THE INTEGRATION OF VALUE CHAIN ACTIVITIES IN DETERMINING PERFORMANCE

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Abstract

This paper examines the role of the value chain activities in determining product quality and product innovation performance. The value chain functions included in this study were marketing, research and development, procurement, and production/operations which represent the stream of activities where material flows from upstream to downstream processes. The empirical data was drawn from 194 managers of Australian firms. The findings indicate that marketing and production were significantly related only to product quality. On the other hand, research and development was related only to product innovation, whilst procurement being related to both product quality and product innovation. Despite these different roles, the findings also show significant correlations among the four value chain functions.

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INTRODUCTION

In outlining the idea of competitive advantage, Porter (1985) introduced the concept of value-chain which represents a system of interdependent functions within an organization. He suggests that a firm's value chain is the potential source of competitive advantage which in turn determines the value of the product delivered into the marketplace that creates differentiation with competitors' products. Therefore, in order to gain a competitive advantage, firms need to exploit these interdependent functions by coordinating and optimizing them. In this study, we focused on four core functions within a value chain, namely marketing, design, and production or operations, and supplier management. The interrelationships between the functions of a value chain represent therefore represent the stream of activities where material flows from upstream to downstream processes that will determine a strategic value of the products or services. Among a number of strategic performance, quality and innovation were the most prominent ones. The impact of product quality on business performance has been acknowledged in the last two decades along with the emergence of the TQM concepts, and numerous empirical studies have verified the significant relationship between quality performance and business performance (Buzzels and Gale, 1987; Forker et al., 1996; Kroll et al., 1999; Philips et al., 1983). Innovation, on the other hand, has also received considerable attention as having a crucial role in securing sustainable competitive advantage. Porter (1985) hailed the role of innovation in enhancing competitive advantage as paramount in pursuing competitive advantage through differentiation, and the impact of innovation on business performance has been demonstrated in a number of studies in this area, such as Deshpande et al. (1993), Baldwin and Johnson (1996), and Yamin et al. (1997). We therefore believe that this study is important in order for organizations to identify the role of each function within the value chain, as outlined above, so as to maximize the firm's performance in accordance with its business objectives.

LITERATURE REVIEW

This section discusses the relationship between each of the four functions of the value-chain in organisations and product quality as well as product innovation as identified in literature. The first three functions discussed here are marketing, design, and production or operations, which were upheld by Slack et al. (2001) as the core functions in any organization that are responsible for delivering value to customers.

Marketing plays a critical role in the value chain, since they affect the relationship between a firm and its customers at both pre-development and post-delivery processes. In the pre-development process, marketing is paramount in understanding customer needs before products can be designed and developed (usually known as customer focus). At the post-delivery stage, it addresses the issues of handling customer service and complaints, and not less importantly obtaining feedback from customers on their satisfaction. The relationship between marketing and quality has been one of the major issues during the TQM era. All TQM proponents (Deming, Juran, Crosby) have emphasized the absolute importance of understanding customer needs and expectations as the essential criteria of quality. Indeed, in the context of TQM, quality is commonly defined as meeting or exceeding customer needs and expectations (Kano, 1984). The association between marketing and innovation has also been pointed by several scholars who have suggested that the understanding of market needs is necessary for innovation success (Carnegie et al., 1993; Cooper and Kleinschmidt, 1987; Cooper and Kleinschmidt, 1993; Flores, 1993; Schewe, 1994; Slater and Narver, 1994). 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.

At the same time, the role of suppliers has been recognized in the supply-chain area, with suppliers becoming an integral part of many organizational processes. The recognition of the importance of managing supplier relationships has significantly escalated along with the emergence Total Quality Management (TQM). For example, Deming (1986) highlights several key issues related to managing supplier relationships. He suggests that firms should first attempt to build cooperative relationships with suppliers by developing joint quality improvement programs. In conjunction with this, he encourages companies to award long-term contracts which will allow suppliers to make greater commitments to improving the quality of their products. Literature 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 innovation literature (Bozdogan et al., 1998; Handfield et al., 1999; Ragatz et al., 1997). From a strategic point of view, this means an opportunity to develop strategic alliances with suppliers aimed at enhancing organizational competitiveness through innovation.

