Market orientation, alliance orientation, and business performance in the biotechnology industry

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ABSTRACT
The purpose of this study was to test the unexplored relationship between market orientation (MO), alliance orientation (AO), and business performance (PERF) in the medical/healthcare subsector of the Canadian biotechnology industry. The study surveyed Canadian biotechnology executives via mail and web-based questionnaires. It was found that the relationship between MO and PERF was positive and significant and the relationship between AO and PERF was positive and significant. It was also found that the relationship between MO and AO was positive and significant, supporting the existence of a mediation relationship. Specifically, MO’s influence on PERF was found to be fully mediated by AO. This suggests that Canadian medical/healthcare biotechnology companies that were highly market-oriented were also highly alliance-oriented, and highly alliance-oriented companies were top performing companies. This study outlines the apparent sequential relationship between market-oriented behavioural commitments, alliance-oriented activities, and business performance outcomes among Canadian biotechnology companies. Furthermore, it has business development and the commercialization process implications for biotechnology managers.

INTRODUCTION
Canada is a leader in biotechnology, ranking in the top five countries globally.1–3 The largest subsector of the global biotechnology market is medical/healthcare, accounting for more than 67 percent of total market value.4 In the biotechnology market, effectiveness is predicated on having a strong and complete management team with competencies in all functional areas including marketing.5 Costa, Fontes, and Heitor state that marketing is an imperative managerial competency for successful biotechnology commercialization.6 Additionally, biotechnology ventures with high market knowledge are more likely to be acquisition candidates, obtain licensing deals, and accumulate capital infusions.7 Top managers of biotechnology companies identified having a focus in marketing strategy and the establishment of strategic alliances as critical industry success factors.8 There is a strong demand for biotechnology managers and entrepreneurs with marketing and...
alliance-building competencies, as these traits enable organizational success.9 Due to the biotechnology industry’s competitive intensity with regard to the attainment of capital and survival, managers need to be successful in identifying target markets and sharing knowledge with strategic alliance partners, as these competencies have been proven to perpetuate organizational success.10

Although strategic marketing capabilities are said to be an imperative in the commercialization process, the body of research related to marketing in the biotechnology industry is limited. It is widely accepted that MO is fundamental to the marketing concept and measures an organization’s commitment to marketing and marketing strategy.11-21 Narver and Slater20 theorize that MO is a construct comprised of behavioural components including customer orientation, competitor orientation, and interfunctional coordination. “The theory of market orientation suggests that the three behavioral components are equally important” in determining an organization’s commitment to marketing and marketing strategy (p26).20

Strategic alliances are inter-organizational agreements aimed at collectively achieving individual organizational goals and gaining competitive advantages.22-24 In the biotechnology industry, strategic alliances are highly prevalent, as these cooperative efforts enable global expansion and minimize risk for alliance partners.25,26

Strategic alliances in the North American biotechnology industry have been extensively studied in academic research.27-34 AO is a construct designed to comprehensively measure strategic alliance practices, including the employment of alliance strategies in organizations. More specifically, it measures a company’s ability to scan for new alliance partners, coordinate alliance strategies, and learn from alliance experiences.35

The purpose of this study was to examine the influence of MO and AO on business performance in the medical/healthcare subsector of the Canadian biotechnology industry.

LITERATURE REVIEW

The MO and performance relationship has been studied across various industries (biotechnology, construction/surveyor, exporters, forestry, hotel, internet advertisers, manufacturing, mass-merchandisers, multi-industry, and services) and in many countries (Australia, Canada, China, Ghana, India, Israel, Saudi Arabia, United Kingdom, and United States).11,12,15,17,20,21,36-39,41-47,49-51 Cano, Carrillat, and Jaramillo52 and Kirca, Jayachandran, and Bearden,53 provide evidence for the robustness of MO’s influence on performance. The majority of studies used data from the manufacturing industry or a multitude of sectors,39,54 while only a small number of studies have explored MO and performance in the biotechnology industry:12,55,56

Appiah-Adu and Ranchhod12 employed the Narver and Slater20 instrument to measure MO and performance among UK biotechnology companies. Appiah-Adu and Ranchhod12 hypothesized that MO would be positively related to new product success, growth in market share, profit margins, and overall performance. Their findings supported three of four hypotheses, specifically MO’s positive relationship with growth in market share, profit margins, and overall performance.12 No statistically significant relationship was found between MO and new product success.12 Appiah-Adu and Ranchhod12 concluded that the unsupported hypothesis was a result of the peculiarities of the biotechnology industry.

