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Impact of value chain activities on quality and innovation

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Abstract

Purpose – This paper aims to explore the extent to which four elements of the value chain – marketing, research and development, procurement, and operations – are associated with product quality and product innovation.

Design/methodology/approach – A survey of 194 managers of Australian firms, and multivariate analysis using structural equation modeling was used to test the hypotheses.

Findings – The elements of the value chain differ in their association with product outcomes. Marketing and production are related to product quality, but surprisingly while research and development is related to product innovation, marketing is not. Procurement is related to both product quality and product innovation.

Research limitations/implications – The paper shows that individual elements of the value chain are related to specific competitive strategies and how these elements are related to each other, suggesting the need to direct effort within the firm for better, targeted performance. The results are limited by the sample size and geography of the survey.

Practical implications – Specific value chain functions tend to be associated with specific performance outcomes. This suggests that managers might gain by targeting specific elements of the value chain as their organizations strive for specific competitive goals.

Originality/value – This paper seeks to help managers and decision makers to assess the relationship between the different attributes of the value chain and product quality and innovation. It is often not feasible for managers to emphasize all the elements of the value chain simultaneously, and this paper provides an important step in looking at these individual linkages.

Keywords Value chain, Quality, Innovation, Australia

Paper type Research paper

Introduction

Porter (1985) argues that firms that optimize their value chain activities *vis-à-vis* competition stand a better chance of leveraging valuable capabilities into sustainable competitive advantage. In short, performing value chain activities in ways that would allow a firm the capabilities to outmatch rivals is a potential source of competitive advantage. However, it is unclear if all value chain activities are equally important as firms strive toward specific strategic goals. In order to understand the elements of the value chain, it is important to first understand the resources and abilities that create these underlying elements of the chain. The resource-based view (RBV) of the firm

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maintains that when firms have resources that are valuable, rare, inimitable, and non-substitutable, they can achieve sustainable competitive advantage by implementing value-creating strategies that cannot be duplicated by competitors (Barney, 1991; Eisenhardt and Martin, 2000; Peteraf, 1993; Prahalad and Hamel, 1990; Teece *et al.*, 1997; Wernerfelt, 1984). Thus, the resource model holds that the differences in resources, which other firms may not be able to acquire or easily duplicate, and the particular way in which they are used within a firm, form the basis of competitive advantage.

A number of scholars have extended the RBV to include the concepts of competencies, capabilities, and dynamic capabilities. This extension maintains that the local abilities possessed by a firm or "competencies" must be viewed as resources and are fundamental to the competitive advantage of a firm. Although, the term competence has appeared in the strategy literature for well over 40 years, to date there is still confusion regarding its interpretation. The difficulty arises with the lack of clear definitions regarding terminology usage. Andrews (1971) and Ansoff (1965), as well as many other contemporary academics, have used the terms competence and capability interchangeably. According to Hamel and Prahalad (1994), a competence is a bundle of skills, aptitudes or technologies that enable a firm to deliver a particular benefit to customers. Unlike a single discrete skill or technology, these authors posit that a core competency represents the sum of learning across individual skills and individual organizational units. As such, these authors argue it is improbable for a core competence to reside in a single individual or team.

Hitt *et al.* (1996) define a capability as the capacity for a set of resources to integratively perform a task or an activity. In other words, a capability represents a firm's ability to deploy resources that have been purposely integrated to achieve a desired end state. These authors further contend that core competencies are resources and capabilities that serve as a source of competitive advantage. Teece *et al.* (1997, p. 516) suggest that "when firm-specific assets are assembled in integrated clusters spanning individuals and groups so that they enable distinctive functions to be performed, these activities constitute organizational routines and processes" and thus constitute organizational competencies. Furthermore, dynamic capabilities have been defined by some researchers as the antecedent organizational and strategic routines by which managers alter their resource base – acquire and shed resources, integrate them together, and recombine them – to generate new value creating strategies. As such, they are the drivers behind the creation, evolution and recombination of other resources into new sources of competitive advantage (Eisenhardt and Martin, 2000; Henderson and Cockburn, 1994; Teece *et al.*, 1997).

Although many of these contemporary researchers are focusing on integrating resources, abilities, activities and routines, the terminology remains inconsistent at best. Thus, in an effort to provide consistency throughout the scope of this research and in light of the confusion surrounding the conceptual similarities between the competence and capability constructs, this paper will utilize the term capability to refer to organizational routines and processes, and core competencies as the combination of resources and capabilities that serve as a source of competitive advantage. A firm starts with a capability and it is nurtured and combined with other resources to become a competence. If and when this competence becomes the cornerstone of the firm's competitive advantage, it is then considered a core competence.

The link between competences and the value chain is relatively straightforward. Porter (1985) argues that, a firm's value chain is the sum total of linked activities that a firm executes internally to achieve performance. In short, performing value chain activities in ways that would give a firm the capability to outmatch rivals is a potential source of competitive advantage.

