Cash Flow and Supply Chain Relationship in New Product Quality in Auto Industry

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Abstract
Purpose: The purpose of this study is to know how both the relationship quality between buyer and supplier(s) and financial flow of each firm affect the product quality, and to know whether the relationship between relationship quality and financial focus of buyer on either customer or supplier exists.
Design/Methodology/Approach: The multiple regression and Mean comparison are used to analyze by using archival data.
Findings: The expected finding is that the buyer's payment policy toward suppliers is significantly related with the relationship quality from the perspective of suppliers, and that the relationship quality is one of the critical factors that affect product quality, as consistent with existing studies.
Originality/Value: The study reemphasizes the importance of the relationship in supply chain in consistent with the financial flow.

Keyword: Supply Chain Relationship, Quality, Cash Flow, R&D intensity, National Comparison, Archival Data
Paper type: Research Paper

1. Introduction

Highly turbulent and competitive environments amplify the importance of supply chain management, which refers to the increasing intensity of the competition of "supply chain vs. supply chain" not "firm vs. firm". In order to cope with constant technological changes and shifts in customer interests, most firms need more resources, such as capabilities, knowledge, and physical assets. To overcome resource scarcity, the involvement of supplier(s) has been recognized as one of the necessary factors (Primo and Amundson, 2002).

Furthermore, this turbulent environment has continuously required new products. The creation of new products results from the accumulation and utilization of a firm's knowledge. That is, knowledge of a historically path-dependent fashion is one of the critical resources for new product development (Mowery et al., 1996). Such a characteristic of knowledge development causes a firm itself to have limitations when trying to widen the scope of knowledge needed to develop new product. Firms establish their own networks, including supply chain networks, to act as sources of new knowledge. Thus, reaping necessary knowledge from other firms, including supplier(s) within or outside of its network, is key to surviving in the market, and will allow a firm to introduce an effective new product on time and with high quality (Duysters and de Man, 2003).

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The critical issue in the process of new product development (NPD) is how to find effective supplier(s) and how to quickly and effectively cooperate with the supplier(s) for the efficient exchange and transfer of technological knowledge. Regarding the involvement of supplier(s) in the NPD, potential problems affecting the relationship with the manufacturer might result from different resources, capabilities, cultures, and knowledge bases among involved firms. Most scholars have agreed that even when different firms are integrated to develop a new product, a sound relationship between the two firms, including the improvement of trust, would significantly influence the success of NPD.

Present studies related with new product development have been broadly conducted by exploring the relationship quality with suppliers (Primo and Amundson, 2002), the quality and costs of product, development speed (Petersen et al., 2003; Petersen et al., 2005, Ragatz et al.,1997), human resource management (Fawcett et al. 2005; Wynstra et al., 2001), and the leverage of capabilities (Deeds et al., 1999). Until now, most studies from various disciplines have focused on how the relationship quality between buyer and supplier(s) affects a firm's performance, particularly in regard to financial performance and operational competiveness factors, such as cost, quality, and delivery from the buyer's perspective. However, as many firms depend on supplier(s) to overcome scarcity of resources including technological knowledge and capabilities, the operational performance of the supplier significantly affects the buyer' performance. Although many studies on supplier(s) and NPD have been conducted, there seem to be a gap in examining the financial flow between buyer and supplier(s). This might be an important factor that affects both the relationship quality and the processes involved in better product quality.

Automotive companies which are considered in this paper make up a mature industry. They regularly and aggressively release new models with both incremental and radical changes to compete with competitors. The approach of these firms is associated with the balance of the scope and depth of knowledge to keep customers satisfied (Katila and Ahuja, 2002). In order to design and produce new models, highly complex processes and production designs are required via the support of suppliers. In order to meet this challenge, these companies have focused on improving quality of relationships with Tier-1 suppliers. Also, largely adapting the lean system, auto companies have focused on the management of suppliers as one of competitive advantage (Maloni and Benton, 2000).