De Luca, Verona, and Vicari55 measured MO and performance in the Italian biotechnology industry. De Luca, Verona, and Vicari55 hypothesized that customer orientation, competitor orientation, and interfunctional coordination would be positively related to their newly developed performance construct. Results supported their third hypothesis, indicating interfunctional coordination was positively and directly related to performance.55 It was found that customer orientation and competitor orientation were not positively and directly related to performance, leading to the rejection of the first and second hypotheses.

Renko, Carsrud, and Brannback36 explored the relationship between MO and performance among US and Scandinavian biotechnology companies. Overall, MO was found to be an antecedent to capital invested in biotechnology companies, ultimately supporting their hypothesis. However, when examined separately, the significance of the MO and performance relationship was only present among Scandinavian companies. This suggests that differences, related to the strength of the relationship between MO and performance, may exist across various national borders.

Hypothesis 1: Market orientation will have positive effect on business performance in the medical/healthcare subsector of the Canadian biotechnology industry

Strategic alliances in the North American biotechnology industry have been extensively studied in academic research.27-34 Furthermore, Baum, Calabrese, and Silverman,27 Baum and Silverman,28 and Silverman and Bauml2 have examined the role of strategic alliances in all subsectors of the Canadian biotechnology industry.
Baum, Calabrese, and Silverman\textsuperscript{27} found that new biotechnology companies’ performance increased with the size and efficiency of the alliance networks.\textsuperscript{27} Particularly, biotechnology companies that obtained early alliances with pharmaceutical companies experienced more patenting, a proliferation of revenue, an increase in the number of research and development (R&D) and non-R&D employees, and growth in R&D spending.\textsuperscript{27} Baum and Silverman\textsuperscript{28} investigated differing types of strategic alliances and their relationship with financing and overall performance in the Canadian biotechnology industry.

Baum and Silverman\textsuperscript{28} found that new biotechnology ventures financially benefited most from downstream (partnerships with firms closer to the market) and horizontal (partnerships or agreements with rival biotechnology companies) alliances as opposed to upstream (agreements between biotechnology companies and universities, research institutes, government labs, hospitals, or industry associations) alliances. Baum and Silverman\textsuperscript{28} suggest that biotechnology companies with alliances closer to the market (downstream or horizontal) raise more capital and perform well because it demonstrates legitimacy and commercial viability to venture capitalists.

In their study of Canadian biotechnology firms, Silverman and Baum\textsuperscript{32} found that horizontal alliances, particularly those with rivaled biotechnology firms, can impede exit rates and success. Specifically, forming horizontal alliances with rivaled companies that have greater access to the market and have more efficient networks can have negative implications for the partnering firm.\textsuperscript{32}

In various settings involving biotechnology companies, individual strategic alliance elements (e.g. alliance size) have been empirically shown to have positive and direct relationships with performance.\textsuperscript{27-30,33}

There is collective evidence showcasing how effective strategic alliance management is an antecedent to performance, yet no known study has measured it comprehensively and examined its effect on business performance in the biotechnology industry.\textsuperscript{27-30,33} Therefore, the use of the Kandemir, Yaprak, and Cavusgil’s\textsuperscript{15} AO instrument for this study was appropriate, as it was designed to comprehensively measure a company’s commitment to strategic alliance management. The prior review of literature regarding strategic alliances and performance led to the formulation of the second hypothesis.

**Hypothesis 2:** Alliance orientation will have a positive effect on business performance in the medical/healthcare subsector of the Canadian biotechnology industry.