The value chain concept as postulated by Porter (1985) suggests that achieving competitive advantage begins with an effort to develop deeper organizational expertise in performing certain competitively critical value chain activities, deliberately attempting to harness those capabilities that strengthen the firm's strategy and competitiveness. As one or more of these capabilities become the cornerstone of a firm's strategy and more resources are then placed in building greater proficiency in performing these activities, eventually the targeted capabilities may become a sustainable core competency for the firm. In this regard, numerous examples abound. For instance, Honda, Intel, and Du Pont are well known for their exceptional research and development competencies. Similarly, Sony, Black and Decker, and Toyota are noted for their excellent manufacturing competencies while Gillette has been praised for its effective promotion of branded products, and Wal-Mart for an effective distribution system. It is useful to note, however, that a common criticism of the value chain is that it is more easily codified in manufacturing as opposed to service industries. Moreover, an effective value chain analysis results in the identification of new ways to perform activities to create value. Because these types of innovation are firm specific – that is, they are based upon the firm's unique way of combining its resources and capabilities – they are often difficult to interpret and measure (Hitt *et al.*, 1996). The present study addresses this shortcoming by directly focusing on measuring these competencies and capabilities in a way that is consistent with theory.

Several studies have also linked Porter's work and value chain activities to firm performance (Hines (1993)). Early strategic management research (Hitt and Ireland, 1985; Snow and Hrebiniak, 1980), utilizing the term distinctive competency, have developed pioneering measures based on the effectiveness in the functional areas (general administration, production/operations, R&D, marketing, finance, personnel, and public, and government relations), and used financial measures of performance. Hitt and Ireland's (1985) results of 185 *Fortune* 1000 firms from four industries found a significant relationship between corporate distinctive competencies and firm performance. Further, Acar (1993) empirically examined the relationship between functional competencies, strategic choices, and firm performance among a sample of 96 small Turkish casting and machinery manufacturing firms and found that competencies in terms of technology, procurement management, and sound accounting practices accounted for 61 percent ($p < 0.001$) of the variance in the growth rate of a firm.

No doubt, value chain activities are key to achieving competitive advantage. However, despite the popular notion that best-in-industry proficiency in performing value chain activities may yield competitive superiority, empirical work on the role of the different value chain activities is still emerging. Indeed, it remains unclear how core competencies developed in the individual elements of the chain are related to the generic strategies adopted by the firm. For example, if a firm strives to position itself through industry leading quality, on which element(s) of the chain should the firm focus its resources and effort to achieve such goals? Similarly, on which elements of the

chain would it be most beneficial to focus resources for firms seeking to differentiate through innovation? Poorly aligned decisions (and the associated misallocation of resources) may result in the firm striving for one set of objectives while investing to build competencies in another area, thus undermining the true goal. Hence, it is imperative that firms recognize which elements of the chain are associated with specific organizational metrics.

There are many elements of the value chain. As noted above, the value chain is concerned with the marketing, design, production, delivery, and support of a product or service. This empirical study captures a subset of these elements, each corresponding to one of these activities. In this paper, we examine marketing, R&D (corresponds to design in the above framework), production processes, and supplier management (corresponds to delivery/support). While the list of value chain elements included in the study is clearly not exhaustive, the research design does capture a sense of the breadth of activities in the chain. The study examines the extent to which product quality and product innovation are associated with these four critical elements of the value chain. Next, the study determines their contribution to a firm's performance. We posit that firms which focus on optimizing and integrating organizational expertise in performing certain competitively important value chain activities are more likely to gain superiority over rivals, and thus are able to achieve sustained competitive advantage.

The rest of the paper is organized as follows. We review the literature as background to the development of some of the hypotheses. Next, we discuss the methodology, data, and the variables and measures used in the fieldwork. The paper then reports the results of the analysis using structural equation modeling, and we conclude with a discussion of their implications and offer some suggestions for further research.

Theoretical background

According to Porter (1980), a differentiation strategy seeks to achieve competitive advantage by creating a product or service that is perceived as unique. The firm's ability to satisfy a customer's need in this way suggests that it can charge a premium for its products, considerably above the industry norm. Product differentiation can be achieved in many ways, including product innovation, technical superiority, product quality and reliability, comprehensive customer service, and unique competitive capabilities (Thompson *et al.*, 2005). This paper focuses on two of these differentiators, namely, product quality and product innovation as they are the most prominently recognized strategic performance metrics associated with a differentiation strategy (Belohlav, 1993; Hill, 1988; Porter, 1985).

Quality is commonly defined as meeting or exceeding customer needs and expectations (Kano, 1984). The impact of product quality on competitive advantage is obvious. Providing high-quality products builds brand equity for a firm, leading to a price premium for its products. A substantial body of empirical work has supported the significant relationship between quality and firm performance. For instance, studies based on the PIMS database report that high-quality leads to high-financial measures of revenue through better market share as well as profitability through lower cost (Buzzels and Gale, 1987; Kroll *et al.*, 1999; Philips *et al.*, 1983).

