Abstract Number: 011-0492

# The Cumulative Model of Competitive Capabilities: an Empirical Analysis in Thai Automotive Industry

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POMS 20th Annual Conference Orlando, Florida U.S.A. May 1 to May 4, 2009

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# ABSTRACT

Based on the competitive priorities theory, the relationship among competitive capabilities has been recognized as an important element of operations strategy. This paper analyzes the five competitive capabilities with the data come from 151 firms from 1<sup>st</sup> tier suppliers and automakers in Thai automotive industry. The confirmatory factor analysis, correlation analysis and multiple regression analysis are conducted. This paper concludes that (1) There are positive correlations among elements of five competitive capabilities. (2) The descending importance order of them is product quality, delivery, product innovation, production flexibility, and production cost. This order is somewhat consistent with the cumulative model. This study adds a new knowledge to the operations management by investigating the relationships and fills the gap in the literature on cumulative model. As a result, it takes the next step of trying to not only examine but also strengthen the relationships in the previous cumulative model.

**Keywords:** Operations strategy, Competitive capability, empirical study, automotive industry, Thailand

## INTRODUCTION

In today's business, creating new forms of competitive capability has become a main concern for management as the business environment continues to change rapidly and unpredictably. Based on this challenge, an effective manufacturing strategy must take into account the competitive capabilities of the firms over the competitors. In practice, competitive capability is usually reflected in its superiority in production resources and performance outcomes (Day and Wensley, 1988). These competitive capabilities must also be first identified and evaluated to achieve a firm's strategic goals. In relation to operations management, Skinner (1985) stated that certain competitive capabilities such as cost, quality, and time which can be used as the competitive weapons. Based on the work of Skinner, many scholars have suggested that the relationship between competitive capabilities is an important element of operations strategy formation (i.e. Ferdows and Meyer, 1990).

After having reviewed the literature in operations strategy and competitive capabilities, two opposing concepts emerge: (1) Trade-off model and (2) Cumulative model. First, the trade-off model argues that one manufacturing capability can only be improved at the expense of other capabilities (Skinner, 1974). For example, producing on a lower cost would only be possible with a decree in quality. This is because a plant that is supposed to provide a high level of all capabilities will suffer from a high level of complexity and confusion (Skinner, 1985).

As discussed in cumulative model perspective, modern manufacturing systems allow for improvement in more than one manufacturing capabilities which in a general way states that improvement in certain capabilities can amplify certain other capabilities (Schmenner and Swink, 1998). In this perspective, the sand-cone model by Ferdows and DeMeyer (1990) provides a distinct approach to explain relationships between competitive capabilities. The capability to produce at a low cost could be supported by achieving good performance on other capabilities. Thus, depending on the sequence and the emphasis placed on the improvement of different capabilities, successful sequences of supportive strategic capabilities are so-called "performance improvement paths" (Clark, 1996: and Hayes and Pisano, 1996). Many world-class manufacturing enterprises have developed various ability of enhancing the competitive capability, so the competitive capability is mutually repellent. Thus, this study involved an empirical test of the cumulative model in competitive capabilities. The focus of this study is on competitive capabilities that are cumulative, rather that trade-off. In fact, it is not just the replication to the previous studies conducted by Amoako-Gyampah and Meredith (2007), Größler and Grübner (2006), Flynn and Flynn (2004), and Ferdows and De Mayer (1990), but this study is more as an addition to their studies in order to extend the theory testing in cumulative model in Asian context that has not been fully investigated.

#### LITERATURE REVIEW

#### Competitive Capability

Intense global competition and dynamic markets are creating a complex and uncertain environment. These changes are causing customers to expect the new, highvalue, and high quality products and services. To remain competitive, a firm should focus on competitive capabilities that have an external-customer orientation and manifest the relative strength of the firm against its competitors (Koufteros et al., 2002). According to Porter (1980), competitive capability is the extent to which an organization is able to create a defensible position over its competitors. Moreover, Hayes and Pisano (1996) suggest that capabilities are activities that a firm can do better than its competitors. Giffy et al (1990) point out that the selection of competitive capabilities should be a reflection of the strategic business objectives and should be expressed in terms of primary manufacturing task or order-winning attributes.