Marketing and strategic alliance management competencies have been cited as biotechnology industry success factors.\textsuperscript{8,9} MO has been shown to increase the likelihood of commercial success in the biotechnology industry\textsuperscript{2,55,56} and effective strategic alliance management has been proven to increase biotechnology companies’ performance.\textsuperscript{27-30,33} Therefore, if biotechnology companies’ marketing (measured by MO) and strategic alliance management competencies (measured by AO) are strong and positive, performance is also likely to be favourable. Empirically, MO and other constructs (e.g. organizational entrepreneurship, corporate entrepreneurship, organizational flexibility, export market knowledge, quality and service, cultural affinity, and channel support) have been identified as unique and additive predictors of performance.\textsuperscript{27-30} Combining MO and AO to examine their additive effect on business performance is novel, as it is presumably an unstudied research area. The third hypothesis was developed based on evidence highlighting the importance of MO and strategic alliance management in the biotechnology industry, as well as findings from studies examining the additive effects of MO and other constructs with performance.

**Hypothesis 3:** Market and alliance orientation will have a positive and additive effect on business performance.

**METHODS**

**Data source**

A questionnaire was mailed to 453 Canadian medical/healthcare biotechnology companies. In order to ensure the inclusion of the 115 medical/healthcare biotechnology companies located in the Province of Quebec, with the cooperation of the Université du Québec à Montréal (UQAM), the original questionnaire was translated from English to French. A web-based option was provided as an additional completion option. Senior executives of Canadian biotechnology companies were selected as key informants due to their comprehensive knowledge of marketing, alliance strategy, business performance, and an overall understanding of their companies. Biotechnology executives (CEOs, Presidents, Vice Presidents, or Managing Directors) were identified using the Canadian Life Sciences Database and Industry Canada’s Company Database.

Data collection began in May and ended in August of 2012. At the end of data collection a total of 87 responses and 53 return-to-sender packages were received. Six of the 87 responses explicitly stated that the focus of the biotechnology company was not, nor did it have the potential to become, medical/healthcare focused. These
six were then removed, reducing the responses and sample size to 81 and 447 respectively. Upon receiving the return-to-sender packages, online searches were conducted in order to determine the status of the companies. From the searches it was found that the companies had merged, been acquired, filed for bankruptcy, suspended trading, moved, or dissolved. These 53 companies were subsequently removed from the sample, further reducing its size to 394. Therefore, the response rate of the project was 20.6% (81/394). Comparatively, the number of responses received was favourable to similar studies of MO in the biotechnology industry.12,55,56 Specifically, Appiah-Adu and Ranchhod,12 De Luca, Verona, and Vicari,55 and Renko, Carsrud, and Brannback56 obtained 62 (58.49%), 50 (30.67%), and 85 (44.27%) responses, respectively.

According to Armstrong and Overton,60 subjects that respond later, as opposed to earlier, more closely resemble non-responders. Therefore, in the absence of non-responder questionnaires, key constructs can be compared among early and late responses to determine the existence of a nonresponse bias.60 Leveraging the works of Armstrong and Overton,60 independent sample t-tests were conducted to compare the group of companies classified as early responders and the group of companies classified as late responders, based on their group mean scores of MO, AO, and PERF. No statistically significant differences were found in the analyses, suggesting that early and late responders did not differ. Seeing as early and late responders did not significantly differ, there was no evidence of a nonresponse bias.

**Construct measurement**

Due to its successful use in the biotechnology industry, MO was measured using Appiah-Adu and Ranchhod’s12 adapted version of the Narver and Slater20 instrument. For scale size consistency, a five-point Likert scale was used to assess companies’ customer orientation, competitor orientation, and interfunctional coordination. Good reliability was achieved (α = 0.876), as described by George and Mallery.61 An un-weighted average of MO’s 12 items was used as a composite index score to represent the construct in subsequent analyses.

AO was measured using Kandermir, Yaprak, and Cavusgil’s35 nine-item instrument. The five-point Likert scale was used to assess companies’ alliance scanning, alliance coordination, and alliance learning. Excellent reliability was achieved (α = 0.919), as described by George and Mallery.61 An un-weighted average of AO’s nine items was used as a composite index score to represent the construct in subsequent analyses.

PERF was measured using an adapted and broadened version of De Luca, Verona, and Vicari’s55 R&D Effectiveness instrument. The five-point Likert scale was used to assess companies’ ability to generate new products, file or obtain patents, produce scientific output, recruit new talent, demonstrate technological leadership, attain new capital, and build partnerships. Good reliability was achieved (α = 0.844), as described by George and Mallery.61 An un-weighted average of PERF’s eight items was used as a composite index score to represent the construct in subsequent analyses.

