3, H6 is the only Hypothesis path that did not have > 0.50 standardized solution. And H2 is the only path that is not significant with the required t-value $t\geq 1.96$.

4.3. Analysis of the Full Structural Model

The analysis of the full structural model yields a number of goodness-of-fit indices, as shown in Table 3.

Table 3. Hypothesis standardized solution and t-value

Hypothesis	Path	Standardized solution	t-value $\alpha= 0.05$	Result
Hypothesis 1: Intra-firm information integration is positively associated on information quality	ki => INT	0.44	3.81	Significant.
Hypothesis 2: Intra-firm information integration is positively associated on information technology support	tsp => INT	-0.09	-0.98	Not-significant
Hypothesis 3: Intra-firm information integration is positively associated on cross functional integration	ki => INT	0.23	2.15	Significant.
Hypothesis 4: Supplier information integration is positively associated on intra-firm information integration	INT => is	0.95	8.25	Significant.
Hypothesis 5: Customer information integration is positively associated on intra-firm information integration	INT => ik	0.93	6.19	Significant.

Table 3., Continued...

Hypothesis	Path	Standardized solution	t-value α= 0.05	Result
Hypothesis 6: There is a direct positive relationship between customer service and financial performance	cs => fp	0.48	5.47	Significant.
Hypothesis 7: There is a direct positive relationship between intra-firm information integration and customer service	INT => cs	0.82	2.02	Significant.

The full model result can also be seen in Figure 1.

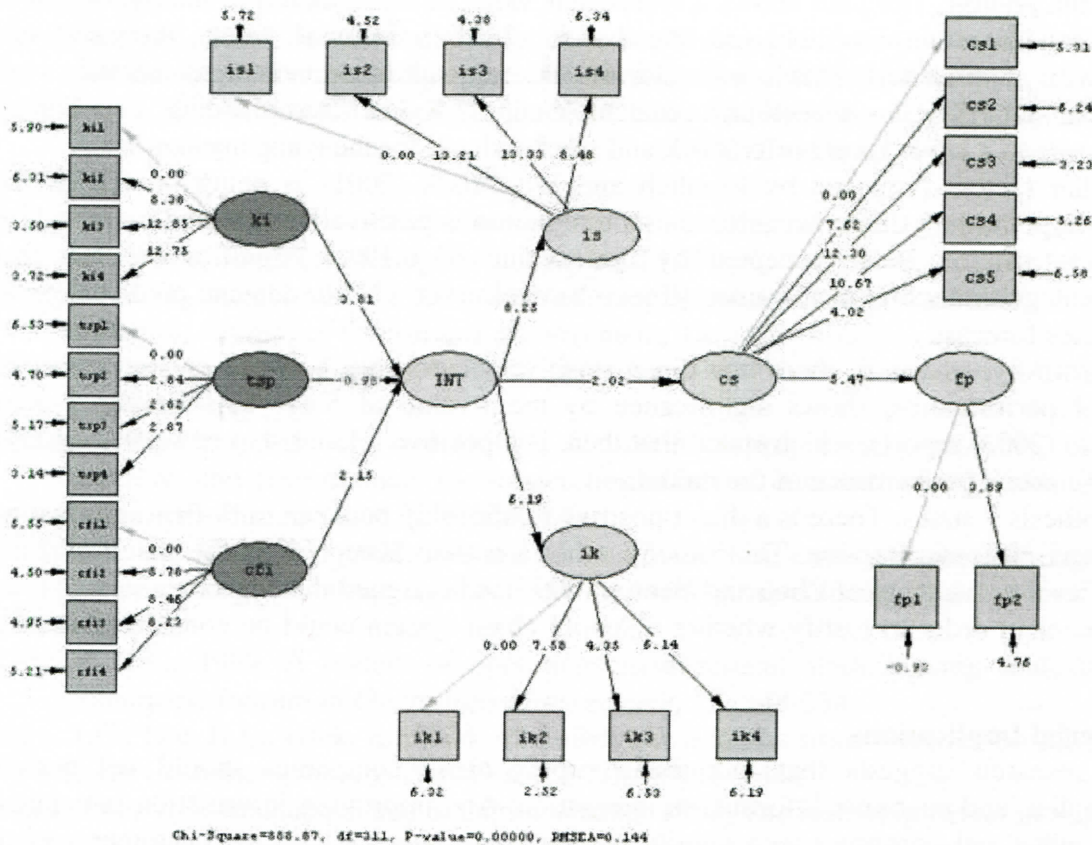Chi-Square=888.87, df=311, P-value=0.00000, RMSEA=0.144

Figure 1. Full model with *t*-test

4.4. Discussion

The findings of the research verify that internal integration supported financial performances indirectly. Furthermore, the studyalso proves that information quality plays a very significant role in achieving internal integration, and although information system support does not provide significant *t*-value, internal integration provide significant value to supplier integration, customer integration, customer support, and to financial performances.