Process management is concerned with how processes are designed and controlled to produce the intended output (i.e. meets the predetermined specifications). The role of process management in determining quality of products has been well recognized. Deming (1986), for example, emphasized the need to study and improve the process using statistical process control (SPC) technique as the primary means to improve quality of the products. The role of process management in innovation has not been discussed extensively in literature. This is because process management is more focused on downstream (i.e. production or operation) processes whilst product innovation is mostly handled in the upstream processes, such as research and development (R&D). However, this does not necessarily mean that process management should be excluded from innovation for the reasons sound downstream processes are always critical in realizing any innovative products developed in the upstream processes.

Opposite to process management, the role of R&D in determining quality (in the context of TQM) appears to be inferior compared to the other functions, such as marketing, procurement or purchasing, and production. This, once again, could be traced back to the origin of quality movement in the early 1980s which put an emphasis more on the downstream processes, even shop floor area. However, similar to the case of process management, it should not be argued that R&D has no significant role to play in achieving quality because quality of the end product is determined by the way it is designed in the first place. On the other hand, the role of R&D in innovation is always instrumental. Indeed, many correspond innovation with R&D, thus, assessing the innovation performance of a firm by measuring the level of its R&D activities. The importance of R&D has not only been evidenced by world-class innovative companies but also numerous empirical studies that have shown 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) which included service firms (Chiaromonte, 2002; Sirilli and Evangelista, 1998). At a strategic level, R&D can be used in different courses, from generating additional product value with a potential of expanding the existing business to developing radically new products which leave the current products in the marketplace obsolete (Lowe, 1995).

**RESEARCH QUESTIONS**

Based on the points raised in the literature review, a research framework was developed to test the relationships between the four value-chain activities and the two performance
variables. In order to capture the ideas of the study, a couple of research questions are articulated as follows:

**Question 1**: What is the nature of the relationship between each function of the value-chain?

**Question 2**: Is there any difference in the relationship between each function of the value-chain and performance in terms of product quality and product innovation?

**DATA COLLECTION**

**Source of Empirical Data**

Empirical data was obtained through a random survey of 1,000 managers, particularly senior managers, who had knowledge of past and present organizational practices relating to continuous improvement and innovation in Australian companies. The sample was selected randomly and encompassed various industry sectors, including both manufacturing and non-manufacturing sectors. The level of analysis of this study was limited to one site (or plant) per organization. A total of 194 managers responded, whilst 150 questionnaires were returned to the researchers with RTS (Return to Sender) messages, indicating that the addresses were no longer valid. By discounting the number of RTS mails, the final response rate accounted for 22.8%. Around fifty percents of the respondents were Operations Managers and/or Quality Managers, followed by General Manager or Managing Directors at thirty percents, and the rest were managers at various departments, including marketing, human resources, and finances. The instrument developed in this study consists of four constructs of independent variables and two constructs of dependent variables. The instrument used is a 5-point Likert scale; representing a range of attitudes as follows: strongly disagree, disagree, neutral, agree, and strongly agree.

**Value Chain Activities Measures**

The scales of marketing, supplier relationship, and process management were defined in the context of Total Quality Management (TQM), and, therefore, their content was derived from the scales used in the previous TQM empirical studies. For marketing activities, we derived the content from the construct used by Samson and Terziovski (1999) – labelled as customer focus – which captures a comprehensive range of practices from pre-development of the product (i.e. searching and identifying customer needs) until 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 Filipini (1998) with one additional element concerning the importance of limiting the number of suppliers to reduce variations 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 research and development construct was mainly derived from the studies by Gupta et al. (2000) and Chiesa et al. (1996) which capture two major aspects of R&D management: capabilities and linkages.

With respect to capabilities of R&D, the scale includes such practices 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 firms. The scale for process management was also derived from the work by Samson and Terziovski (1999) complemented by the work by Flynn et al. (1994). The focus was placed on building
an internal customer-chain along the production/operations processes in which quality was built on through preventive mechanisms, including standardized procedures and statistical quality control techniques.

