Competitive Positioning and Innovative Efforts in SMEs

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ABSTRACT. This paper reports on the results of a study conducted on 455 smaller manufacturing firms. Its aim was to investigate the relationship between competitive positioning and innovative efforts as measured by R&D expenditures, process innovation, and the use of patent data bases. Results indicate that a relationship does indeed exist and that firms which hold a stronger competitive position in terms of cost, quality, and diversity generally make greater efforts with regard to innovation. In fact, some differences have been found to exist in the intensity of the various innovative efforts between groups of firms having different realized competitive strategies. These findings support the assumption that a link exists between business strategy and innovative efforts, and that this link is strongest in those firms which have the best competitive positioning.

1. Introduction and background

The current environment of market globalization, trade liberalization and rapid technological change poses new challenges to manufacturing firms. In this context, the innovative efforts of these firms assume critical importance. These innovative efforts are not limited to the introduction of new products, services or procedures, efforts that have traditionally been evaluated in terms of investment in research and development (R&D) or of new technology acquisition. Increasingly, firms must develop internal mechanisms which will foster technological awareness through systematic scanning of technical and commercial developments.

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Many studies have investigated the relationship between certain types of innovative efforts, such as R&D, and performance measures like sales growth (Franko, 1989; Morbey, 1988), productivity growth (Chakrabarti, 1990) or profitability (Morbey and Reithner, 1990). Few have specifically focused on the relationship between competitive positioning and overall innovative efforts, as has been pointed out by Schroeder (1990) and Miller (1988).

Given the important role competitive environment plays in defining a firm's actions, we chose to conduct a study of the innovative efforts of small and medium-sized enterprises (SMEs), initially characterized in terms of their current competitive positioning. More specifically, the following research questions will be explored: Is increased competitiveness in manufacturing SMEs associated with greater innovative efforts? Is there a link between competitive positioning and the nature of innovative efforts?

2. Innovative efforts and competitive positioning in SMEs

In a recent study, Clarke et al. (1989) have noted that it is often difficult to define and conceptualize technology strategy and that the technological strengths and weaknesses of different firms are hard to assess. It is therefore assumed that formal policies on technological innovation would be even harder to come by in SMEs and that quantifiable innovative efforts could be indicators of the degree of technological innovation attained by these firms. Even without formal policies on technological innovation, SMEs implicitly emphasize efforts oriented towards the improvements or modification of the technical characteristics of a product (product innovation) or towards the adoption of a new manufacturing process or the

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introduction of new computer-based technologies (process innovation). The classical distinction between product and process innovation has been recognized in many previous studies (e.g., Leong et al., 1990; Adam and Swamidass, 1989; Kimberly, 1987).

In terms of product innovation, it would appear that, historically, smaller firms may have contributed greatly to the improvement of existing products and even to the creation of new ones (Acs and Audretsch, 1988; Rothwell, 1978). Nevertheless, the amounts of money dedicated to research and development are not large, and the existence of a laboratory or a research team is exceptional in the SME environment (Santarelli and Sterlacchini, 1990; Kao, 1983). Formalized R&D activities continue to be concentrated in the larger companies, as shown by the official data from the OECD and the empirical studies of Acs and Audretsch (1987, 1988). In smaller companies, these activities remain informal (Santarelli and Sterlacchini, 1990; Kleinknecht, 1987), often based on the creative talents of a few individuals including the owner/chief executive officer (CEO) himself (Kao, 1983). This may result in an underestimation of the amounts of money dedicated to R&D, at least as they appear in official sources of information (Kleinknecht and Reijnen, 1991). It may also explain why it is so difficult to empirically assess the amounts that actually are attributed to R&D. Not only are the internal accounting procedures inadequate (Kleinknecht, 1987), but the actual reporting of these figures may imply unnecessary time consuming administrative hassles. Within the framework of this study, we merely asked the owner/CEO to estimate the amount spent on R&D. While the cause and effect relationship between the amount spent on R&D and competitive positioning is far from obvious, it is nevertheless assumed that informal R&D activities could well constitute a significant factor in reinforcing this positioning. Given that R&D activities are at the very heart of the process of innovation, patents, which are considered to be the outcome of such activities, are also an indication of innovative efforts (Dror, 1989), although they do not necessarily translate into a competitive advantage (Sanders, 1971).