**Discriminant validity**

Discriminant validity between MO, AO, and PERF was tested using composite index scores. Table 1 shows the correlations between MO, AO, and PERF group mean scores. The Pearson correlation coefficient between MO and AO was 0.470, the standard error was 0.098, and the 90 percent confidence interval was 0.296 ≤ r ≤ 0.622. The Pearson correlation coefficient between MO and PERF was 0.303, the standard error was 0.118, and the 90 percent confidence interval was 0.133 ≤ r ≤ 0.525. The Pearson correlation coefficient was 0.668, the standard error was 0.094, and the 90% confidence interval was 0.581 ≤ r ≤ 0.892. These confidence intervals did not contain the number one, suggesting that acceptable discriminant validity between the group means was achieved.62

**RESULTS**

Hypothesis 1 predicted that the relationship between MO and PERF would be positive and statistically significant. The result from the first regression analyses is presented in Table 2. Findings showed that MO had a positive and statistically significant effect on PERF, thus supporting H1. According to Erdfelder and Buchner’s63 post hoc power analysis, with an effect size of $f^2 = 0.101$, no statistically significant differences were found in the analyses, suggesting that early and late responders did not differ. Seeing as early and late responders did not significantly differ, there was no evidence of a nonresponse bias.

<table>
<thead>
<tr>
<th>Table 1: Correlation Matrix</th>
<th>MO</th>
<th>AO</th>
<th>PERF</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AO</td>
<td>0.470</td>
<td>0.000</td>
<td>1</td>
</tr>
<tr>
<td>PERF</td>
<td>0.303</td>
<td>0.668</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Listwise N=79*
Table 2: MO and PERF Regression Analysis

<table>
<thead>
<tr>
<th>IV</th>
<th>DV</th>
<th>R²</th>
<th>Beta</th>
<th>t-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO</td>
<td>PERF</td>
<td>0.092</td>
<td>0.329</td>
<td>2.791</td>
<td>0.007</td>
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Table 3: AO and PERF Regression Analysis

<table>
<thead>
<tr>
<th>IV</th>
<th>DV</th>
<th>R²</th>
<th>Beta</th>
<th>t-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO</td>
<td>PERF</td>
<td>0.446</td>
<td>0.737</td>
<td>7.877</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 4: MO, AO, and PERF Regression Analysis

<table>
<thead>
<tr>
<th>IV</th>
<th>DV</th>
<th>R²</th>
<th>Beta</th>
<th>t-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO</td>
<td>PERF</td>
<td>0.446</td>
<td>0.737</td>
<td>7.877</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 5: MO and AO Regression Analysis

<table>
<thead>
<tr>
<th>IV</th>
<th>DV</th>
<th>R²</th>
<th>Beta</th>
<th>t-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO</td>
<td>AO</td>
<td>0.220</td>
<td>0.459</td>
<td>4.690</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**DISCUSSION**

The finding from the first hypothesis confirmed that Canadian medical/healthcare biotechnology companies with high MO scores outperformed companies with lower scores. The finding from the second hypothesis confirmed that Canadian medical/healthcare biotechnology companies with high AO scores outperformed companies with lower scores. The third hypothesis envisaged that MO and AO would have a positive and statistically significant additive effect on PERF. The results showed that MO had a positive and statistically significant effect, but MO had a non-significant effect, on PERF, thus only partially supporting H3. A post-hoc mediation analysis revealed that the effect of MO on PERF is fully mediated through AO. The mediation relationship suggests that MO influences AO which in turn influences PERF. In other words, market-oriented biotech companies are better at managing strategic alliances, of which leads to having better performances.

“Market orientation is the organization culture that most effectively and efficiently creates the necessary behaviors for the creation of superior value for buyers and, thus, continuous superior performance for the business” (p21). MO is an organizational culture that encourages customer-oriented, competitor-oriented, and interfunctionally-coordinated behaviours. AO is a comprised of three organizational capabilities including alliance scanning, alliance coordination, and alliance learning. “Alliance orientation will be strong when a firm possesses higher degrees of each of these capabilities and is able to skillfully configure and deploy them” (p326). In the case of Canadian medical/healthcare biotechnology companies, perhaps MO is the foundation and AO is the vehicle for increasing PERF. Consequently, companies that encourage organizational behaviours including customer orientation, competitor orientation, and interfunctional coordination may be better equipped to engage in alliance scanning, alliance coordination, and alliance learning activities. Ultimately, it is
the successful execution of these alliance activities that appears to increase business performance.