Various studies have suggested many different dimensions of competitive capabilities (White, 1996). Wood et al. (1990) examined dimensions of competitive capabilities which focused on the following performance: low price, high product performance, high durability, high product reliability, short delivery time, delivery on due date, product customization, number of features, product cost, conformance to design specifications, improved manufacturing quality, cost, on-time delivery, product cost, quality consistency, quality perceived by customer, and product price. Likewise, Vickery et al. (1993) suggest a list of production competence including product flexibility, volume flexibility, process flexibility, low product cost, delivery speed, delivery dependability, production lead time, product reliability, product durability, quality, competitive pricing, and low price. In these studies, several items are very similar and they offer opportunity for combination (White, 1996). For instance, production lead time can be categorized as the sub-dimension of delivery. Also, it seems reasonable to combine product cost, low price, and competitive pricing under the dimension of cost.

Particularly, the notion of competitive capability is well established in the operations management literature. Being a part of strategic objective, manufacturing strategy has an impact on the development of competitive capabilities (Vickery et al.,

1997; Tracey et al., 1999). Driven by business strategy, a firm sets competitive priorities and develops action plans. As action plans are implemented, manufacturing competencies are developed and these competencies allow a firm to build competitive capabilities that enable them to compete in the market (Koufteros et al., 2002). Corbett and van Wassenhove (1993) point out that competitive capability represent to a great extent of product, place, and price dimensions. Product refers to the physical dimension such as quality. Place includes delivery issues and the availability of products. Price refers to the amount a customer pays for the product or service. Additionally, they state that these measures of capabilities have their counterpart in terms of competencies in the sense that capabilities are outward looking while competencies are inward looking. As an example, the counterpart of price is cost.

Based on the literature review, consensus on the dimensions of the competitive capability exists within the empirical literature. Hayes and Wheelwright (1984) defined this term as price (cost), quality, delivery dependability, and flexibility. Similarly, Ferdows and De Meyer (1990) identified four dimensions: cost, quality, dependability, and flexibility. These dimensions are also described by Cleveland et al. (1989), Wacker (1996), White (1996), Vickery et al. (1997), Li (2000), Bowyer and Lewis (2002). Moreover, Ward et al (1997) extended the number of capabilities to five dimensions including innovativeness. This classification is consistent with the study of Noble (1997). Further studied by Koufteros (1995), five dimensions of competitive capabilities are also viewed as: 1) competitive pricing, 2) premium pricing, 3) value-to-customer quality, 4) dependable delivery, and 5) production innovation.

Based on the previous studies, firm competitive capabilities in this study are further measured based on the dimensions such as product quality, production cost, production flexibility, and delivery. The list of these sub-constructs, along with their definition and supporting literature, are provided in Table 1 below.

--Insert Table 1 about here--

# **Product quality**

The attainment of quality in products and services had increasingly become a major focus in the 1980s (Holcomb, 1994). Flynn et al. (1995) and Anderson et al (1995) point out that quality performance is significantly related to competitive advantage. Moreover, among competitive capabilities, quality has often been cited as the highest competitive priority and a means of competitive performance (Buzzel et al., 1987).

According to Koufteros et al. (2002), product quality is defined as the extent to which the manufacturing enterprise is capable of offering product that would fulfill customer expectations. With the similar concept, Vickery et al. (1997) view product quality as the ability to manufacturer a product whose operating characteristics meet performance standard. Product quality is also defined as fitness for use and includes product performance, reliability, and durability (Tracey et al., 1999).