An integral part of the innovation process is the active search for information. Systematic scanning for external technical information is of the utmost importance, since innovative ideas are more likely to arise as sensitivity to the environment increases (Utterback, 1971; Aguilar, 1967). Furthermore, a deliberate search activity aimed at acquiring technical information must increasingly be an integral part of a firm's technology-based strategies (Link and Tassey, 1987). It is therefore proposed that this constitutes a valid indicator of the innovative efforts which may ultimately contribute to an improvement in a firm's competitive positioning.

A firm that wishes to maintain and improve its competitive position may also consider new computer-based manufacturing technologies (Lefebvre et al., 1991b). Specific strategic advantages have been associated with the adoption of these technologies: a larger flow of new products, greater customization of products, and shorter product life cycles (Buffa, 1985). To this list, other authors have added improved product quality, improved inventory turnovers and shortened delivery cycles (Meredith, 1987a; NRC, 1987; Skinner, 1984, 1985). All of these advantages enable firms to improve their competitive positions (Blois, 1988; Meredith, 1987a). For smaller firms, technology adoption is indeed a crucial decision. Special concerns might be raised regarding their capacity to modernize their facilities in order to respond to the increasing competitive pressures expected in the coming decade (Schroeder et al., 1989). Admittedly, it might seem that the adoption of innovative production processes is the prerogative of large firms, given the necessity for a substantial capital investment and the skilled workforce required to install and operate the new technologies. Nevertheless, this assumption is increasingly being challenged on the grounds that the introduction of new manufacturing technologies has contributed to making small-scale production economically feasible and therefore accessible to smaller firms (Carlsson, 1991; Carlsson et al., 1991). Meredith (1987b) has further justified the adoption of technology by smaller businesses, suggesting that such firms, less hampered by organizational inertia than larger ones, can react more quickly to internal and external pressures. Because managers, even at the highest levels, are less isolated by the organizational hierarchy, they are able to play a greater role in the process of introducing the technology. Lefebvre et al. (1990) also claim

that new technology permits smaller firms to become more flexible, allowing them to respond more rapidly to customers' needs while improving the quality and variety of their products and increasing "made-to-order" production. In fact, the type and range of benefits realized by manufacturing SMEs when adopting these new technologies correspond to the advantages smaller firms are already accustomed to exploit (Lefebvre et al., 1991a; Meredith, 1987b) and thus reinforce their competitive positioning.

3. Method

Sample

A systematic sample was drawn from an up-to-date government master-file of all manufacturing firms operating actively in Quebec, the second largest province in Canada by population. A self-administered questionnaire pre-tested during an on-site exploratory study (Lefebvre et al., 1989) was sent to the CEO of each of the firms selected. The CEO was chosen as respondent because of his/her knowledge of the firm's operations (Hambrick, 1981) and influence in selecting its strategic direction (Miller and Toulouse, 1986).

Response rate to the survey was slightly more than 12%, which is quite acceptable for this type of broad data collection strategy, where no respondent has any particular incentive to participate. No follow-up was done. Respondents to the survey came from every major sector of industrial activity, including furniture manufacturing, pulp and paper, plastics, food, chemicals, electronics and metals. The sectorial representation does not differ from that observed in the population of manufacturing firms operating in Quebec (goodness of fit test $\chi^2 = 11.87$, $p = 0.221$). Annual sales of the firms in the sample amounted to over 31 million dollars, which is not surprising given that 97% of all manufacturing firms operating in Quebec — and in Canada for that matter — are small firms with fewer than 200 employees. The responding firms are also representative of the actual size distribution of firms in the population, although there is a small bias in favour of larger firms. For the purpose of this study and in order to provide comparative data in terms of homogeneity as it relates to firm size, only firms with fewer than 200 employees were analyzed. This upper limit corresponds to one of the accepted definitions of SMEs (Standworth et al., 1982). All subsequent statistical analysis is carried out on the 445 responding firms that met this criterion.

Due to the survey approach used in this study, data should be interpreted keeping certain limitations in mind. The self-reporting procedure by a single respondent may have introduced certain biases. This procedure may also have induced the overrepresentation effect noticed by Kleinknecht (1989), who claims that firms may be more inclined to respond to a survey on innovation if they feel they are innovative in the first place. In that respect, official sources of published data on technological indicators may be more reliable in terms of statistical inference to the population, but they do not address the more specific issues relating to market positioning, strategic orientation and innovative efforts. The purpose of this study is not to provide accurate information on the innovative efforts of Canadian SMEs but rather to analyse relationships that may exist between various innovative efforts and strategic positioning in smaller manufacturing firms.