The purpose of this paper is to examine whether the focus of the cash flow of the buyer on either supplier(s) or customer(s) affects the quality of product and the quality of relationships with supplier(s).

The rest of this paper is organized as follows. In the next section, I provide hypotheses based on the resource-based view. In the third section, the research methodology to test suggested hypotheses and the results are provided. And, this paper ends with the conclusions, managerial implications, and limitations.

2. Theoretical Background and Hypothesis Development

According to the Resource-Based View (RBV), resources with inimitable, valuable, rare, and un-substitutable attributes provide a firm with a competitive advantage (Barney, 1991). As one such resource, the relationship with suppliers as an intangible resource allows the firm to stand out among competitors, along with the improvement of process. A firm with higher relationship capability will have a smooth exchanging process regarding higher-level technology, indicating tacit knowledge (Kotabe et al., 2003).

In addition, the financial stability of a supplier facilitates smooth processes with focal firms, which are also directly linked to of the creation of a new product. Conversely, even minor problems resulting from one supplier negatively affects the buyer' performance (Hendricks and Singhal, 2003). Thus, the stability of suppliers in the operational process is associated

with the overall stability of the buyer, affecting speed in the process of NPD and the quality of new products.

2.1. Financial Relationship of the Supplier and Product Quality

Recently, financial pressures on U.S. automotive firms such as Ford, GM, and Chrysler have indirectly shown that firms with financial difficulties also affect the well-being of suppliers. In a similar vein, corporations such as Wal-Mart recently have tried to support the financial stability of suppliers by using outside financial institutions (O'Connell, 2009).

Smooth and fast payments to suppliers from the buyer allow suppliers to operate efficiently, and that in turn is associated with the inflow of products to the focal firm. Such payments to supplier(s) and customer(s) are shown in firm's financial statements as Accounts Payable and Accounts Receivable. Such accounts can be represented as average days for each account. Account Payable Periods represent as "the number of days between the purchase of an input from a vendor and cash payment to that supplier" and Account Receivable Periods as "the number of days between sale of a product and the receipt of a cash payment" (Hofmann and Kotzab, 2010). Overly long account payables periods (APP) mean that suppliers would have problems in operating due to the shortage of cash, while the buyer may possess available cash to operate its own process in the short-term. In sum, deferred cash inflow to supplier(s) from customer(s) would affect supplier's processes to conduct research and development process in the long term as well as its production process in the short term.

Buyers achieve useful knowledge resources by interacting with suppliers, and that may be manifested in the speed of NPD process and the quality of the product (Roy et al. 2004). The quality of the knowledge transfer between supplier and buyer results from the relationship quality, based in turn on the buyer's relational capability (Kotabe et al. 2003). However, from the perspective of suppliers, inflow of cash from the buyer would be more important for business than the maintaining or improvement of relationship quality, even though the buyer may provide business opportunities to the suppliers. In the studies related with the relationship between the duration of payments and customers, Pike and Cheng (2001) find that slower payments from customers are related with poor relationship with supplier(s). On the other hand, the buyer would more focus on the relationship with its customers when it delays account receivable periods (ARP). Even though longer receivable periods may harm the buyer's operations, they are meant for customers' convenience.

It can be summarized that a longer APP may negatively affect the efficiency of supplier(s), while a longer ARP may be utilized for the convenience of customers. Generally speaking, from the perspective of the main firm, both the relationships with its supplier(s) and with its customers should be simultaneously emphasized. The greater the difference between APP and ARP, the greater the extent of focus on either supplier(s) or customer(s) may be differentiated, indicating that the quality of relationships with supplier(s) and customer(s) is distinctly different. Therefore, the following hypotheses are suggested:

H1) A firm with relatively an APP less than an ARP will positively affect the quality of a product.

H2) A firm with relatively an APP less than an ARP will positively affect the quality of a relationship with its suppliers.