Innovation has also received considerable attention as having a crucial role in securing sustainable competitive advantage. Innovation can be defined as anything

new or novel about the way a company operates or the products it produces (Hill and Jones, 2001). Thus, innovation includes advances in the products, production processes, management systems, organizational structures, and strategies developed by a firm. Porter (1985) hails the role of innovation in enhancing competitive advantage as being paramount for success. While not all innovations succeed, those that do can be a critical source of competitive advantage. By definition, successful innovation affords a firm something unique and which their rivals lack, at least until they imitate the innovation. This uniqueness enables a firm to differentiate itself from competition and to charge a premium price for its products.

The impact of innovation on firm performance has been demonstrated in a number of studies. Deshpande *et al.* (1993) when studying Japanese firms in terms of their corporate culture, customer-orientation and innovativeness and their association with organizational performance (in terms of relative profitability, size, market share, and growth rate) found that both innovativeness and customer-oriented marketing are most positively related to performance. Baldwin and Johnson (1996), in their study on Canadian firms, report that firms which are more-innovative do better across a wide range of performance measures, including market share gain and return on investment. In their study amongst Australian manufacturing firms, Yamin *et al.* (1997) concluded that organisational performance, *vis-à-vis* liquidity, leverage, and return on investment, is closely related to innovation performance with regard to administrative and process innovations. Han *et al.* (1998) extend this argument by showing empirically that in the banking industry, the relationship between marketing orientation (measured through customer orientation, competitor orientation, and inter-functional coordination) and corporate performance is mediated by the two core components of organizational innovativeness (technical versus administrative).

Marketing and performance

Indeed, marketing performs a critical role in the value chain, since it affects the relationship between a firm and its customers at the pre-development and post-delivery stages. In the pre-development stage, customer focus is paramount in understanding customer needs before products can be designed and developed. At the post-delivery stage, it addresses the issues of customer service and satisfaction. Several TQM proponents (e.g. Deming, Juran, Crosby) have emphasized customer focus as the starting point of the quality philosophy. They argue that the marketing function, being the primary point of contact with the customer, should play a major role. Marketing needs to identify what customers want from the good or service provided by a firm; what the company actually provides to customers; and the gap between what customers want and receive, i.e. the quality gap. Along with the other functions of the firm, marketing then needs to formulate a plan to close this gap.

The association between marketing and innovation has also been alluded to by several scholars who suggest that an understanding of market needs is key to innovation success (Carnegie *et al.*, 1993; Cooper and Kleinschmidt, 1987, 1993; Flores, 1993; Schewe, 1994; Slater and Narver, 1994). As customers are a main source of new product ideas, the marketing function of a firm, in interfacing with customers, can provide valuable information in this regard. Several empirical works (Appiah-Adu and Singh, 1998; Han *et al.*, 1998; Lukas and Ferrell, 2000) also substantiate the positive and significant relationship between customer orientation and organizational innovation.

More recently, Cho and Pucik (2005) showed that, a firm's capability to balance innovativeness with quality influences growth and profitability.

Based on the above discussion on the relationships between customer focus and quality and innovation, we posit that:

H1. Better customer focus leads to better product quality performance.

H2. Better customer focus leads to better product innovation performance.

R&D management and performance

R&D management performs a critical role in innovation. Indeed, many scholars associate innovation with R&D management, thus, assessing the innovation performance of a firm by measuring the level of its R&D activities (Harryson, 1997). Mikkola (2001) argues that increasing complexity of technology, coupled with shorter product life cycles, is forcing many firms to rely on R&D management as a source of strategy. R&D has two primary roles in achieving superior innovation. First, it is in new product and process development. Second, the effectiveness of R&D management in this development depends on its ability to cooperate with marketing and manufacturing. Goffin and New (2001) argue that successful high-technology firms consciously invest in their core management processes, especially on product development, product strategy, and supply-chain integration as these are competencies that provide competitive advantage. This is why high-technology firms have been pioneers in the advancement of cross-functional management processes.

The importance of R&D has not only been evidenced by world-class innovative companies, such as Sony and Canon, but also by empirical studies demonstrating the relationship between innovation and R&D activities and investment in organizations (Baldwin and Johnson, 1996; Franko, 1989; Hall and Bagchi-Sen, 2002; Koen and Kohli, 1998), including service firms (Chiaromonte, 2002; Sirilli and Evangelista, 1998). At a strategic level, R&D management can be used in different ways, from generating additional product value with the potential to expand the existing business to developing radically new products which leave the current products in the marketplace obsolete (Lowe, 1995). Consequently, we argue that good R&D management is a critical source of a firm's innovation performance, and hypothesize that:

H3. Better R&D management leads to better product innovation performance.

Production process and performance

TQM principles stress the need to identify defects during the work process, trace them to their source, determine their causes, and to take preventive action (Hackman and Wageman, 1995). The production process is therefore concerned with how processes are designed and controlled to produce the intended output (i.e. meet pre-determined specifications). Deming (1986), for example, emphasized the need to control processes using statistical process control (SPC) techniques as the primary means to improve product quality. Also, there is a shift of emphasis from corrective to more preventive practices, and this includes the use of fail-safe tools and mechanisms (Shingo, 1986). Consequently, we argue that good process management is critical to a firm's quality performance, and it is hypothesized:

H4. Better process management leads to better product quality performance.