Research variables

Two sets of research variables were retained. The first set allows one to determine the competitive positioning of the firms and is based on variables similar to those found in PIMS (Profit Impact of Market Strategies). The firm's CEO must thus position his company in relation to its closest competitors along the following dimensions: product price, production cost, product quality, product image, product diversity, quality of customer service and frequency of introducing new products. Relative financial performance (adapted from Lippman and McCardle, 1987) is an additional variable that we have retained to validate the strategic positioning of companies. These eight dimensions, including financial performance, are therefore based on perceptual measures captured using five point Likert scales.

The second set of variables corresponds to certain indicators of the innovative effort of a company. Special attention was paid to providing a comprehensive measure of innovative efforts comprising numerous indicators. This approach

has been used successfully by Chakrabarti and Halperin (1990), who have demonstrated that a correlation exists between the different indicators of technical productivity. The first indicator, the percentage of sales devoted to research and development, is a standard measure and allows one to derive a normalized R&D intensity measurement. It has, however, been argued that R&D expenditure per employee might be a better proxy for innovative efforts (Hill and Snell, 1989) because of the high fluctuations registered in annual sales, although the same argument might be made for the number of employees, which in SMEs is extremely variable due to factors such as seasonal demand and market fluctuations. Yet, in the context of a SME, R&D investments do, after all, tend to relate to informal R&D activities, corresponding to the time invested by a few individuals, often including the owner/CEO. This phenomenon was recognized in an earlier exploratory study conducted in 44 small manufacturing firms using semi-structured interviews (Lefebvre et al., 1989). The other classical measure retained in the study corresponds to the company's holding of at least one patent. Information relating to patents was further qualified by looking into the reasons evoked by firms for consulting patent data bases. This, we feel, provides an indication of the underlying strategic actions motivating this search for external technical and market information.

With regard to innovations in the manufacturing process, an innovation score is calculated for production technologies. The actual score derived takes into account the fact that a process innovation may be either radical or incremental, depending on the organizational and industrial contexts (Dewar and Dutton, 1986; Ettlie et al., 1984). To determine the incremental or radical nature of each process innovation, a panel of 40 experts familiar with the computerized processes found in smaller manufacturing firms was asked to classify on a scale of 1 to 7 (where 1 = process innovations of a more incremental nature and 7 = process innovations of a more radical nature) each of the computerized process innovations. A weighted sum for each firm was then calculated based on the mean attributed by the panel of experts to each of the process innovations, taking into account the presence or absence of each. This weighted sum is considered a proxy of the relative degree of innovativeness of a firm with respect to the adoption of computer-based production technologies. This definition of the degree of process innovativeness permits a more subtle gradation, capturing both a traditional measure (number of process innovations) and the nature of these innovations. The scores obtained in this manner appear preferable to the well-known Khandwalla score (Khandwalla, 1977), based on fixed pre-established criteria that do not take the organizational context into account.

Specific measures for these two sets of variables, as well as the survey instrument, are available from the authors.

4. Results and discussion

Multivariate analysis in the form of factor analysis (principal components) was conducted on all competitive positioning variables in order to investigate interdependencies among these variables and derive a limited number of meaningful factors with a minimum loss of information. Varimax rotation allows one to obtain orthogonal factors and therefore eliminate problems of multicollinearity (Table I). Hierarchical cluster analysis performed on the factors derived from the factor analysis resulted in the identification of three significantly different groups of firms (Table II). Further analysis attempted to identify distinctive innovative efforts associated with each cluster of firms (Tables III and IV).