Indeed, quality performance is difficult to define precisely (Flyne et al., 1995; White, 1996). Garvin (1988) proposed that product quality is actually multidimensional construct with the list of eight critical dimensions. Garvin's list includes: 1) performance (characteristics of product); 2) features (characteristics that supplement the basic functioning of the product; 3) reliabilities (the probability of the product malfunctioning of failing within a specified time period; 4) conformance (the degree to which the product's design and operating characteristics meet standard); 5) durability (the amount of use the customer gets from the product before replacement is preferable to continued repair; 6) serviceability (the speed, courtesy, competence and ease of repair); 7) aesthetics (individual preference for how the product looks, feels, sounds, and smells); and 8) perceived quality (image, brand name and advertising that makes inferences about quality).

Product quality may be measured into two different definitions: 1) manufacturingbased definition, or quality of conformance; and 2) product-based definition, or quality of design (Maani and Sluti, 1990). Safizadeh et al. (1996) empirically measure quality by measuring four variables. Two of the four variables (product performance, number of features on the product) deal with quality level and the physical aspects of product. The two variables make up manufacturing-based definition. The other two variables, including quality consistency and customer perception of quality, relate to the ability to conform to specifications, or product-based definition. Further discussed by Flynn et al. (1994), they suggest that it is difficult to precisely measure the dimensions of the quality construct in an objective fashion. They propose that perceived quality market outcomes focuses on management's perception of the plant's product quality and customer service, relative to its competition. The product characteristics include conformance, reliability, performance and durability, and perceptions of customer satisfaction.

## **Production cost**

Competing in the marketplace based on the cost efficient requires low-cost production. Specifically, inventories have been the focus of cost reduction for manufacturers and are one of the justifications for the just-in-time (JIT) system. To keep manufacturing competitive, firms also have to emphasize materials, labor, overhead, and other costs (Li, 2000). Noble (1997) suggests that cost-efficiency addresses low-cost product, low work-in-process inventories, production flow, reduction overhead, and so forth. Swink and Hegarty (1998) focus on production and transfer cost, and define them as the cost to a manufacturer to make and deliver the product including the cost to return or replace the item if necessary. Moreover, cost capability can emphasize on reducing production costs, reducing inventory, increasing equipment utilization, and increasing capacity utilization (Ward and Duray, 2000).

According to Safizadeh et al. (1996) and Tracey et al. (1999), there is a strong positive relationship between cost and price. In other words, plants with higher costs also tend to charge in higher prices. Likewise, Koufteros et al. (2002) points out that competitive pricing can reflect the ability of firms to compete against their major competitors based on low price.

#### **Production flexibility**

An increasing number of manufacturing managers recognize that achieving low cost and high quality is no longer enough to improve or sustain their firms' competitive advantages (Lau 1996; Lau, 1999). The ability to respond quickly and profitably to customer and market demand is critical to success in the business. Flexibility has received much attention from both researches and manages as a source of competitive advantage (Dreyer and Gronhaug, 2004). Gupta and Somers (1996) found the interrelationship between production flexibility and organizational performance based on the empirical study of manufacturing firms. The result indicated that production flexibility contributed to organizational performance. In addition, Yusuf et al. (2003) suggest that having the ability to vary capacity, respond to rapid changes in demand, mass customize at the cost of mass production is critical in today's business. Narasimhan and Das (1999a) point out that there are four changes that have occurred in the competitive market environment: 1) rapid technological shift, 2) higher risk level, 3) increased globalization, and 4) greater customization pressures. These changes are causing an increasing the level of flexibility required by a company.

In general, extensive studies have defined the concept of flexibility. For example, flexibility is described as the ability of a manufacturing system to cope with environmental uncertainties (Narasimhan and Das, 1999a). According to Li (2002), flexibility is the ability to respond to changes and to accommodate the unique needs of each customer. It can typically imply that the production operating system must be flexible to handle specific customer needs and changes in design. Flexibility is also defined as the ability to change or react with little penalty in time, effort, cost or performance (Upton, 1994). In the narrow sense, Zhang et al. (2003) provide the definition of manufacturing flexibility as the ability of an organization to manage production resources and uncertainty to meet various customer requests.