Supplier relationship and performance

The role of suppliers in achieving superior quality has been recognized in the supply chain arena, with suppliers becoming an integral part of many organizational processes. Suppliers are relevant as they perform activities and incur costs when creating and delivering the purchased inputs used in a firm's end products. The costs, performance features, and quality of these inputs influence a firm's costs and product differentiation capabilities. Helping suppliers to reduce their cost or improve the quality and performance of the supplied materials can only enhance a firm's competitiveness, which is a prevailing incentive for closer supplier collaboration in managing supply chain activities. In this regard, Deming and Juran are among those TQM proponents who place significant emphasis on the role of suppliers. In particular, Deming (1986) highlights several key issues related to managing supplier relationships such as the practice of US firms of making purchasing decisions and supplier selection, based solely on price, resulting in the frequent change of suppliers. Instead, Deming advocates that firms should build cooperative relationships with suppliers by developing joint quality improvement programs, and consciously award long-term contracts to suppliers so as to allow them to make greater commitment to improving the input product quality. Through this, firms can then reduce the supplier base, thus saving on administrative costs and any quality variability. Further, Juran (1989) proposes the use of vendor rating systems as a systematic means to select suppliers. By assessing supplier capability prior to the decision to purchase materials or products, firms are now able to continually monitor supplier performance to ensure the integrity of supply.

Prior work on innovation has identified the important role of suppliers in determining innovation performance. Among a number of supply chain practices, supplier involvement in product development has attracted significant attention in the literature (Bozdogan *et al.*, 1998; Handfield *et al.*, 1999; Ragatz *et al.*, 1997). Indeed, developing strategic alliances with suppliers can enhance organizational competitiveness through innovation. McGinnis and Vallopra (1999) have also demonstrated the value of thoughtful supplier involvement in determining new product success, through the implementation of supplier identification, selection, monitoring, and control.

Consequently, we argue that a strong supplier relationship is a critical source of a firm's quality and innovation performance, and thus we hypothesize:

H5. Better supplier relationship leads to better product quality performance.

H6. Better supplier relationship leads to better product innovation performance.

Research framework

The six hypotheses above were captured in the research framework shown in Figure 1. In the framework, the four value chain activities were treated as independent variables and the two competitive performance indicators were considered as dependent variables. The six path relationships represent the six hypotheses tested in this study.

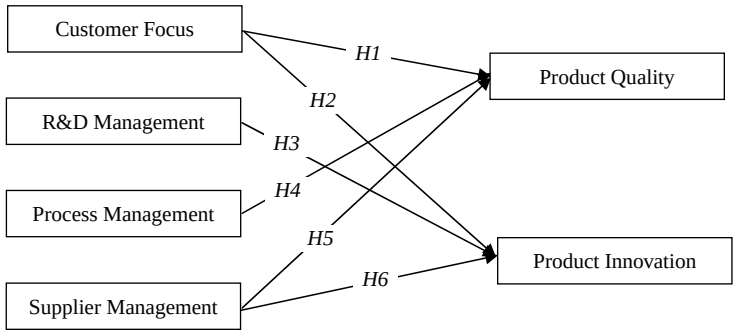

Figure 1.
Research model and hypotheses

Research method

Sample and procedures

The sample of the survey was derived from the database of individuals who subscribed to the membership of the Australian Organisation for Quality (AOQ) encompassing both manufacturing and non-manufacturing sectors. A single business unit was selected as the unit of analysis (e.g. plant for a manufacturing firm) for the reason that the operations and practices were homogenous at this level. The questionnaire was sent via postal mail to 1,000 companies randomly selected from the database containing 2,000 names supplied by AOQ. The total number of the AOQ membership was 7,000. The respondents selected for this survey were manager(s) who have knowledge of past and present organisational practices relating to continuous improvement and innovation at the site.

In all, 194 managers responded, while 150 questionnaires were returned to the researchers with return to sender (RTS) messages, indicating that the addresses were no longer valid. Discounting these RTS mails, the final response rate was 22.8 percent. The proportion of the respondents was nearly equal between manufacturing and non-manufacturing sectors (52 and 48 percent, respectively). The manufacturing sectors included food, wood, chemical, metal, machinery, and electrical equipment. The non-manufacturing sectors included construction, consulting, health care, information technology, and retail/distribution. In terms of organizational size (based on the number of employees), 90 percent of the respondents represent firms with 500 employees or less, with around 60 percent of them representing small-to-medium sized firms (SMEs) with less than 100 employees. More than half of the respondents (58 percent) were either quality managers or production/operations managers, followed by senior managers (general manager or managing director), which accounted for 35 percent. The remainder held various managerial positions in finance, marketing, human resources, and administration.

