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Beyond the functional silos: a performance analysis based on the cumulative capabilities perspective

Abstract

Cross-functional integration and its influence on business strategy is a relevant topic in operations management since the classic articles of Skinner and Whelwright decades ago. At the same time competitive priorities identification is a relevant issue in order to link operations decisions to business strategy. We consider competitive priorities from a cumulative capabilities perspective. Thus, this study aims to evaluate the relationship between cross-functional integration, competitive priorities and business performance. We used a survey methodology to collect the data. The sample includes ninety and nine (99) companies from food and machinery industries. We used structural equation modeling to analyze the proposed model. The results suggest that cross-functional integration and competitive priorities influence positively business performance.

Introduction

Anecdotic references have shown that companies have been compelled for developing higher levels of integration between their functional areas in order to strengthen their capabilities and to improve business performance. Literature also has discussed the need for more collaboration and integration among different functional areas. According to the seminal articles, this process may enhance organizational performance and company’s
competitiveness (Shapiro 1978; Critenden, 1992). Even thus, articles exploring cross-functional integration and performance are scarce.

At the same time, the debate between trade-offs and cumulative capabilities perspective still is present in the literature. Even that, there is not a consense that cumulative capabilities follow a pre-defined sequence (Flynn and Flynn, 2004).

We explore these issues integrating cumulative capabilities approach with cross-functional integration. Complementarly, we analyze how competitive priorities may influence business performance.

In order to discuss this issue, the article presents the following structure. Firstly, we present the theoretical references. Secondly, the research methodology is discussed. Thirdly, we present the results. Finally, we present the conclusions.

**Competitive Priorities: Trade-Offs or Synergetic Perspective?**

Operations performance and competitive priorities several times are analyzed from a trade-off perspective. This was one of the main debates in the early articles in manufacturing strategy stream. Thus trade-offs can be expressed through a function of two variables that are inversely correlated (Hayes and Pisano, 1996).

The concept of trade-off should orient manufacturing decisions in the shop-floor and along the supply chain especially between cost and other competitive priorities or criteria (Skinner, 1969, 1978; Wheelwright, 1984). Current studies also have identified the existence of trade-offs between competitive criteria such as flexibility, costs and delivery (Boyer and Lewis, 2002). Even that, Da Silveira and Slack (2001) argued that sometimes managers present difficulty to understand and to identify trade-offs concept within a practical view.
An alternative model for trade-offs is expressed through a synergetic approach. The sand cone model is the main example (Collins, Cordon and Julien, 1998; Corbett and Wassenhove, 1993; Ferdows and De Meyer, 1990). The idea of cumulative capabilities instead of inversely correlated dimensions is the key aspect in this approach (Ferdows and De Meyer, 1990). In this case a competitive criterion would be positively related to the other ones (Mapes et al., 1997; Noble 1995; Rosenzweig and Roth, 2004).

Within a similar view, the concept of world class manufacturing (Schonberger, 1986) presents other alternative view to the trade-off approach. In this case, companies would seek to improve quality, cut their costs and reduce their lead times simultaneously.

Even that, there is not a concordance between the authors regarding the cumulative capability approach. Flynn and Flynn (2004) did not identify a single pattern in the sequence of the capabilities in a cross-country comparison as suggested by Ferdows and De Meyer. Diversely, the authors found that industries or countries are possible determinants for the capabilities sequence.

We expect that managers from the most competitive companies would seek to achieve high performance in several competitive criteria simultaneously through cross-functional integration. Several studies have empirically suggested the existence of this approach in the last years (Ferdows and DeMeyer, 1990; Vickery et al., 1993; Ward et al., 1994; Flynn and Flynn, 2004). Therefore, companies instead to focus in a narrow group of competitive criteria, they would seek to accomplish high performance in multiple competitive criteria simultaneously.
Cross-Functional Integration

The link between performance and manufacturing’s cross-functional integration is frequent in the literature (Skinner, 1969, Wheelwright, 1984, Ward et al., 1994). Hayes (2002) stated that manufacturing needs to act beyond the functional silos in order to achieve a performance suited to the current competitive landscape.

Related to this approach, integration between manufacturing and marketing has been studied along the last decades (Abernathy, 1976; Shapiro, 1977; Hutt and Speh, 1984; Crittenden, 1992). Some classical articles like Shapiro (1977) and Crittenden (1992) emphasized the gap between manufacturing and marketing management and identified their different points of view as a cause of the cross-functional distance.