Similar to quality, flexibility is recognized as a multi-dimensional construct. In addition, researchers do not appear to have reached the level of agreement on its dimensions (Upton, 1994; White, 1996; Koste and Malhotra, 1999; Narasimhan and Das,

1999a; Lau, 1999; Yusuf et al., 2003). However, extensive reviews of manufacturing flexibility such as operational flexibility, product and process flexibility, volume flexibility, and market flexibility can be found in the study of Hyun and Ahn (1992) in which their review focused mostly on the taxonomies of flexibility. In an attempt to clarify, Upton (1994) contended that according to the ambiguity of definition, flexibility can be categorized by three attributes including dimensions, time horizon, and elements. Consequently, the definition of flexibility can be extended and become practical for the business.

In an attempt to reduce the dimensions of flexibility, Cox (1997) suggests the two dimensions of product flexibility and volume flexibility. To be consistent, Hill (1994) lists volume flexibility as 'demand increase' and product flexibility as 'product range' as the only two dimensions of flexibility. Moreover, based on the list of Sethi and Sethi (1990), the literature on manufacturing flexibility can be classified into a hierarchical set of distinct flexibilities. At the basic level are the components of operational flexibility: equipment flexibility, material flexibility, routing flexibility, material handling flexibility, and program flexibility. These cumulative impact the development of tactical flexibilities (production flexibility): mix flexibility, volume flexibility, expansion flexibility, and modification flexibility. The highest level flexibilities consist of long term, strategic flexibilities that relate to marketing and corporate competitiveness: new product flexibility, and market flexibility (Narasimhan and Das, 1999a).

Previous researches have attempted to provide an overview of the relationships among different levels and dimensions of flexibility. For example, Narasimhan and Das (1999a) suggest that volume and modification flexibility are found to influence new product flexibility. Moreover, the result of their study can point out that each flexibility may have different drivers, and understanding the relevant relationship is important to implement flexibility program in the organization. Zhang et al. (2003) also develop the instrument to measure flexibility and provide the result indicating the direct and positive relationship between flexibility competence (machine, labor, material handling, and routing flexibilities) and flexibility capability (volume and mix flexibilities). Koste and Malhotra (1998) developed a five –tier hierarchy of flexibility and described relationships among the tiers. These frameworks can explain the contribution of aggregating flexibility from individual shop floor to strategic business unit level.

Based on the previous discussion, this research study will concentrate on production flexibility (plant level flexibility). There is a primary evidence that production flexibility can be influenced by the sourcing strategy and the amount or type of uncertainty which a firm needs to focus. For example, supplier responsiveness to uncertainties in demand and supplier involvement in production processes can enhance volume and modification flexibilities. In addition, sourcing strategy cannot contribute to operational flexibilities, which mainly depend on the setup times or the machine capacities and workers (Koste and Malhorta, 1999; Narasimhan and Das, 1999a). In sum, it is reasonable to state that different levels and dimensions of flexibility are influenced by different strategies.

#### Delivery

In recent years, even as cost and quality have become baselines by which competitiveness is measured, time and delivery performance has turned out to be increasingly important as a vital differentiator. Indeed, delivery performance has become the focal point of many firms' competitive strategies (Fawcett et al., 1997; Lederer and Li, 1997). Kumar and Sharman (1992) also point out that on-time delivery performance can reduce pretax profits by as much as 30 percent, depending on order size and the number of change per order. In an attempt to explain the benefits of delivery time, there are three reasons that the strategic value of time can affect the firm's performance: 1) faster response time commands a price premium; 2) faster delivery of customized products attracts more customers and increases brand loyalty; and 3) accelerated pace of activities in production and logistics process results in higher profitability (Kumar and Motwani, 1995).