Measures

The instrument developed for this study comprises four scales of independent variables and two scales of dependent variables. The instrument used, as listed in the Appendix, is a five-point Likert scale (1 – strongly disagree and 5 – strongly agree). Prior to the full survey, a pilot study was administered to 20 managers in the state of Victoria, Australia. Since most of the contents of the survey were derived from pre-tested constructs, the goal of the pilot study was not primarily to examine the

content validity of the questionnaire; rather it was aimed at getting feedback concerning technical issues associated with the questionnaire including its structure and the length, the clarity of the statements and terminologies used, and its layout and presentation. A total of 12 responses were received, and none of the respondents indicated serious difficulties in completing the questionnaire pertaining to the clarity of the contents and time for completing the questionnaires.

Independent variable measures. The scales of customer focus, supplier relationship, R&D management, and process management were defined in the context of TQM, and, therefore, their content was derived from the scales used in earlier TQM empirical studies. For customer focus, we adopt the construct used by Samson and Terziovski (1999) since it captured a comprehensive range of practices from pre-development of the product (i.e. searching and identifying customer needs) to post-delivery processes (i.e. mechanism for handling complaints). For supplier relationship, the content was derived from the construct used by Dow *et al.* (1999) and Forza and Filippini (1998), with an additional element concerning the importance of limiting the supplier base to reduce variation in the supplied materials, as strongly suggested by Deming (1986). The use of TQM-based scales for measuring supply-chain partnerships also provides an opportunity to examine the applicability of TQM principles in innovation management. The R&D management construct was derived mainly from Gupta *et al.* (2000) and Chiesa *et al.* (1996), which capture two major aspects of R&D management: capabilities and linkages. On the capabilities of R&D management, the scale includes practices such as the capacity to handle truly innovative and leading-edge research, as well as the level of risk and return involved in R&D projects. In terms of linkages, the scale measures the extent of integration between R&D with business strategy as well as with other departments within the firm. The scale for process management was derived from Samson and Terziovski (1999), complemented by the work of Flynn *et al.* (1994). The key practices of process management were focused on the building of an internal customer-chain along the production/operations process to produce high-quality products, based on preventive mechanisms, including standardized procedures and SQC techniques.

Performance measures. Since, we maintain that quality performance contains multifaceted aspects, a construct is used to measure product quality performance as applied in studies on TQM such as Ahire *et al.* (1996), Grandzol and Gershon (1998) and Dow *et al.* (1999). Among these measures, the scale of quality performance used by Ahire *et al.* (1996) was considered to be well suited to the needs of this study. The content was derived from selected items of Garvin's (1984) dimensions of quality, namely, reliability, performance, durability, and conformance to specification, hence, establishing its content validity.

A review of past research on organizational innovation also indicates that there have been variations in measuring innovation performance in firms. To comprehensively capture these aspects of innovation performance, we developed our own construct for measuring product and process innovation using several criteria which have been conceptualized and used in previous empirical studies on innovation such as Miller and Friesen (1982), Deshpande *et al.* (1993), Karagozoglu and Brown (1988), Avlonitis *et al.* (1994), Hollenstein (1996) and Kleinschmidt and Cooper (1991). These criteria are the number and speed of innovations, the degree of innovativeness, and being the "first" in the market. By including the last two criteria, the scope of the

innovation performance measures contains areas that are viewed as "radical" innovation. Similar to quality performance, perceptual data were used in which respondents were asked to evaluate a firm's innovation performance against a major industry competitor to minimize industry effects. The advantages of this approach can be found in Kraft (1990). The two scales measuring product innovation and process innovation have shown their validity and reliability in other studies (Prajogo and Sohal, 2003, 2004).

Data analysis

Scale validity and reliability

The six scales incorporated in this study were factor analysed using principal component analysis and varimax rotation to examine their construct validity, following the method employed by Flynn *et al.* (1994), Samson and Terziovski (1999) and Meyer and Collier (2001). The result supports the validity of these six scales as indicated by the variance explained which was close to, or exceeded, 50 percent and the load factors of all items within each scale which exceeded 0.5 (Table I). The reliability analysis, through calculating the Cronbach's α for each scale, revealed that the Cronbach's α values for the six scales surpass the threshold of 0.7 as suggested by Nunnally (1978). An exception was the supplier relationship construct, though it still met the recommended critical point of 0.6 for exploratory studies (Hair *et al.*, 1998). The culling of any measure in this construct did not produce any improvement.

Since the data set was drawn from a single respondent in each organization, common method variance needs to be checked to ensure that the data had no major problem with this issue. The test for checking common method variance used in this study was Harmann's single-factor test suggested by Podsakoff and Organ (1986). This test was run by loading all 26 items into a principal components analysis and examining the number of factors extracted from these items. The result indicated that six factors were extracted from the un-rotated solution. This result was double-checked by forcing the 26 items into one factor, and it produced a poor result as indicated by only 30.1 percent variance extracted and many items suffered from poor factor loadings, which fell below 0.5. These results suggest that common method variance was not a significant problem in the data set.

Having met the requirements of construct validity and reliability, the composite scores of each construct were measured by calculating their factor scores from principal components analysis. The final results of the construct validity and reliability tests are reported in Table I.

MANOVA was also performed to check any differences in the six composite scores between manufacturing and services firms as well as between SMEs and large firms. The results indicated that there was no statistical difference between the two different types of industries or between the two groups of different sized firms. Therefore, it is appropriate to run the analyses using the sample as a whole.