The acceptance level with degree of confidence α= 0.05require t≥ 1.96 to be accepted. As hypothesis 1stated Intra-firm information integration is positively associated on information quality. The *t*-value of the path is 3.81, therefore the hypothesis is accepted. Thus verifies prior researchers conducted by Dougherty (1992), Griffind and Hauser (1992) and Rukert and Walker (1987), which stated that successful inter-departmental integration could be achieved by ensuring good information sharing activities among functional departments.

Furthermore, although hypothesis 2 Intra-firm information integration is positively associated on information technology support, it did not show a significant value of relationship (-0.98). Therefore, we still could not conclude whether there is an affirming association between the role of the information system in ensuring the process of supply chain integration as being stated by Dedrick *et al.,* (2003).

Hypothesis 3 which stated that Intra-firm information integration is positively associated on cross functional integration is proven to be supported within the model, by *t*-value of 2.15. This signifies the fact that successful inter-departmental integration could be achieved by ensuring good information sharing activities among functional departments, as being proposed by Dougherty (1992), Griffind and Hauser (1992) and Rukert and Walker (1987).

From hypothesis 4: Supplier information integration is positively associated on intra-firm information integration. The path shows a significant value of 8.25, therefore the hypothesis is accepted which signifies Frohlich and Westbrook (2001) statement which proposed that integration with supplier will enable both sides a win-win solution in order to maintain both parties' operational efficiency as well as a predictable supply and demand planning. This finding would also leads to a lower level buffer stock and stock in hand for the company.

Another factors proposed by Frohlich and Westbrook (2001) is being proven by the model when hypothesis 5 Customer information integration is positively associated on intra-firm information integration isalso accepted by the *t*-value of 6.19. It signifies the fact that information integration with the customer offers information for a better demand prediction as in product or sales forecast.

Stated in hypothesis 6, there is a direct positive relationship between customer service and financial performance, shows significance by the *t*-value of 5.47. This finding proved Vickery *et al.,* (2003) reports, which stated that there is a positive relationship between customer service and financial performance of the model.

Hypothesis 7 states: There is a direct positive relationship between intra-firm information integration and customer service. This last hypothesis is also accepted by the value of 2.02, which signifies the statement of Zhou and Benton (2007), who argued that customer service is an important factor in order to justify whether a supply chain system could be considered to be a good or not.

4.5. Managerial Implications

The research suggests that Indonesian supply chain companies should not neglect internal, supplier, and customer information integration. And improving information integration with the supplier and consumer to a significant level can help to leverage customer service quality and as one of the factors to leverage financial performances.   This study should be able to encourage and assist managers to make efforts to improve the points where they might be able to affect financial performance.

4.6. Conclusion

Through our survey on Indonesia's supply chain companies, we have found that while internal information integration plays a significant role in and has a direct effect on financial performance, there is still no significant relationship with information technology support. The research suggests that although internal information integration leads to better information integration between suppliers and customers, the relationships between information integration for suppliers and customers do not significantly increase. But even without such significant support, customer services can have a positive *t*-value to financial performance.

The results imply that there is still a lot of room for improvement within this area, and that financial performances can be further improved in this regard. Limitations of this paper can be seen as lying within the sampling technique, data collection and methodology. The sampling technique applied has limited the possible responses for the study, thus resulting in the poor

response rate for the study. Furthermore, data collection through online surveys presents difficulties in ensuring that it is the person in charge who actually takes the survey, since there is a possibility PICs assigns somebody else to help them.As well as ensuring the commitment of such high level respondents in participating within the online survey. From methodology perspective, this study should consider applying more than one model in order to determine the best model fit for Indonesian supply chain integration practice.

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