**Performance Measures**

Since we maintained that quality performance contains multifaceted aspects, therefore a construct is used to measure product quality performance, and the scale of quality performance used by Ahire *et al.* (1996) was considered as optimally suited to the needs of this study. The content was derived from the literature which has been acknowledged as one of the authorities in the area of quality (i.e. 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 organizations. For the purpose of comprehensively capturing these aspects of innovation performance, we developed our own construct for measuring product and process innovation on the basis of several criteria which have been conceptualized and used in previous empirical studies of innovation. These studies include those conducted by Cohn (1980), Miller and Friesen (1982), Deshpande, *et al.* (1993), Karagozoglu and Brown (1988), Avlonitis, *et al.* (1994), Subramanian and Nilakanta (1996), Hollenstein (1996), and Kleinschmidt and Cooper (1991). These criteria are the number of innovations, the speed of innovation, the level of innovativeness (novelty or newness of the technological aspect), and being the ‘first’ in the market. By including the last two criteria, the scope of the innovation performance measures captured areas that could be considered as ‘radical’ innovation. Similar to quality performance, perceptual data were used in which respondents were asked to evaluate the company’s innovation performance against the major competitor in the industry to minimize industry effects.

**DATA ANALYSIS**

**Data Reduction and Preliminary Relationships Analysis**

The data reduction process was conducted in order to bring the six constructs - each consisting of four to five items - employed in this study into their composite scores. These six constructs were subjected to validity and reliability tests before a single composite score could be calculated to represent each construct. Confirmatory Factor Analysis (CFA) using LISREL 8.52 was employed for examining the construct validity of each scale by assessing how well the individual item measured the scale. During this process, only one item in the customer focus scale was deleted due to poor loading on its latent variable. The Goodness of Fit Indices (GFI) of the six constructs exceeded the 0.9 criterion suggested by Kelloway (1998), hence, establishing the construct validity. The reliability analysis was conducted by calculating the Cronbach’s alpha for each scale. The result shows that the Cronbach’s alpha measure for five of the six constructs exceeded the threshold point of 0.7 suggested by Nunnally (Nunnally, 1978) The exception was the Supplier Relationship construct, although it still met the recommended critical point of 0.6 for an exploratory study (Hair et al., 1998). Also, culling of any variable in this construct did not produce any improvement.
Having met the requirement of construct validity and reliability, the composite measure of each construct can be measured by calculating their mean values (Hair et al., 1998). The final results of construct validity and reliability tests as well as the composite scores of the six constructs are reported in Table 1.

### Table 1: Construct Validity and Reliability

<table>
<thead>
<tr>
<th>Construct</th>
<th>Goodness of Fit Index (GFI)</th>
<th>Normed-Fit Index (NFI)</th>
<th>Cronbach’s alpha</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Relationship</td>
<td>0.992</td>
<td>0.989</td>
<td>0.7853</td>
<td>3.918</td>
<td>0.684</td>
</tr>
<tr>
<td>Supplier Relationship</td>
<td>0.983</td>
<td>0.960</td>
<td>0.6255</td>
<td>3.701</td>
<td>1.161</td>
</tr>
<tr>
<td>Research and Development</td>
<td>0.999</td>
<td>0.999</td>
<td>0.8483</td>
<td>2.888</td>
<td>0.903</td>
</tr>
<tr>
<td>Process Management</td>
<td>0.997</td>
<td>0.996</td>
<td>0.7569</td>
<td>3.437</td>
<td>0.779</td>
</tr>
<tr>
<td>Product Quality</td>
<td>0.983</td>
<td>0.985</td>
<td>0.8839</td>
<td>4.197</td>
<td>0.547</td>
</tr>
<tr>
<td>Product Innovation</td>
<td>0.983</td>
<td>0.984</td>
<td>0.8684</td>
<td>3.377</td>
<td>0.697</td>
</tr>
</tbody>
</table>

Table 2 shows the bi-variate correlations between the six constructs in this study. The results suggest that the four independent variables are strongly correlated to each other. Therefore, in response to Question 1, the finding indicates that firms implement these four areas in a holistic fashion. The correlations between the four independent variables with the two dependent variables also indicate strong relationships, but, interestingly, the strengths of correlations appear to vary across different variables. Further to this, it is also important to note that product quality and product innovation are also strongly correlated with each other, further indicating that companies pursuing one area of innovation could also enhance its performance in the other area.