Bivariate correlations

Table II, on the bivariate correlations between the six constructs of this study, suggests that the four independent variables are significantly correlated to each other, indicating that firms commonly implement those practices holistically. The correlations between the independent and dependent variables also indicate strong relationships,

Scales	Items	Factor loading	Extracted variance (percent)	Cronbach's α
Customer focus (cust)	Search customer needs and expectations	0.75	54.2	0.78
	Disseminating customer needs in the firm	0.82		
	Maintaining close relationship with customers	0.73		
	Effective process for resolving complaints	0.73		
	Regularly measure customer satisfaction	0.65		
R&D management (rese)	Communication with other departments	0.80	68.9	0.85
	Pursuing leading-edge research	0.91		
	High risk projects with high return	0.76		
	A major part in our business strategy	0.85		
Process management (proc)	Applying the concept of "internal customer"	0.73	58.7	0.76
	Designing preventive-oriented processes	0.78		
	Standardizing documented instructions	0.82		
	Using statistical techniques (e.g. SPC)	0.73		
Supplier management (supp)	Long-term relationships with suppliers	0.72	47.6	0.63
	Use a supplier rating system to select suppliers	0.72		
	Rely on a small number of dependable suppliers	0.63		
	Involving suppliers in product design	0.69		
Product quality (qual)	Performance	0.84	73.5	0.86
	Conformance to specifications	0.80		
	Reliability	0.90		
	Durability	0.84		
Product innovation (inno)	Level of newness (novelty)	0.84	63.9	0.87
	Use of latest technology	0.81		
	Speed of product development	0.76		
	Number of new products	0.79		
	Early market entrants	0.79		

Table I.
Construct validity and reliability

		(cust)	(rese)	(proc)	(supp)	(qual)	(inno)
Customer focus	(cust)	1.000					
R&D management	(rese)	0.273	1.000				
Process management	(proc)	0.593	0.327	1.000			
Supplier management	(supp)	0.486	0.299	0.536	1.000		
Product quality	(qual)	0.478	0.249	0.466	0.397	1.000	
Product innovation	(inno)	0.258	0.454	0.318	0.334	0.333	1.000

Notes: All correlations are significant at $p < 0.01$; two-tailed

Table II.
Correlation analysis

but, interestingly, the strengths of the correlations vary across different variables. For example, customer focus and process management have a stronger relationship with product quality than product innovation, whilst R&D management shows an opposite direction of relationship. Supplier relationship has a nearly equal value in its

relationship with both product quality and product innovation. This provides a preliminary finding on the unique role of different operational functions in determining different types of operational performance. Also, product quality and product innovation are strongly correlated with each other, implying that firms pursuing an area of innovation could also enhance performance in another area (quality) as well.

Path analysis

Path analysis was used to examine the relationships between the four value chain activities and the two performance indicators simultaneously. As this is an exploratory study, the model trimming approach was followed by initially estimating all possible paths relating the four value chain activities as exogenous variables and the two performance measures as endogenous variables (Kline, 2001). With a four-by-two structural relationship, eight possible paths need to be estimated in the initial model. The result, however, produced a poor fit. Not all relationship paths (γ) were statistically significant. The insignificant paths were subsequently deleted, and each time one of those paths was deleted, the model indicated an increase in its χ^2 indices. This process was repeated until the best competing model was identified (Figure 2).

The overall goodness-of-fit indices indicate that the path model is acceptable. Both RMSEA and SRMR are well below 0.08 and 0.05, and both the GFI and AGFI surpass the recommended values of 0.9. The robustness of the model is also supported since the result does not show any offending estimate in terms of negative error variances, excessive standardized coefficients, and excessive standard errors (Hair *et al.*, 1998).

When analyzed in the context of the structural model, the nature and characteristics of the relationships between the independent and dependent variables are further clarified. Customer focus and process management have a significant relationship with product quality only, while R&D management shows a significant relationship with product innovation only. Only supplier relationship is significantly linked to both product quality and product innovation. Thus, the findings support hypotheses *H1, H3, H4, H5*, and *H6*, but not *H2*.

For confirmatory purposes, we checked the paths that we did not hypothesize to see if there are direct paths between the value chain activities and the performance. This was done by creating an additional path and checking the estimated coefficient.

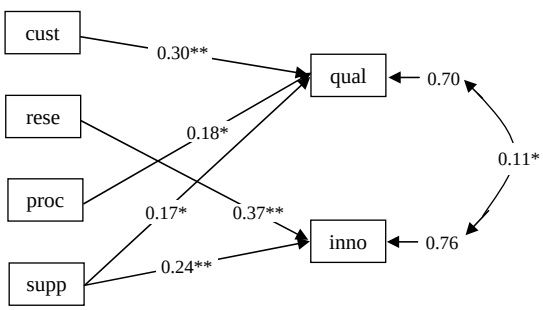

Figure 2.
Path analysis of research model

Notes: $\chi^2 = 5.37$; df = 3; RMSEA = 0.065; NFI = 0.989; NNFI = 0.974; GFI = 0.991; AGFI = 0.936; significant at $^*p < 0.05$; $^{**}p < 0.01$, respectively

The results indicate that none of the additional paths were statistically significant, neither did they improve the goodness of fit of the relationship models captured in Figure 2.