2.2. The Relationship with Supplier and Product Quality

In the process of product development, the involvement of suppliers is common, due to the typical scarcity of the buyer's capabilities and resources against costs and time. When a supplier is involved, there may be potential problems as well as benefits. Many studies have

agreed that the supplier's involvement reduces costs and time and increases the quality of products (ex. Ragatz et al., 2002). On the other hand, the involvement of a supplier may require increased managerial resources and integration costs for the buyer. Also, if many suppliers are involved, this may lead to overload of information, which might cause problems for the focal firm's own processes (Dittrich et al., 2007).

Kotabe and Swan (1995) suggest that cooperating firms that fail to balance each other's demands will be limited in their ability to be innovative. In addition, Primo and Amundson (2002) state that uncooperative attitudes between firms harm the process of new product development. Petersen et al (2003) found that different corporate cultures posed one of the problems when trying to integrate a supplier into the process of product development.

More recent studies found that a firm, to overcome the scarcities of resources and capabilities, needs to balance the advantage and disadvantages stemming from the involvement of suppliers. However, due to current market conditions such as the technological change, involvement of suppliers in NPD has been used as a means to survive. The solution lies in "how" to efficiently involve suppliers rather than "why." That is, it is not a question of whether to form a relationship, but to improve the relationship.

Barratt (2004) lists four elements for successful collaboration, which is also critical for the development of NPD: 1) A collaborative culture to support collaboration, 2) external and internal trust for long-term stability, 3) mutuality for win/win outcomes of partners, and 4) information execution for the improvement of performance.

In order for a manufacturer to absorb and apply a supplier's technological knowledge for NPD, the socialization process between supplier and manufacturer is important. This is because a supplier's technological knowledge is close to tacit knowledge, which is not easy to transfer and learn (Nonaka, 1994). The relationship between firms plays a key role in improving the effects of the socialization process. In sum, the improved relationship quality between buyer and suppliers positively affects the transfer of technological knowledge and of smooth processes. That improvement would be reflected in the quality of the new product. Thus, the following hypothesis is suggested:

H3) The buyer's relationship with a supplier is positively related with the quality of a new product

Based on the suggested hypotheses, a conceptual model is shown in Figure 1.

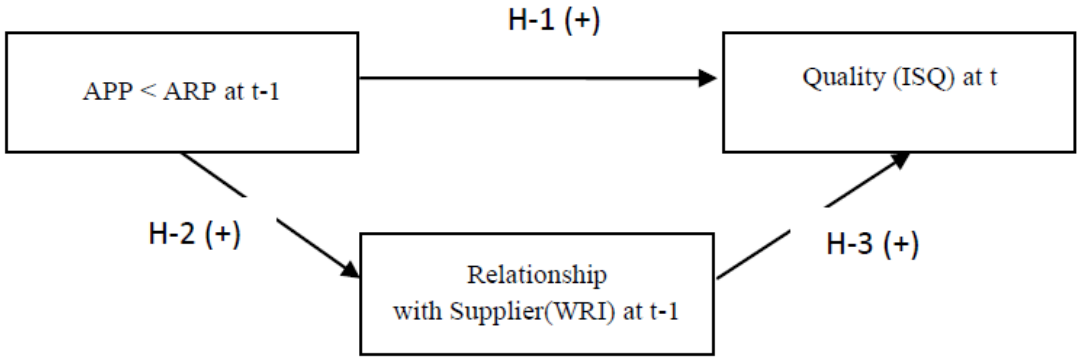

Figure 1: Conceptual Model

3. Methodology and Results

3.1. Data Source:

Planning Perspectives (PPI, www.ppi1.com) has performed an annual in-depth analysis for the relationship between Tier-1 supplier and manufacturer from six North-American Automotive companies.