### Table 2: Bivariate Correlation

<table>
<thead>
<tr>
<th></th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
<th>V4</th>
<th>V5</th>
<th>V6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Relationship</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplier Relationship</td>
<td>0.486</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research and Development</td>
<td>0.273</td>
<td>0.299</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Management</td>
<td>0.593</td>
<td>0.536</td>
<td>0.327</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Quality</td>
<td>0.478</td>
<td>0.397</td>
<td>0.249</td>
<td>0.466</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Product Innovation</td>
<td>0.258</td>
<td>0.334</td>
<td>0.454</td>
<td>0.318</td>
<td>0.333</td>
<td>1.000</td>
</tr>
</tbody>
</table>

All correlations are significant at p<0.01, two-tailed

Path Analysis

In conducting the path analysis, we followed the model generation approach along the process by estimating all possible paths between the four dependent variables are related to the two dependent variables, resulting in eight relationship paths. However, the first model indicated a poor fit because some of the paths were insignificant. These insignificant paths were subsequently deleted, and every time one of these paths was deleted the goodness of fit indices of the model were improved. This process was carried on until the best competing model was identified, as presented in Figure 1.
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 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). The result further reveals the nature and characteristics of the relationships between independent and dependent variables.

Customer focus and process management show a significant relationship with product quality but not with product innovation, whilst R&D shows the opposite. Surprisingly, it is supplier relationship that shows a significant relationship with both product quality and product innovation. Therefore, in response to Question 2, the findings indicate the unique role of each operational function within the value chain in determining different types of performance.

DISCUSSION

The first insight drawn from these results is the uniqueness of the role of each function within a value chain in determining performance. Customer focus shows a significant relationship with quality performance and this is consistent with the findings obtained the past studies on TQM (Ahire et al., 1996; Dow et al., 1999; Grandzol and Gershon, 1997; Samson and Terzirovski, 1999). On the other hand, customer focus does not indicate a significant relationship with innovation performance. Whilst this seems to be surprising, this finding concurs with the arguments raised by a group of authors that consider customer focus philosophy as detrimental for product innovation. For example, customer focus could trap firms in a ‘tyranny of the served market’ in which managers see the world only through their current customers’ eyes (Slater and Narver, 1998). Similar to the case of customer focus, process management also shows a significant relationship with product quality but not with product innovation. This confirms what is pointed in the previous section that process management included in this study is mainly concerned with downstream processes with the primary emphasis being on controlling the processes to produce products that conform to predetermined specifications. R&D, on the other hand, shows an opposite direction of relationship where it has a strong and significant relationship with product innovation but not with product quality. This confirms that both R&D and product innovation embodied in this
The study has a strong orientation towards radical innovation, particularly the early market entrants or first-mover strategy. Interestingly, it is supplier relationship which indicates strong relationships with both product quality and product innovation. This perhaps could be related to the trend where firms now become more and more focused on their core competence and therefore outsource the peripheral areas of their business.

The second point of discussion is the need for an integration of all functions along the value-chain processes. From a theoretical point of view, the improvement in product quality, to a certain degree, would result in the development of new products (i.e. innovation). This is particularly true when the elements of product quality begin to aim at delighted level beyond the basic and stated levels suggested by Kano (1984). On the other hand, product innovation, for example by exploiting new technology, is also often aimed at improving several aspects of quality of the products. Accordingly, we argue here that it is important for companies to appreciate the complementary relationship between control and innovation and use them strategically to achieve multidimensional performance, particularly between quality and innovation. For example, firms also need to incorporate the innovative segment of the customer focus principles such practices as educating rather than following customers as well as generating, or driving new needs rather than simply meeting their current needs. On the other hand, R&D also needs to consider incremental innovation, such as product rejuvenation and reorientation, along with the cutting-edge research. These incremental approaches have been proven to be valuable as a point of leverage for business, not to mention their advantages of being less risky and less costly (Banbury and Mitchell, 1995; Berenson and Mohr-Jackson, 1994).

CONCLUSION

The study presented in this paper has shown the strong interrelationship between the marketing, procurement, R&D, and operations functions in a firm and the different role of each of them in determining quality and innovation performance. Marketing and production were significantly related only to product quality, research and development was significant related only to product innovation, whilst procurement were related to both. The major implication of the findings above is that firms should consider the development of complementary resources and practices which allow them to achieve high quality and innovation simultaneously.

We acknowledge several limitations inherent in this study which warrant further research. First, the accuracy of the research data could be improved by 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 also replicate this study with a more complex structure (i.e. sequential) that reflects the flow of materials along the value-chain in the firm using mediating or moderating effects.
REFERENCES