The Canadian medical/healthcare biotechnology industry has embraced Narver and Slater’s market-oriented organizational culture, as companies in the industry understand its target markets and customers, recognize its competitors’ strengths and weaknesses, and disseminate knowledge throughout its departments. Having this market-oriented organizational culture is necessary for, but not directly related to, performance. Canadian medical/healthcare companies have adopted Kandermir, Yaprak, and Cavusgil’s alliance-oriented organizational capabilities, as companies actively scan for new alliance partners, effectively manage existing alliances, and learn from its partners. The alliance management organizational capabilities act as catalyst that enables the realization of the full benefits of a market-oriented organizational culture.

In summary, a sequential relationship exists between MO, AO, and PERF, as a business’ philosophy needs to be established prior to its undertaking of activities, and the execution of those practices, grounded in the organizational philosophy, perpetuates business performance.

LIMITATIONS

The first limitation of this study was the response rate. Although this study compared favourably to similar studies in terms of the number of responses received (N = 81), the response rate was comparatively lower (20.6%). The timing of the study may have negatively impacted the response rate. Specifically, data collection was conducted over the summer months, beginning in late May and ending in late August. It is possible that some executives were on holiday during the time of data collection. Another limitation of this study is the single-respondent approach, as one respondent per company answered questions related to marketing, alliance management, and performance. The final limitation of the study is the scope and nature of the investigation. This study investigated the importance of marketing and strategic alliances in determining business performance, a topic that was salient to the researcher. The hypothesized antecedents were generated from literature and guided by the researcher’s knowledge and interests.

IMPLICATIONS AND CONCLUSION

Empirical data from this study lends support for the importance of market and alliance orientation in determining Canadian medical/healthcare biotechnology companies’ performance. The findings from this study have several implications for biotechnology entrepreneurs and managers. First, the results provide evidence that behavioural orientations toward customers, competitors, and business units are the foundation needed to increase business performance. The findings also indicate that managers should pay particular attention to alliance scanning, coordinating, and learning, as these activities enable business performance. Third, managers should understand the sequential relationship between the market-oriented behavioural commitments, alliance-oriented activities, and business performance outcomes, as it can aid in business development. For instance, the sequential relationship between these behaviours, activities, and outcomes can act as a theoretical pathway to increase performance. Companies that were highly market-oriented were also highly alliance-oriented, and highly alliance-oriented companies were top performing companies. The apparent sequential relationship is not the only commercialization pathway, nor does it explain all of the behaviours and activities needed to be commercially successful, but it is important for managers and entrepreneurs to be mindful of its significance.

These findings produced several contributions to marketing and management academic research. First, Narver and Slater’s MO instrument proved to be successful with an unstudied population. The instrument’s success in the Canadian medical/healthcare biotechnology industry contributed to a large body of research that confirms MO positively influences performance. Second, this was the first known study to comprehensively measure strategic alliance management activities in the biotechnology industry. This study employed the underutilized Kandermir, Yaprak, and Cavusgil AO instrument, thereby expanding AO research and the use of the instrument. Moreover, the findings contribute to a large body of research that suggests strategic alliance management positively influences biotechnology performance. Third, this study goes beyond confirming MO and AO’s importance in the relationship with PERF, as the existence of a mediation relationship was tested and confirmed. Fourth, and perhaps the most significant contribution was the development and successful use of the PERF instrument. The PERF instrument proved to be an effective instrument when measuring biotechnology business performance. Finally, the findings expand the scope of biotechnology marketing and strategic alliance management research. It may be fruitful to explore MO in other biotechnology subsectors, expand the use of the AO instrument in other industries and cultural contexts, utilize the newly developed and successful PERF instrument to measure biotechnology performance in other subsectors and cultural contexts, and investigate the influence of other possible antecedents to biotechnology business performance.
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