By definition, time refers to the totality of time required to perform all activities on a critical path that commences from the identification of a market need and ends with the delivery of a matching product to the customer (Kumar and Motwani, 1995). It has been pointed out that the definition of time-based performance and delivery performance is somewhat different, and both dimensions should not be used interchangeably. To clarify this confusion, Kumar and Motwani (1995) suggest that delivery has somewhat narrower connotations than time since it includes only the post-manufacturing segment of the critical path.

Delivery is defined as competition on the basis of quick and reliable deliveries (Nobel, 1997). When considering the dimensions of delivery performance, Li (2000) suggests that delivery is a time issue, and usually defined in the following aspects: 1) how quickly a product is delivered, 2) how reliably the products are developed and brought to the market, and 3) the rate at which improvements in products and processes are made. Similarly, Wacker (1996) proposes that delivery has three meanings: 1) delivery

reliability or delivery dependability, 2) speed of delivery for current products, and 3) new product delivery. However, recent conceptual work suggests that delivery performance should emphasize on customer service as indicated by delivery reliability and delivery speed (Ward and Duray, 2000). The delivery time for new product should be discussed under innovation and new product design flexibility performance because new product must be delivered within a short time span (Wacker, 1996).

By developing a measurement for delivery speed, Vickery et al. (1997) and Jayaram et al. (1999) define delivery speed as the ability to reduce the time frame between order taking and customer delivery is close to zero as much as possible. Nobel (1997) also measures delivery speed as the ability to delivery a product quickly or short lead time. Moreover, Milgate (2000) evaluates delivery speed by two factors: 1) the average actual time that elapses from the placement of an order until its shipment to the customer, and 2) the time to complete an order from the start of its production to its completion.

Delivery reliability or dependability can be defined as the extent to which the manufacturing enterprise is capable of meeting customer delivery requirements (Koufteros et al., 2002). Li (2002) views delivery dependability as the ability of an organization to provide on time the type and volume of product required by customers. Delivery dependability may also be defined as the ability to exactly meet quoted or anticipated delivery dates and quantities (Vickery et al., 1997.). Based on the previous studies, delivery dependability can be operationalized in the various dimensions. For example, Rosenzweig et al. (2003) measure delivery dependability as the reliability of delivery times (on time), and the ability of firm to promptly handle customer complaints.

Rondeau et al. (2000) and Koufteros et al. (2002) measure delivery dependability as the capability of providing on-time deliveries, and delivering the correct quantity with the right kind of products needed.

#### **CUMULATIVE MODEL AND HYPOTHESES**

Nakane (1986) put forward the cumulative model first. He proposed that Japanese enterprise followed a pre-arrange sequence in the development of competitive capability. Similar to Hall's research, he suggested that manufacturers should pursue a step-wise progression through the capabilities, which are offered as a typical goal progression: quality, dependability, cost, and then flexibility. In other words, firms should first concentrate on the quality before the realization of the progressive capability objective (Hall, 1987). As discussed in cumulative model perspective, modern manufacturing systems allow for improvement in more than one manufacturing capabilities which in a general way states that improvement in certain capabilities can amplify certain other capabilities (Schmenner and Swink, 1998). In this perspective, the cumulative model by Ferdows and DeMeyer (1990) provides a distinct approach to explain relationships between competitive capabilities. The capability to produce at a low cost could be supported by achieving good performance on other capabilities. Thus, depending on the sequence and the emphasis placed on the improvement of different capabilities, successful sequences of supportive strategic capabilities are so-called "performance improvement paths" (Clark, 1996: and Hayes and Pisano, 1996).

Based on the former research of the competitive capability in manufacturing strategy and the cumulative theory, this study concentrates to examine the sequence of cumulative model. This model includes the following two factors: competitive capacity variables (quality, delivery, cost, and flexibility), and the cumulative model. The basic model can see in Figure 1. In other words, this study points out that there are internal cumulative relationship among the competitive capabilities, and establish the framework of the cumulative model in Thai automotive industry context. This study constructs and defines the key elements of competitive capability (product quality, delivery, production cost, and production flexibility), and lays a foundation for the quantitative analysis with verification of the relationship among the competitive capabilities to validate the existence of the cumulative model in Thai automotive industry context.