Parente (1998) listed possible approaches in manufacturing-marketing integration research. One of these is related to the hierarchical level: strategic, tactical or operational. According to her, the contact between the two functional areas are more direct at the operational level, because short time adjustments are sometimes at this level. At the same time, while in the tactical level some individual characteristics are not at the center of the interaction, individual and functional integrations are the spotlight at the strategic level.

On the other hand, Malhotra and Sharma (2002) also listed key-decision areas, which are dependent of cross-functional integration between manufacturing and marketing. These areas include strategic planning integration, strategic or visionary forecasting, new product/process development, tactical forecasting, demand management and operational integration. Thus, Parente (1998) and Malhotra and Shama (2002) suggest that manufacturing marketing integration should range from strategic to operational aspects. Nevertheless, despite the importance to the interactions among marketing and other functions (Kohli and Jaworski, 1990, Narver and Slater, 1990, Slater and Narver, 1994, 1995), empirical evidences on how this integration influences company’s performance are still scarce.
Cross-Functional Integration and Performance

Operations performance is usually linked to the competitive criteria. The four competitive criteria (quality, costs, flexibility and delivery) with slight variations have been cited for many authors in the last decades, such as Skinner (1969), Wheelwright (1984), Miller and Roth (1994), Ward et al. (1998) and Boyer and Lewis (2002). Vickery (1993) linked production competence to company’s strategy and identified also an influence of production competences over company’s overall performance.

Along the years, articles have focused on different competitive criteria and their relation with manufacturing and marketing integration. Some of them have preferentially discussed flexibility and product development. We may mention Song, Montoya-Weiss and Schmidt (1997), Olson et al. (2001) and Tatikonda and Montoya-Weiss (2001). Considering customer’s satisfaction, Kahn and McDonough III (1997) also explored the possible links between collaboration, performance and satisfaction.

Another aspect is related to the overall business performance. Shapiro (1977) and Crittenden (1992) analyzed barriers and performance improvements when higher level of cross-functional integration occurs. Studies such as Leary-Kelly and Flores (2002) explored the link between operations, business performance and manufacturing and marketing integration. The authors used the classic competitive criteria as the moderating variables. Managerial practices that present a cross-functional orientation like quality management also may influence the whole business performance (Kaynak, 2003). Finally, Hausman et al. (2002) identified better performance when companies seek higher levels of manufacturing and marketing integration.
Operations Management and Business Performance

The link between operations and business performance has been a challenge for the literature on operations management. Cleveland et al. (1989) was one pioneer article linking competence to performance. They showed that internal competences explained the business performance in the cases studied. Nevertheless, Vickery et al. (1991) claimed that only production competence can not explain business performance. The authors mentioned external environment as another key aspect for business performance. In a second study, Vickery et al. (1993) identified that business performance is better when production competence is coherent to business strategy.

Thus, a cross-functional orientation in operations may create the needed links between production competence, external environment or business strategy. The literature usually is based on the traditional competitive criteria (cost, quality, flexibility and delivery/dependability) as measures of operations performance. Similarly, Roth and Miller (1992) and Kaynak (2003) showed that quality management and resource exploitation leads to superior performance. Swink et al. (2007) as well identified that the integration along the company’s value chain is related positively to business performance. Therefore, according to the literature we may state that a business performance is related to production competence as well to the external environment.

Hypotheses

Different authors have stated that manufacturing and marketing leads to high performance (Shapiro, 1977; Crittenden, 1992). Based on a cumulative capabilities approach we claim that companies may have high performance in multiple competitive criteria
simultaneously (Ferdows and De Meyer, 1990, Mapes et al., 1997; Noble 1995; Rosenzweig and Roth, 2004). Thus, we may address the following hypothesis:

**Hypothesis 1** – Competitive priorities (Cost, Quality, Flexibility and Delivery) are positively related among themselves.

Crittenden (1992) identified a lack of integration between manufacturing and other functional areas. Malhotra and Sharma (2002) also showed that the lack of integration between manufacturing and marketing has been a recurrent theme in the literature. We hypothesize that companies with high level of manufacturing and marketing and cross-functional integration will seek high performance in multiple competitive criteria. Therefore, we propose the following hypothesis:

**Hypothesis 2** – Competitive priorities (Cost, Quality, Flexibility and Delivery) are related to manufacturing marketing integration.