Correlation between product quality (qual) and product innovation (inno)

The SEM model in Figure 2 also exhibits a strong and significant error correlation between product quality and product innovation ($\psi = 0.12$ at $p < 0.05$) indicating an exclusive relationship between the two, over and above that which is contributed by the independent variables. This result was further examined to verify if the causal relationship was genuine, or if it was spurious due to the influence of common antecedents (i.e. strong correlations among the independent variables). The test was conducted using partial correlations between the two types of performance when the four independent variables were controlled for (Bagozzi, 1980). The results yielded significant values at $p < 0.05$ with the correlation coefficient $r = 0.17$, verifying the result indicated by the path analysis.

Discussion

The first insight drawn from these results is the uniqueness of the role of each function within a value chain in determining the performance of a firm. The marketing function, through the customer focus construct, shows a significant relationship with product quality performance and this is consistent with past studies (Dow *et al.*, 1999; Grandzol and Gershon, 1997; Samson and Terziovski, 1999). However, customer focus does not exhibit a significant relationship with product innovation performance. While this appears counter intuitive, it concurs with the arguments raised by some authors who consider the customer focus philosophy as not primarily intended to produce product innovation, particularly not radical innovations. For example, Lynn *et al.* (1996) suggest that, the use of commonly known market research tools, such as concept testing, customer surveys, conjoint analysis, focus groups, and demographic segmentation, is limited when it comes to developing innovative products, as such techniques assume that users are capable of articulating their needs. Our finding related to customer focus also supports Atuahene-Gima (1996), in that market orientation has a positive relationship with product advantage (i.e. conformance) but not with product newness to customer (innovation).

R&D management exhibits a relationship with product innovation, whilst process management does not and instead has a significant relationship with product quality. The combination of these two results suggest that process management is mainly concerned with downstream processes with the primary emphasis on controlling the processes to produce products that conform to pre-determined specifications handled in the upstream processes by R&D division.

Supplier management shows strong association with both product quality and product innovation. This suggests that, the scale embodies practices that are suitable for pursuing both types of performance. While establishing a long-term partnership, reducing the supplier base and imposing stringent criteria for a supplier rating system will ensure that firms acquire materials which conform to their quality specifications, the role of the suppliers in enhancing product innovation performance could follow from firms involving the suppliers early in the product development process.

The overall findings of this study support the contrast between the exploration and exploitation capabilities as posited by Benner and Tushman (2003), who specifically highlight the close link between process management, customer focus, and exploitation. They argue that good process management techniques, by design and intent, exploit existing capabilities. This is because process management focuses on incremental improvement that involves routines and increased proficiency through repetitive organizational activities within an existing capabilities set; and this is undertaken with a view to better understanding and satisfying existing customers. This is particularly true when both are implemented under a TQM context. Benner and Tushman (2003, p. 245) further argue that "where short-term performance pressures, the demands of existing customers, and ease of measurement dominate, exploitation overwhelms exploration."

The contrast between exploitation and exploration is also evident from the low reliability of the supplier management scale. As discussed, the scale incorporates practices where some support quality performance and others support innovation performance. Coupling these two findings confirms the contrast between the elements of exploitation and exploration in determining different types of performance in which one could not be effectively applied to pursue the other's goal. Specifically, relying on the reduction of the supplier base and long-term contracts (as mentioned in the TQM literature) do not seem to be critical in the innovation literature. Indeed, their application to innovation is questionable. This is because in a turbulent environment of increasingly shorter and uncertain product life cycles, firms would be hard pressed to award long-term contracts to their suppliers anyway (Sako, 1994). Whilst our finding supports the influence of supplier management on both quality and innovation performance, it also calls for a possible segregation of the content of supplier management practices which relate to quality and innovation. This would theoretically improve our understanding of the different roles of the different practices of supplier management in pursuing competitive performance as well as sharpening the empirical results when multiple performance indicators are included in the study.

Despite the contrast between quality and innovation discussed above, the findings suggest a significant link between product quality and product innovation. From a theoretical perspective, any improvement in product quality would, to a certain degree, result in the development of new products (i.e. innovation). For example, improvement in the durability or reliability aspect of a product would require firm to change the materials or even the technological or mechanical design of the product. This is particularly true when the elements of product quality focus on the "delighting" level beyond the "basic" and "stated" levels of customer needs and expectations as suggested by Kano (1984). Product innovation, by exploiting new technologies, is also often aimed at improving several aspects of product quality. This, again, reinforces the need to integrate all functions along the value-chain, and balance exploitation and exploration as recommended by Benner and Tushman (2003). The issue of integration arises when it is linked to the context of prevailing competition where firms are required to accommodate more complex and interrelated aspects of performance (Corbett and van Wassenhove, 1993).