Based on the formal research and literature, this study develops the following hypotheses to make further investigation on the cumulative model of competitive capability:

Hypothesis 1 (H1): There are correlations between the two elements of competitive capability, and the relationship is mainly positive.

Hypothesis 2 (H2): There are preferential sequences among the competitive capability, and the relationship among them provided greatest competitive importance to product quality.

#### **RESEARCH METHODOLOGY**

# Constructs and survey instrument

The instrument used to test the hypotheses was a mail survey. This study used five-point Likert scale for all constructs to draft a questionnaire. This draft questionnaire then was pre-tested with academics and practitioners to check its content validity and modified accordingly. The modified questionnaire was pilot tested to examine its suitability for the target population before large-scale mailing.

#### Data collection

Empirical data was obtained through a mail survey to managers, who had knowledge of manufacturing capability. These respondents were asked to rate their firms relative to their understanding on product quality, delivery, production cost, and production flexibility. The unit of analysis in this study was limited to plant level. Within this perspective, Flynn et al (1994) point out that most empirical research in operations management occurs at the corporation or individual level of analysis. Moreover, the variables of manufacturing capability usually reflect corporate level practices.

The survey was selected specifically to automotive industry in Thailand because of the following reasons. First, automotive industry is seen as an indicator to measure the wealth of the economy. Second, automotive sector has been a leader in focusing on manufacturing capability in Thai industry. We forwarded the questionnaire with a cover letter indicating the purpose of this study to 403 qualified suppliers and automakers. After six weeks, we received 91 completed responses following 20 questionnaires returned as the second wave. The total 111 responses were returned to the response rate of 27.5 %.

#### Non-response bias

In this study, non-response bias was evaluated using the method suggested by Armstrong and Overton (1977). This method tested for significant different between early and late respondents, with a late respondents being considered as a non-respondent. By using this method, although it did not investigate non-response directly, a comparison was made between those subjects who responded in the first wave and the second wave (Larson and Poist, 2004). A one-way analysis of variance (ANOVA) was used to make the comparisons in demographic variables, namely, number of employee, respondent's position, and number of years in business. Along with the demographic variables, randomly selected variables were also included in this analysis. The results indicate no significant different on any criteria, which the significant level, is far from 0.1. Based on the ANOVA test, non-response bias may not be the problem in this study; and the two waves were pooled for subsequent analysis.

# **The Measurement Properties**

The focus of confirmatory factor analysis is to assess measurement properties and test a hypothesized structural model. A systematic process was used to determine whether items should be eliminated from the measurement considering weak loading, cross loading. Evaluation of the proposed model was made using structural equation models (SEM). All SEM analyses were run using AMOS program. Table 2 presents results of the measurement model. Multiple fit criteria are considered in order to rule out measurement biases. The fit indices considered are those most commonly recommended for this type of analysis (Bagozzzi and Yi, 1998). In this case, all the indices were within the recommendation range.

--Insert Table 2 about here --

In order to perform meaningful analysis of the causal model, measures used need to display certain empirical properties of convergent validity, which illustrates the degree to which individual items measure the same underlying construct. To test convergent validity, researchers can evaluate whether the individual item's standardized coefficient from the measurement model is significant and greater than twice its standard error (Anderson and Gerbing, 1988). Table 3 shows that coefficients for all items greatly exceed twice their standard error. In addition, coefficient for all variables are large and significant provides evidence of convergent validity.

--Insert Table 3 about here --

## RESULTS

## Correlation analysis

In order to test whether the relationship among competitive capability is cumulative or not, this would be basically judged by the positive and negative correlation. In this study, the correlation analysis results are shown in Table 4.

--Insert Table 4 about here-

By the correlation analysis with the factors, this study can get all Pearson Correlation coefficients that are positively significant at the 0.01 level. It means that there are mainly positive relationships between the different competitive capability and they are significant. The positive correlations between the competitive capabilities are the basic characteristics, which form the cumulative relationships among the competitive capabilities. So the hypothesis 1 is proved and supported.