Skinner (1969), Hayes and Wheelwright (1985), Hill (1989) showed that an effective cross-functional participation in the strategic process strengthen company’s competitiveness. Cross-functionality has been understood as the basis for the creation of competencies that enable firms to exploit competitive advantages (Grant, 1996). Thus, we claim that cross-functional orientation is the ability of manufacturing to interact with other functional areas in order to improve company’s strategies and processes.
Hypothesis 3 – Competitive priorities (Cost, Quality, Flexibility and Delivery) are related to cross-functional orientation.

Hypothesis 4 – Manufacturing and marketing integration is positively related to cross-functional orientation.

Literature on production competence shows that the link between operations performance and business performance is not only related to production competence. We consider that manufacturing and marketing are key functional areas for company’s performance (Shapiro, 1977; Crittenden, 1992; Parente, 1998) because they may link the external and internal aspects. Ward, Leong and Boyer (1994) and Hausman, Montgomery and Roth (2002) linked cross-functional approach to performance. We should expect that companies with higher levels of cross-functional integration present a high performance at the business level (Leary-Kelly and Flores, 2002). Thus, we may address the following hypotheses:

Hypothesis 5a – Cross-functional orientation is positively related to profitability.

Hypothesis 5b – Cross-functional orientation is positively related to sales increase.

Hypothesis 6a – Manufacturing and marketing integration is positively related to profitability.

Hypothesis 6b – Manufacturing and marketing integration is positively related to sales increase.
Methodology

We carried out the research in two steps. The first step followed an exploratory approach. The second step was a survey, which is discussed in the next sections. We studied three companies in the exploratory step.

The first company is a manufacturing automation specialist. The second company is a global supplier of components for agricultural machines and heavy transport equipment. The third company is a global competitor in port loading equipment. These three cases analysis and the theoretical review oriented the first version of the questionnaire. Additionally, a group of three scholars and three managers analyzed the questions and suggested some adjustments.

We developed the variables based on the theoretical domains discussed in the literature review. The questions are at the end of the article. We used a survey by mail to collect the data. We mailed twice the questionnaires.

Shortly, the steps followed during the field research were: (a) framework validation with researchers and managers; (b) first mail of the definitive questionnaire to the chosen sample; and (c) second mail to no responder companies.

Sample

We sent the questionnaires to 366 companies located in the Southern region of Brazil from the food and machinery industries. These two industries are the main Brazilian exporters. These companies were chosen from Sebrae’s (Brazilian Service for Companies’ Support) database. All the companies have more than 100 employees. We received answers from CEOs, vice-presidents, manufacturing directors, and manufacturing managers.
The response rate was 27.2 % (99 companies). There was a response bias related to the industry. This fact may be related to a possible higher integration between companies from machinery industry and universities which leads to a higher response rate. (Table 1)

Table 1 – Return rate for each industry.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Number of Companies</th>
<th>Return rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>163</td>
<td>31 (19 %)</td>
</tr>
<tr>
<td>Machinery</td>
<td>203</td>
<td>68 (30.3 %)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>366</td>
<td>99 (27 %)</td>
</tr>
</tbody>
</table>

Annual revenues variable measured company size in the sample. Table 2 shows that there is a proportional distribution regarding this profile characteristic.

Table 2 - Company’s profile – Annual Revenues (US$1,000)

<table>
<thead>
<tr>
<th>Function</th>
<th>Freq</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5,000</td>
<td>22</td>
<td>22.2</td>
<td>22.2</td>
</tr>
<tr>
<td>5,000 - 25,000</td>
<td>31</td>
<td>31.3</td>
<td>53.5</td>
</tr>
<tr>
<td>25,001 - 250,000</td>
<td>21</td>
<td>20.2</td>
<td>74.7</td>
</tr>
<tr>
<td>More than 250,000</td>
<td>25</td>
<td>25.3</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
Scales

We based our analysis on a group of scales: cross-functional orientation, manufacturing and marketing integration, competitive priorities and business performance.

The manufacturing marketing integration (MMI) scale measures how extent that these two functional areas are integrated in the three hierarchical levels, i.e., strategic, tactical and operational (Parente, 1998; Malhotra and Sharma, 2002). Variable I1 is related to the strategic level (product and service development). Variable I2 evaluate the tactical level (integrated coordination) and variable I3 focus on the operational issues (problem solving).