The relationship with a supplier is achieved from Planning Perspectives, Inc. (PPI). Since 2002, PPI has conducted studies and released a working relationship index (WRI) indicating the relationships with Tier-1 suppliers for the six major automotive companies: GM, Ford, Chrysler, Toyota, Honda, and Nissan. Recently, PPI has included German Automotive companies in Annual WRI survey. The results of WRI have been quoted in highly reputed news sources such as Industry Week and Forbes.
To measure the quality of new product, the Initial Quality Survey (ISQ) of J. D. Power is used. J. D. Power has periodically announced its analyzed results for the quality of new produced product. The results of J.D. power have extensively used in other disciplines such as Marketing and Strategy.
The financial information for manufacturers including APP and ARP has achieved from COMPUSTAT.
The total sample size is 54 for six firms except European companies from 2002 to 2010.

3.2. Variables:

1) Quality of New product: The data for the quality of a new product is achieved from the Initial Survey Quality (ISQ) conducted by J.D. Power. ISQ represents the quality after three months for a new model, and a lower ISQ means that the surveyed model has fewer defects. In this study, even though each firm has a different brand name, the combined data relevant to each parent firm (eg. Lexus is included in the Toyota brand) is used. This study uses averaged ISQ scores based on major brands. The value of lower ISQ represents that the quality of the product show less defects.

2) WRI (Working Relationship Index): The range of the index is from 0 to 500, with 500 representing the best relationships from the perspective of supplier(s). Since this variable is the survey on prior year, I assume that WRI of prior year affect the product quality on next year.

3) RAT: In order to acknowledge whether certain firm has preference on either customer(s) or supplier(s), variable "RAT" is created, which is ratio of ARP to APP. Higher ratio indicates that the firm allows more days for customer(s) to do payments. On the other hand, this represents that the firm has longer payments periods to supplier(s). In order to achieve APP, the accounts payable (AP) and cost of goods sold (COGS) are achieved from Compustat and the following formulation is used:

$$\text{APP(Account Payable Period)} = \frac{365}{\text{APT}}$$

$$\text{Where Account Payable Turnover(APT)} = \frac{\text{COGS}}{\text{AP}}$$

Also, in order to achieve ARP, the accounts receivable (AR) and net sales are achieved from Compustat and the following formulation is used:

$$\text{ARP(Accont Receivable Period)} = 365 * \text{ART}$$

$$\text{Where Account Receivable Turnover(ART)} = \frac{\text{Account Receivable}}{\text{Sales}}$$

4) R&D as control variable: R&D activity of firms contributes on the improvement of quality and the release of new product. Since R&D activity often holds higher uncertainty with higher investment, higher R&D activities within firm would negatively affect the payment periods to supplier(s). This may cause that the relationship with supplier(s) would

be negatively affected while the quality of products is improved. R&D intensity is achieved by using logarithm of R&D expenditure divided by number of employees.

Table1: Descriptive Statistics and Pearson Correlation

N=54	Descriptive Statics				Correlation			
	Minimum	Maximum	Mean	Std. Deviation	ISQ	WRI	RAT	R_D
ISQ	87.50	156.00	118.10	13.66	1.00			
WRI	114.00	415.00	254.35	89.09	-0.57**	1.00		
RAT = $\frac{ARP}{APP}$	0.23	6.26	2.84	1.53	0.14	-0.43**	1.00	
R&D	2.74	3.54	3.19	0.22	-0.61**	0.47**	-0.31*	1.00

*: p<0.05, **: p<0.01

3.3. Result

The overall sample size is 54. Table 1. shows that there is significant relationship between WRI and ISQ (p<0.01), indicating better relationship with supplier(s) is positively related with the quality of new product.

The relationship between RAT and ISQ show insignificant, indicating that Hypothesis-1 is not supported.

The negative relationship between RAT and WRI shows significance (p<0.01). This represents that as a firm shows quick payments to supplier rather than from payments, a firm has better relationship with its supplier(s). Thus, Hypothesis -2 is supported.

In the case of R&D intensity, this variable shows significant relationship with all other variables. Specifically, variables, ISQ and RAT, have significantly negative relationship with R&D intensity (respectively, p<0.01 and p<0.05). This implies that as a firm focuses on its R&D activities, the firm may need to occupy more financial resources while the quality of the product is improved. However, in order to achieve the better relationship with supplier(s) for better product, firms attempt to shorten their payment periods (APP) to supplier(s). Thus, by shortening their payment periods to supplier(s) rather than the inflow of cash from customer(s), the relationship quality with supplier(s) become better and this causes the quality of new product to be better. Further results will be shown throughout regression analysis.