# Multiple regression analysis

For a deeper understanding of the relative importance of multivariate competitive capabilities, this study also employs multiple regression analysis to provide in-depth analysis which proves the cumulative relationship. As shown in Table 5, there are positive standardized coefficients. This notes that the competitive capability elements have positive correlation between each other. This is consistent with the results in Table 4 and also proves the support of hypothesis 1. In addition, this multiple regression analysis is also tested whether product quality was at the foundation of the sequence of cumulative capabilities. There were a total of four cumulative capabilities that include product quality (Table 5). This is more than other capabilities: three relationships included a dimension of production cost, and two relationships included dimensions of delivery and production flexibility. Thus, hypothesis 2 was supported.

--Insert Table 5, 6 about here -

#### Competitive capability importance

To analyze the accumulative relationship of the competitive capability, this study ranks the competitive capability factors with their priority sequence using factor's mean. According to Flynn and Flynn (2004)'s study, this study also ranks the factor by their mean capability and the results are shown in Table 6.

Based on Table 6, according to their factor means, the priority order of competitive capability (in decreasing order) is: product quality, delivery, production flexibility, and production cost. This result is in fact partly consistent with most of the competitive capabilities' cumulative model. As the basic capability, product quality is the first factor, and then delivery was the second basic capability. Having satisfied with the former two capabilities, other capabilities were developed one by one as production

flexibility and production cost. However, for a deeper insights regarding competitive capability ranking, paired sample t-test was used to analyze the factor means significantly different. According to Table 6, there was only one pair relationship that was not significantly different between product quality and delivery. Based on the results from multiple regression analysis, this result also supports the previous findings that product quality seems to be the most important and basic capability for other capability factors. Therefore, hypothesis 2 was confirmed and supported.

#### DISCUSSION AND CONCLUSION

Based on the analysis shown above, there are only positive relationships indicating cumulative capabilities exist within the Thai automotive context. According to the interpretation, these findings are consistent with the studies by Amoako-Gyampah and Meredith (2007), Größler and Grübner (2006), Flynn and Flynn (2004), and Ferdows and De Mayer (1990) who also found supports for the structure of cumulative model in their studies. In addition, in terms of the cumulative capability, it explains that product quality has to be considered as the base capability that supports other capabilities. When a firm has high quality product it may provide better delivery to its customers. According to Phusavat and Kanchana (2007), manufacturers in automotive industry in Thailand still emphasize on quality management, especially quality control to help develop superior product quality. In other words, an overall direction among Thai manufacturers is to use quality as a foundation for formulating other manufacturing strategies. The firms are then developing delivery performance, improving production flexibility, and reducing production cost. In other words, it seems that production cost is ranked in the final level

in competitive capability importance, which shows that the majority of suppliers and automakers in Thai automotive industry still consider production cost as the slightest important competitive capability in automotive industry. Firms have to emphasize on product quality and delivery as the first level priority in the competitive capability in this industry. It is to say that production cost should be developed only after operations achieve good standards in the other competitive capabilities.

As a practical implication, the cumulative relationships among the competitive capabilities help managers understand the effects of the choice of the competitive capabilities. Based on this understanding, the manager also should pay more attention to the practices exploring new effective ways to obtain long-term competitive advantage. Managers should also attempt at developing superior product quality because of the current quality and delivery capability requirement in Thai automotive industry.

However, this study did not find evidence supported the sequence of Ferdow and DeMeyer's (1990) cumulative model (quality, delivery, cost, flexibility). Although this sequence was observed in only automotive industry in Thailand, it seems that Ferdow and DeMeyer's model is far from universal. For example, there is evidence that production cost is the final level. But, it is not necessary that under different contingencies such as industry, country, business environmental uncertainty, and industry maturity will provide the same sequence for cumulative model. Thus, this study could be further in searching for more complex and contingent investigations in to the development of competitive capabilities. Furthermore, this study is limited by the cross-sectional nature of the data. A more thorough analysis would be longitudinal in order to test a sequence model of cumulative capabilities.