The results of the factor analysis with varimax rotation conducted on the competitive positioning variables suggest the presence of three very distinct factors (Table I). This analysis produces a clean factor structure with strong items loading on each factor. The first factor, which accounts for 36.8% of total explained variance, is largely loaded with measures of the quality (of products and services) and image of products, and is labelled the "quality" factor. The second deals with the "diversity" of products and frequency of new product introduction. The third factor relates to "cost" dimensions, namely production costs and production price. The three factors thus derived — quality, diversity and cost — are consistent with dimensions that have previously been identified as important for the competitiveness of the smaller manufacturing firms. Globally, they account for

TABLE I
Results of factor analysis using varimax rotation[a] (n = 445)

Strategic posture variables[b]:	Factor 1: *Quality*	Factor 2: *Diversity*	Factor 3: *Cost*
Relative price of products	0.21	0.01	*0.84*
Relative cost of production	−0.11	0.03	*0.87*
Relative product quality	*0.87*	0.05	0.09
Relative product image	*0.82*	0.18	0.10
Relative product diversity	0.28	*0.83*	0.03
Relative quality of customer services	*0.67*	0.26	0.08
Relative frequency of new product introduction	0.11	*0.89*	0.01
Cumulative percentage of explained variance	36.8%	57.6%	72.9%

[a] Kaiser-Meyer-Olkin measure = 0.67 (sample adequacy test).
[b] Variables measured on 5 point Likert scales (1 = very inferior to direct competitors and 5 = very superior to direct competitors).

TABLE II
Profiles of groups of firms derived from cluster analysis on all three competitive dimensions: group means and significance levels

Competitive Dimensions[b]	Group 1 "worst" ($n_1 = 104$)	Group 2 "niche" ($n_2 = 199$)	Group 3 "best" ($n_3 = 142$)	p[a]
Quality	3.24	4.40	4.28	0.0000***
Diversity	3.05	3.47	3.51	0.0001***
Cost	3.04	3.48	2.36	0.0000***
Financial performance	3.22	3.43	3.65	0.0003***

[a] Level of significance of the Kruskal-Wallis test:
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.
[b] Variables measured on 5-point Likert scales (1 = very inferior to direct competitors and 5 = very superior to direct competitors).

72.9% of total explained variance in our sample of 445 small manufacturing firms. Internal reliability tests performed on the dimensions "quality," "diversity" and "cost" show fairly strong Cronbach alphas (0.74, 0.73 and 0.64 respectively), which confirms the interpretation given to the factors.

When hierarchical cluster analysis is performed using these three factors as inputs, three groups of firms are identified (Table II). The first group ($n_1 = 104$), which demonstrates the low mean values on all three dimensions of quality (mean value = 3.24), diversity (mean value = 3.05) and cost (mean value = 3.04), would appear to constitute the least competitive firms since they have no identifiable explicit strategy, and seem to be lagging behind on all three competitive dimensions. The second group ($n_2 = 199$) focuses on quality and diversity while maintaining high costs. This appears to correspond to firms operating in a specific "niche", which would explain why they are able to obtain higher product prices and provide high quality products and customer services.

TABLE III
Competitive strategies and innovative efforts (Comparison between the three groups)

Innovative efforts	Group 1 "worst" ($n_1 = 104$)	Group 2 "niche" ($n_2 = 199$)	Group 3 "best" ($n_3 = 142$)	p[a] for the 3 groups	p[b] for gr. 1 vs. gr. 2	p[b] for gr. 1 vs gr. 3	p[b] for gr. 2 vs gr. 3
R&D as a percentage of annual sales[c]	2.43	3.21	3.62	0.093*	0.031**	0.022**	0.342
Proportion of firms holding at least one patent (%)	6.7	12.6	10.6	0.292	0.058*	0.149	0.285
Proportion of firms using patent information[d] (%)	7.7	14.6	13.4	0.217	0.041**	0.079*	0.377
Score of innovativeness[e] for computer-based production technologies	1.27	1.93	2.39	0.123	0.072*	0.020**	0.204

[a] Level of significance for the Kruskal-Wallis test (continuous variables) and for the χ^2 test (nominal variables):
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.
[b] Level of significance for the Mann-Whitney test (continuous variables) and for the χ^2 test (nominal variables):
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.
[c] Including informal activities.
[d] It should be noted that only a few of the firms consulting patent data bases actually make use of this information for technical or commercial reasons.
[e] This score is a composite measure of the number of computer-based manufacturing applications and the degree of radicalness of these applications as assessed by a panel of experts.