The competitive priorities scale is related to the four competitive criteria (cost, quality, delivery and flexibility). We measured how extent that manufacturing management seeks to improve performance in each competitive criterion.

We measured cross-functional orientation (CFO) using the scale Ward et al. (1994). Finally, business performance focuses on two competitive dimensions of the business unit. One is related to the short time performance (profitability). The second evaluate medium and long time performance (sales increment).
Validity and Reliability Analysis

Several authors have argued that traditional Exploratory Factor Analysis presents clear limitations (Heck, 1998; Ahire et al., 2000; Jiang et al., 2000; Das et al., 2000). We used a Confirmatory Factor Analysis (CFA) in order to verify validity and reliability. The analysis was based on three dimensions: reliability, unidimensionality and convergent validity.

We analyzed the scales through a CFA. We tested two alternatives models. The first model with all the relations between competitive criteria and MMI and CFO did not present robust goodness-of-fit indices (Figure 1). The model showed in the Figure 2 was the best solution considering the goodness-of-fit indices.
Figure 1 – Proposed model with direct relations between all the competitive criteria and manufacturing and marketing integration and cross-functional orientation.
GFI, AGFI, CFI and NFI present recommendable values (above .90). The model presents chi-square equal to 11.667 and the probability level is not significant, as expected.

Table 3 – General statistics for goodness-of-fit

<table>
<thead>
<tr>
<th>Stand Alone Indices</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>11.667</td>
</tr>
<tr>
<td>Degrees of Freedom (df)</td>
<td>3</td>
</tr>
<tr>
<td>Probability Level</td>
<td>.55</td>
</tr>
<tr>
<td>Goodness of Fit (GFI)</td>
<td>.971</td>
</tr>
<tr>
<td>Adjusted Goodness of Fit (AGFI)</td>
<td>.921</td>
</tr>
<tr>
<td>Standardized RMR</td>
<td>.071</td>
</tr>
<tr>
<td>RMSEA</td>
<td>.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incremental Indices</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Normed Fit Index (NFI)</td>
<td>.904</td>
</tr>
<tr>
<td>Incremental Fit Index (IFI)</td>
<td>1.01</td>
</tr>
<tr>
<td>Comparative Fit Index (CFI)</td>
<td>1.00</td>
</tr>
<tr>
<td>Tucker-Lewis Coefficient (TLI)</td>
<td>1.03</td>
</tr>
</tbody>
</table>
Figure 1 - Competitive priorities, manufacturing and marketing integration, cross-functional orientation, and performance.

* Significant at $p < .10$
** Significant at $p < .05$
*** Significant at $p < .001$
The chi-square difference tested the discriminant validity between the scales (Anderson, 1987; Ahire et al., 1996; Stratman and Roth, 2002). Using the usual procedure of fixing the correlation for the three pairs of scales, the models showed statistically significant differences. Thus, the results suggest that the scales present acceptable levels of validity and reliability (Table 4)

Table 4. Results of confirmatory factor analysis test of measurement scale discriminant validity

<table>
<thead>
<tr>
<th>Construct Scale Pairs</th>
<th>Unconstrained</th>
<th>Constrained</th>
<th>$\chi^2$</th>
<th>Differe</th>
<th>$\chi^2$</th>
<th>DF</th>
<th>$\chi^2$</th>
<th>DF</th>
<th>nce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing Cross-Functional</td>
<td>10.8</td>
<td>8</td>
<td>95.6</td>
<td>9</td>
<td>84.8*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marketing Integration Orientation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at $p < .01$

MMI also presented satisfactory reliability indices. Cronbach’s Alpha was equal to .83, Average Extracted Variance equal to .51 and Composite Reliability equal to .76 as recommended. Cross-Functional Orientation (CFO) is a scale with two past applications in the literature, including Ward et al. (1994) and Paiva et al. (2008). Again the scale presented satisfactory reliability indices with Cronbach’s Alpha equal to .90.
Results

Hypothesis 1 was confirmed. All the competitive criteria presented a positive covariance in the model indicating that managers seek a high performance in multiple competitive criteria simultaneously. Only cost and flexibility did not present a statistically significant result. Possibly, companies in the sample are adopting Advanced Manufacturing Technologies in order to achieve new performance patterns. Lean systems or microelectronic based equipments are able to lead to high levels of performance in quality, cost and flexibility simultaneously.