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Table 1: List of the Sub-cons	ruct for Manufacturing Capability
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Constructs	Definitions		
Product	The extent to which an organization is capable of		
Quality	designing and offering products those would create		
-	higher value to customers.		
Production	The extent to which an organization is capable of		
Cost	offering low cost product by reducing production		
	costs, reducing inventory, increasing equipment		
	utilization, and increasing capacity utilization.		
Production	The extent to which an organization is capable of		
Flexibility	managing production resource and uncertainty to		
· ·	accommodate various customer requests.		
	*		
Delivery	The extent to which an organization is capable of		
, v	offering the type and quantity of product required		
	by customer(s) with short lead time.		

# Table 2: Results of the measurement model

Fit Statistic	Notation	Model value	Acceptable value
Chi-square to degree of freedom	χ2/d.f	1.13	$\leq 2.0$
Root mean square error of approximation	RMSEA	0.03	$\leq 0.06$
Root mean square residual	RMR	0.04	$\leq 0.05$
Goodness of fit index	GFI	0.95	$\geq 0.95$
Normed fit index	NFI	0.96	$\geq 0.95$
Comparative fit index	CFI	0.99	$\geq 0.95$
Incremental fit index	IFI	0.99	$\geq 0.95$

# Table 3: Measurement Properties

Factor and Scale items	Standardized	Standard	t-value
	Coefficient	Error	
Product Quality			
High performance products that meet customer needs	0.86	a	a
Produce consistent quality products with low defects	0.79	0.09	10.9*
Offer high reliable products that meet customer needs	0.64	0.12	8.14*
High quality products that meet our customer needs	0.66	0.12	8.48*
Delivery			
Correct quantity with the right kind of products	0.76	a	a
Delivery products quickly or short lead-time	0.79	0.10	10.09*
Provide on-time delivery to our customers	0.76	0.12	9.45*
Provide reliable delivery to our customers	0.90	0.09	11.28*
Reduce customer order taking time	0.67	0.12	8.23*
Production Cost			
Produce products with low costs	0.56	a	a
Produce products with low inventory costs	0.72	0.19	6.46*
Produce products with low overhead costs	0.86	0.20	6.73*
Offer price as low or lower than our competitors	0.51	0.19	5.01*
Production Flexibility			
Able to rapidly change production volume	0.56	a	a
Produce customized product features	0.63	0.19	5.06*
Produce broad product specifications within same facility	0.70	0.20	6.55*
The capability to make rapid product mix changes	0.80	0.25	5.97*

\* Significance at the p  $\leq 0.01$  level a Indicates a parameter fixed at 1.0 in the original solution

Table 4:	Pearson	correl	ation	anal	vsis
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Factor	PQ	D	PC	PF
PF	0.314	0.271	0.368	1
PC	0.467	0.454	1	
D	0.525	1		
PQ	1			

All significance at  $p \le 0.01$  level Note: PQ=Product quality, D=Delivery, PC=Production cost, PF=Production flexibility

Competitive capability	Regression analyses			
Independent var.	Dependent var.	Standardized β	Significance	R-square
PQ				
	D	0.362	0.00	0.436
	PC	0.202	0.01	
D				
	PQ	0.418	0.01	0.348
	PC	0.260	0.00	
PC				
	D	0.266	0.00	0.33
	PQ	0.238	0.01	
	PF	0.195	0.01	
PF				
	PC	0.226	0.01	0.236

Table 5: Multiple regression analysis

Note: PQ=Product quality, D=Delivery, PC=Production cost, PF=Production flexibility

Competitive capabilities	Factor means	
Product quality	4.64*	
Delivery	3.99*	
Production flexibility	3.69	
Production cost	3.17	

Table 6: Competitive capability factor mean

Note: \* Not significantly different between Product quality and delivery