In order to identify whether national factor exist before regression analysis, the mean difference of U.S. firms and non U.S. firms are compared and shown in Table 2 which also provides the comparison of all firms.

Table 2: National Comparison

	U.S. firms vs. non U.S.			Six Firms
	Mean		F-value	F-value
	U.S.	Non U.S.		
ISQ	125.61	111.10	23.07**	10.39**
WRI	177.48	334.56	163.21**	72.54**
RAT	3.51	2.12	12.79**	12.79**
R&D	3.11	3.27	8.26**	10.50**

** : P< 0.01

The results from mean comparisons for all variables show that U.S. firms and non-U.S. firms show significance difference ($p<0.01$). This result shows that Non U.S. firms show better performance in both the quality of new product and the working relationship with their supplier(s) rather than U.S. firms. And, it shows that U.S. firms provide preference in payments for their customers rather than quick payments to suppliers. Also, in the comparison of the R&D spending based on their size, U.S. firms less spend than Non U.S. firms.

In order to overall relationship among variables, the model for this study is provided in following;

$$\mathbf{ISQ_t} = \beta_0 + \beta_1 \mathbf{WRI_{t-1}} + \beta_2 \mathbf{RAT_{t-1}} + \beta_3 \mathbf{R\&D_{t-1}} + \varepsilon$$

(Basic Model)

The overall results for the regression model are shown in Table 3.

Table 3: The results of Regression

Independent Variables	***Dependent Variable(ISQ)***		
	Model 1	***Model 2***	***Model 3***
R&D intensity	-0.61**	-0.44**	-0.472**
WRI		-036**	-0.442**
RAT			-0.204†
R-Squared	0.37	0.48	0.51
Adjusted R-Squared	0.36	0.46	0.48
F-value	31.75**	23.84**	17.78**

** : $p< 0.01$ and † : $p<0.10$

All assumptions for regression analysis are not violated. Also, since the maximum value of VIF shows 1.46, multicollinearity is not problematic.

The regression results supports Hypothesis 3($p<0.01$). However, the results do not support Hypothesis 1 and 2 which represent that the relative quick payments to supplier(s) do not directly affect the quality of new product.

Overall regression results represent that rather than the effect via quick payments to supplier(s), both the relationship quality of supplier(s) and R&D intensity of a firm strongly affect the level of the quality. This can be interpreted that as a firm focused on its R&D activities for NPD, the quality of new product may have fewer defects. Additionally, the working relationship with supplier(s) plays a significant role to produce better products. Also, although the shortening APP positively affects the relationship quality with supplier(s), its effects on the quality of new product is less than both R&D activity of a firm and relationship quality.

In addition, in order to detect whether RAT and ISQ throughout WRI, mediation test is conducted by using steps which is suggested by Baron and Kenny (1986). The results of the mediation test were not significant, indicating that the payment to supplier(s) is associated with not the quality of new product but the relationship quality with supplier(s). And, the better relationship quality positively affects the quality of the product. The overall results showing the relationship between variables are presented in Figure 2.