TABLE IV
Motives for consulting patent data bases (Comparison between the three groups)

Motives for consulting patent data bases	Group 1 "worst" ($n_1 = 19$)	Group 2 "niche" ($n_2 = 53$)	Group 3 "best" ($n_3 = 42$)
As a source of technical information	32.1%	46.0%	49.1%
To follow activities of competitors	35.7%	19.0%	28.3%
To prevent duplication of R&D efforts	14.3%	25.4%	28.3%
To develop new products	25.0%	41.3%	37.7%
To develop new processes	10.3%	15.9%	22.6%
To patent a new product or process	14.3%	30.2%	20.8%

Firms belonging in this second group are able to offer a service or product perceived as unique by customers. The third group ($n_3 = 142$) is quite similar to the second with respect to both quality and diversity but differs considerably on the cost dimension, which probably constitutes its greatest competitive advantage. In other words, competing on product cost through efficient production and therefore being able to offer a relatively low cost product, while maintaining high quality and diversity is the characteristic profile of the firms in this group.

Comparative analysis of the three groups leads us to qualify the first group as the least competitive

and term them the "worst", whereas the second group are the "niche" group and the third group the "best" group, since they appear to be efficient producers in terms of cost, diversity and quality of products, and to be very effective in terms of service quality and product image. This analysis is confirmed by the financial performance measures of the three groups presented in Table 2, where the differences are found to be statistically significant at $p = 0.0003$. As expected, the "best" group displays the highest mean financial performance whereas the "worst" group has the lowest. Further validation of these three groups is provided by results of the multiple discriminant analysis performed on the three clusters: the classification rate for the first group was 88.5%, for the second group 77.5% and for the third group 91.5%. Overall, the predictive membership for all groups was 86.29%. Both discriminant functions were highly significant ($p = 0.0000$). The results from the discriminant analysis and the results presented in Table II suggest the presence of compact and homogeneous groups.

Characterization of the three groups with respect to the indicators of innovativeness (Table III) reveals interesting findings that appear consistent with the results shown in the previous table. The "worst" firms do not show any evidence of making particular efforts with regard to R&D, patents or use of patent information, or the adoption of advanced manufacturing technologies. This is in sharp contrast with the "best" firms, whose innovativeness score is the highest, which may explain how they can maintain low production costs and high product diversity. The R&D level is also strongest in these firms, and we may speculate, based on the knowledge we gathered from our on-site studies, that in small firms operating in the manufacturing sector this factor is closely related to process innovation. In fact, Link and Tassey (1987) found in their studies that the estimated rates of return on process R&D were 2.5 times those on product R&D.

The proportion of firms in this group holding patents, while being quite acceptable, is not as high as that found in the second group. This last finding seems reasonable since the second group of firms, operating, as they do, in a "niche", could be expected to rely more heavily on product differentiation, which is likely to be associated with the holding of patents. These firms also demonstrate a proportionately greater percentage of users of patent information. In fact, additional analysis of the principal reasons or motivations for consulting patent information revealed interesting results, which should nevertheless be considered as being purely descriptive since sample size drops somewhat drastically (Table IV).

The number one motivation indicated by the "niche" firms was to consult patents as a source of technical information, while their second and third most important reasons were to develop new products and to patent products or processes. This suggests that those firms which do consult patent information are strongly engaged in a systematic search of technical information in order to keep abreast of new developments while remaining actively involved in the development of new products, as could be expected of firms in a "niche" position. It also indicates much more aggressive behaviour than is found in the "worst" firms, which seem to be primarily in a defensive position, following the activities of competitors. As for the group which we termed the "best", they definitely demonstrate a strong preoccupation with new product development and the search for technical information. Yet, of all three groups of firms, this group is also the most preoccupied with the development of new processes, which may explain why these firms compete the most effectively on all dimensions.

5. Conclusion

The results of this empirical research tend to support the assumption that a link exists between a firm's competitive positioning and its innovative efforts. In order to better understand a small firm's innovative strategy, efforts should first be made to understand the grounds on which that firm has chosen to compete. Smaller firms need to be constantly preoccupied with market signals if they wish to compete, and even to survive. Their innovation strategy must be closely fitted to their market strategy in order to derive the full benefits that innovation may provide. Yet achieving and maintaining a distinctive competitive strategy may require differentiated innovative efforts. It has been shown here that efforts with respect to R&D, patents, and advanced manufacturing technology

adoption differ according to the competitive positioning of a firm; although these results are not completely conclusive, they nevertheless indicate differences in innovative behaviour. This leads us to believe that, for the smaller manufacturing firms, competitive positioning guides, to a large extent, innovative efforts.

Clearly, though, more empirical research, in the form of longitudinal studies, is required for us to fully understand the underlying dimensions of innovation and strategy in smaller manufacturing firms.

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