The correlation between product quality and product innovation also indicates a potential mediating effect between the two, following the work by Cho and Pucik

(2005). Whilst this point is beyond the scope of analysis of this study, it is plausible to infer from the result that product innovation, for example, could mediate the relationship between R&D management and product quality. As mentioned, the end goal of innovation must be related to improved quality of the product.

Conclusion

Despite the popular notion within the strategy literature that best-in-industry proficiency in performing key value chain activities may allow a firm superiority over competition, empirical work on the role of the different value chain activities is still emerging. Until now, it has been unclear how core competencies, developed in the individual elements of the value chain, are related to the generic competitive strategies. Building on insights from both the resource based view of the firm and the value chain model, we have argued that firms which recognize that specific elements of their value chain are associated with specific performance metrics, and exploit these elements appropriately, have the strongest potential to yield competitive superiority. The empirical analysis resulting from this study furthers our understanding of the inter-relationship between quality and innovation, and the interdependence between the four attributes of the value chain.

The empirical analysis evokes a number of important findings. First, the results suggest that each value chain function has a different relationship nature with different types of competitive performance, specifically quality and innovation. A number of results of the study are consistent with past studies, and indicate that marketing (as represented by customer focus), procurement, and production functions (as represented by process management) are significantly related to one metric of performance, namely product quality. However, interestingly, in our sample, both the marketing and the production functions were not related to product innovation.

A second finding from this study suggests that R&D is only significantly related to product innovation. The relationship between procurement and innovation was also significant. Interestingly, within our sample, marketing is notably absent in this relationship. While the role of marketing is clearly critical in every organization, it appears that in our sample it was greatly overshadowed by the importance of the other two competencies, unlike that of Han *et al.* (1998). It is also notable that procurement is the only competency that was significantly related to both quality and innovation. This underlines the increasingly important role that procurement and supply chain issues have in the value chain of organizations, and apparently it is not limited by the strategic direction the organization chooses.

Additionally, within this study, quality and innovation were shown to be positively and significantly related to each other. This concurs with Cho and Pucik (2005). These results suggest that firms should pursue both performance dimensions synergistically rather than maximizing one at the expense of the other. Hence, firms should consider developing complementary resources and practices to achieve high quality and innovation simultaneously, balancing exploitation and exploration.

The practical significance of these findings suggests that managers and decision makers within organizations aiming to differentiate via quality should dedicate their resources and attention to building competencies in marketing, procurement, and production value chain functions. The findings also suggest that organizations striving to achieve differentiation through innovation should focus their energies and

resources on building competencies in R&D and procurement value chain activities. Overall, although each of the value chain functions is important, the level of importance of each varies dramatically depending upon the type of strategy the company is pursuing.

We acknowledge several limitations inherent in this study, which warrant future research. First, the accuracy of the research data could be improved by involving more people in the firm. This means assigning areas of the study to the specific personnel with relevant position in the firm (marketing, procurement, R&D, and operations). Second, further research could replicate this study with a more complex structure (i.e. sequential) that reflects the flow of materials along the value-chain in a firm using mediating or moderating effects. Third, we have only selected certain elements of Porter's value chain, in view of the interest of the treating the firm as a value chain member within a large network of firms rather than as an individual entity. We do acknowledge that there are other elements which can be considered. Last, we could also explore the impact of these four value chain activities on the overall financial performance of the firm.

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Appendix. Survey instrument

Please tick the number that best reflects what this company has been practising so far.
(1 – strongly disagree, 5 – strongly agree).

Customer focus

- We actively and regularly seek customer inputs to identify their needs and expectations.
- Customer needs and expectations are effectively disseminated and understood throughout the workforce.
- We involve customers in our product design processes[a].
- We always maintain a close relationship with our customers and provide them an easy channel for communicating with us.
- We have an effective process for resolving customers' complaints.
- We systematically and regularly measure customer satisfaction.

R&D management

- We have excellent communication processes between R&D and other departments.
- Our R&D pursues truly innovative and leading-edge research.
- Our R&D strategy is mainly characterised by high risk projects with chance of high return.
- R&D plays a major part in our business strategy.

Process management

- The concept of the "internal customer" (i.e. the next process down the line) is well understood in our company.

- We design processes in our plant to be "fool-proof" (preventive-oriented).
- We have clear, standardized and documented process instructions which are well understood by our employees.
- We make an extensive use of statistical techniques (e.g. SPC) to improve the processes and to reduce variation.

Supplier management

- We strive to establish long-term relationships with suppliers.
- We use a supplier rating system to select our suppliers and monitor their performance.
- We rely on a reasonably small number of highly dependable suppliers.
- Our suppliers are actively involved in our new product development process.

Please tick the number that best reflect how your organisation has been doing so far relative to the major competitors in your industry.
(1 – worst in industry, 5 – best in industry).

Product quality

- Performance.
- Conformance to specifications.
- Reliability.
- Durability.

Product innovation

- The level of newness (novelty) of our firm's new products.
- The use of latest technological innovations in our new products.
- The speed of our new product development.
- The number of new products our firm has introduced to the market.
- The number of our new products that is first-to-market (early market entrants).

[a]Deleted due to weak factor loading.

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