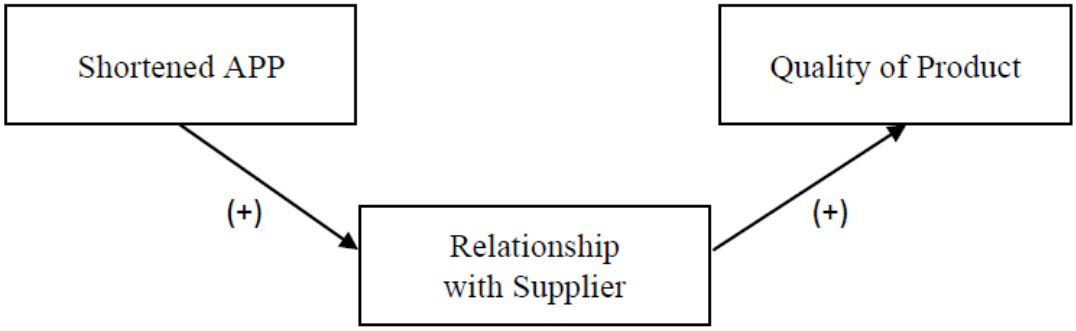

Figure 2: Regression Results

4. Conclusion

Most firms adopt knowledge from other firms, including suppliers, and apply that knowledge to a new product. In particular, firms involved in the mature automotive industry have strongly struggled to differentiate their new products from those of competitors. The complicated process involved in creating a new product has spurred firms to increasingly depend on outside firms. During such a process, cash flows to suppliers become a critical component that affects the relationship quality, as the results of this study have shown. In this study, a buyer's relationship with supplier(s) has been re-emphasized in terms of the quality of a new product, along with whether the financial focus of the buyer is on either customer(s) or supplier(s).

Specifically, this study attempted to discover the relationship between the quality of new products and relationships with suppliers by using publically available data. The result from this study reconfirms that the relationship quality with supplier(s) is positively associated with the quality of the product. And, it is shown that the prompt payment of a firm to its supplier(s) is associated with the improvement of relationship quality with supplier(s).

Recently, many firms have tried to maintain the financial stability of their suppliers as one way to mitigate possible supply chain disruptions. Also, buyers have tried to overcome their limited knowledge resources by drawing on inter-firm relationships, such as strategic alliances or supply-chain relationships. To do so effectively, and to create successful new products with high quality, the relationship quality with supplier(s) is critical factor. It is shown in this paper that the shortening of payment period to supplier(s) is important factor to improve the relationship quality. And, with such payments to supplier(s) and relationship quality, this study shows that the R&D of a firm is important factor for the new product development with better quality.

In addition, this paper shows the comparison between U.S. and non U.S. firms. In the comparison of country between U.S. and non U.S., non U.S firms have show higher relationship with their suppliers. Also, those firms show the shorter payments to their suppliers and more R&D intensity, resulting in better quality in new product. In the case of R&D intensity, according to Womack et al. (1991), non U.S. firms in the later 1980 shows less R&D investment rather than U.S. firms. Their strength in better quality and more new products comes from with the relationship with their suppliers. However, in this study, while the relationship quality has been better, non U.S. firm in investments in R&D show higher than U.S. firms. This implies that the market success from current automotive industries is initiated from the balance between the internal factor (such as R&D) and external factor (from Suppliers) of a firm. Either one of them cannot be ignored. One of factors to balance them would be the payment policy to suppliers as well as the establishment of trust.

This study has several limitations. Small sample sizes in certain industry would not be easily generalized in other industries. The data associated with the measurement of the relationship quality was limited to publicly available archival data, even though the importance of relationship quality has been widely acknowledged. Also, ARPs and APPs from financial statements of firms included all associated customers and suppliers. Yet, an APP associated with a tier 1 supplier might be different from that associated with other suppliers. The initial assumption of this study was that APPs to all supplier(s) would be similar.

Future research should consider both ARP and APP as components to measure operational efficiency along with inventory turnover ratio, called cash-to-cash cycle (CCC), connecting financial flows within and outside of the firm. Different firms will have significantly different CCCs, even among major companies. APP associated with a supplier would be related to the supplier's operational performance. Many small suppliers have limited financial capability. That financial capability would be related to the buyer's future operational performance. Recently, the recognition of supply chain financing has been altered from reflecting strengthening of financial stability from buyer to both buyer and supplier(s). A study on the relationship between APP and ARP with a broader range of industries would help fill the research gap regarding the financial focus between supplier(s) and customer(s) from the perspective of buyers by helping firms learn how to balance ARP and APP as well as improve operational efficiency.

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