On the other hand, the results confirm only partially hypothesis 2. Manufacturing and marketing integration are directly correlated to two competitive priorities (cost and quality). Even that, this result shows some relationship with the cumulative capabilities approach because quality is present as a basic capability (Ferdows and Meyer, 1990).

Similarly, hypothesis 3 is partially confirmed. Delivery and flexibility influences positively CFO. Therefore, the results found suggest that when companies seek higher performance in more than one competitive criterion it is important to integrate their functional areas internally. In this specific case, manufacturing and marketing are potentially the key functional areas in order to accomplish high performance in cost and quality.

Hypothesis 4 is confirmed. MMI is positively related to CFO. This is an expected result. When theses two key areas are integrated manufacturing presents better conditions to participate in the company’s strategic decisions.

At the same time, manufacturing and marketing integration is positively related to business performance with statistically significant results. Thus, the hypothesis 5a is partially confirmed and hypothesis 5b is confirmed because its result is statistically significant. This is result is coherent to several studies such as Shapiro (1977) and Crittenden (1992). Hausman et
al. (2002) also had identified empirically a positive relationship between the performance and manufacturing and marketing integration exploring cultural aspects.

Hypothesis 6a is also partially confirmed and hypothesis 6b is confirmed with the same reason of the last paragraph. Companies that manufacturing management seeks to participate in strategic decisions achieves higher business performance. This is also an expected result (Ward et al, 1995; Swink et al, 2007). Thus, this result suggests that like world class manufacturing companies the sample analyzed also presents relationship between MMI and CFO with business performance. Even that, high levels of performance are more identifiable in the sales performance than in the profitability.

Conclusions

The study showed empirically that manufacturing and marketing integration and cross-functional orientation are directly related to competitive priorities based on a cumulative capabilities approach. The results suggest that when manufacturing management is concerned to achieve high performance in multiple competitive criteria, manufacturing is more integrated to other functional areas and participates directly in the strategic decisions. The results are coherent to the literature on manufacturing and marketing integration. In this way, manufacturing and marketing with shared goals would be a characteristic of the most competitive companies.

The path analysis between competitive criteria and manufacturing and marketing integration and cross-functional orientation may indicate a sample’s cumulative capabilities sequence. Thus, cost and quality would be the basic capabilities because they influence directly manufacturing and marketing integration. Delivery and flexibility would be the capabilities in the sequence because they presented a positive correlation with cross-
functional orientation, which is a wider action compared to manufacturing and marketing integration because it involves strategic decisions and more than two functional areas. The positive covariance between all the competitive criteria indicate that there is no trade-off preponderancy in the sample analyzed.

Business performance is positively related to manufacturing and marketing integration and cross-functional orientation. These results are also coherent to the literature on manufacturing and marketing integration and cross-functionality. Along the last decades different authors have stated that both these aspects are key elements for business performance. Therefore, the results confirmed our expectation that companies achieve better results when manufacturing plays a decisive role in the strategic process.

Finally we emphasize that all the results need caution considering the sample size and the focus in only two industries. Future research may explore other performance measures for business performance and manufacturing performance. Other industries also may be analyzed in order to test the results found.

References


ROTH, A. e MILLER, J., Success Factor in Manufacturing, Business Horizons, July/August, 1992, p. 73-80.


Questions

I1 – Indicate how often manufacturing develop conjoint activities with marketing in order to develop new products/services.

I2 – Indicate how often manufacturing develops activities in order to improve its coordination with marketing.

I3 - Indicate how often manufacturing develops cooperative activities for problem solving with marketing.

P. Indicate which are the manufacturing managerial priorities.

1. Manufacturing costs

2. Product conformity to the project specification
3. Capability for quick new production introduction

4. Manufacturing lead time reduction

<table>
<thead>
<tr>
<th>Scale</th>
<th>Unimportant</th>
<th>Modestly important</th>
<th>Sometimes</th>
<th>Important</th>
<th>High Important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

BP1. Which is the company’s profitability in the last year?

- Negative 1
- Equal to zero 2
- Until 5% 3
- 5% to 10% 4
- More than 10% 5

BP2. The sales improvement in the last three years was

<table>
<thead>
<tr>
<th>More than</th>
<th>Less than</th>
<th>Stable</th>
<th>Less than</th>
<th>More than</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20%</td>
<td>-20%</td>
<td>+20%</td>
<td>+20%</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>