Competencies and innovative performance of Croatian manufacturing companies

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Introduction

In the last decades competence based view gained considerable attention in the literature on competitive advantage (Prahalad and Hamel, 1990; Hamel and Heene, 1994; Sanchez at al., 1996; Hafeez et al., 2002; Sanchez, 2004; Hafeez et al., 2007). It is also claimed that a combination of technological and marketing capabilities and competencies can create such competitive advantage (Chang, 1996; Dutta et al., 1999; Song et al., 2005). A firm with strong technological competencies is capable of using scientific knowledge to promptly develop products and processes that offer new benefits and create value for customers (McEvily et al., 2004). A firm with strong marketing competencies is able to use its deep understanding of customer needs to foster development of new products and organize marketing activities that provide a unique value to consumers (Day, 1994; Vorhies, 1998). In addition to each of the direct effects discussed above, technological and marketing capabilities operate also in an integrated manner (Fisher and Maltz, 1997; Rothaermel, 2001; Wang et al., 2004; Song et al., 2005).

Competencies influence firm performance by affecting the rate and success of innovation (Tidd and Bodley, 2002). The knowledge represented by these competencies contributes to speed and flexibility of the development process and results in competitive products. As proposed by Swink and Song (2007) there is substantial impact of both marketing and technological capabilities in each stage of product development which in turn is associated with higher project return on investment. Competencies not only influence product competitive advantage but also project lead times.

Greenly and Oktemgil (1997) suggest that as a moderating effect external business environment may severely influence managerial choice. Managers are expected to formulate strategies in accordance with the relevant information about the environment. It is argued that successful new product development depends on the characteristics of the competitive

environment in which the industrial firm operates (Langerak et al., 1997), more specifically technological and market turbulence (Calantone et al., 2003).

Based on data from Croatian manufacturing companies we determined segments of companies based on their innovative performance characteristics and point out the differences in the competitiveness of their technological, marketing and complementary competencies. Distinctions are made between firms in the positions of technology followers and leaders. Technological and market turbulence as key factors in strategy planning for new product development were also analyzed.

Background theory

Competencies as such refer to the ability to utilize resources that spread across multiple functions, products and markets in a sustainable and synchronized manner. They differ from company to company, yet represent a broader, more general perspective on strategy and are not strictly industry specific. Their main constituents are capabilities, a portfolio of capabilities, respectively. Capabilities are repeatable patterns of actions in the use of assets to create, produce and/or offer products to a market (Grant, 1991). Only those key capabilities that are relatively unique and common to various business functions, products and business units are likely to form competencies of a company (Sanchez, 2004). These are industry specific and can be identified by using internal and external knowledge of experts (managers) (Hafeez et al., 2007; Prašnikar et al., 2008).

Technological competencies incorporate practical and theoretical know-how, as well as the methods, experience and equipment necessary for developing new products (Wang et al., 2004). They encompass a portfolio of technological capabilities concerning the capacity of the company to utilize scientific and technical knowledge for research and development of products and processes, which leads toward greater innovativeness and performance (McEvily et al., 2004). According to Swink and Song (2007) technological competencies influence all four stages of the new product development process. At the first stage of business/market analysis technological competencies help address the technical feasibility of products in question. Technical development stage incorporates product and process engineering studies and continues with establishing product designs and specifications, prototyping the product

and approving final designs. In all of these tasks technological competencies have a central position. During the third stage of product testing technological competencies are of secondary importance, still, they influence the design of consumer tests and interpretation of the results. At the last stage of product commercialization they are key for production plans and production ramp-up.

Companies with well developed marketing competencies are well aware of customer needs and are capable of value creation on all elements of a product or service that are relevant to the customers (Day, 1994). Constituent marketing capabilities are therefore an interwoven system based on knowledge and skills that allow the company to generate customer value and also facilitate timely and effective response to the marketing challenges (Vorhies, 1998; Vorhies and Harker, 2000; Song et al., 2005). At the business/market analysis stage marketing competencies provide an evaluation of market impacts of product feature options (Kahurana and Rosenthal, 1997) as the aim is to understand the competitive positioning of the future product. During the technical development stage marketing competencies facilitate product feature decisions. Marketing usually takes a leading role in product testing which encompasses selection of key customers and sites, testing of markets and result analysis. Marketing plans, product promotion and distribution are tasks that require marketing competencies for product launch at the product commercialization stage (Paul and Peter, 1994; Swink and Song, 2007).

Complementary competencies reflect the degree of fit between the two groups. They should be treated as a distinct network of capabilities and a failure to value them properly can lead to a deficient identification of key capabilities. The role of complementary competencies according to Wang et al. (2004) is to: 1) integrate different technological specialties; 2) combine different functional specialties; 3) exploit synergies across business units; 4) combine in-house resources with external capabilities required and 5) integrate the dynamic competence building process for superior performance. To align the new product features (technological aspect) with potential customers' needs (marketing aspect) is the role of complementary competencies at the first stage of new product development. They are also employed in the assessment of the needed investment and accompanying risks (Swink and Song, 2007). Similar complementarity of technological and marketing knowledge is also key during the second stage of technical development. At the same time it proves to be positively related to translating testing results into product and process design modifications (Song et al.,

1998) during the product testing. Integration of both streams of competencies contributes to better coordination of production planning and demand management activities during product commercialization.

Firms' new product portfolios balance between new products based on incremental innovation and fundamental innovation (Ali et al., 1993; Schewe, 1996). Development of new generation products based on radical innovations and development of products shaping new industry trends draws from substantially different and novel technologies. In the case of incremental modifications of products "market pull" provides the information on customers' preferences, while "technology push" prevails with completely new technologies that address customers' latent needs (Tidd and Bodley, 2006). Since consumers buy products for the benefits they gain from them, "technology push" still has to observe customer needs. Therefore, customer and market analysis are crucial also for technologically more novel innovations (Bacon et al., 1994).

Innovation and corresponding competencies demonstrate some specific characteristics when a distinction is made between firms that are technology leaders and those that are technology followers. Forbes and Wield (2000) state that basic research and applicative research enable technologically advanced companies – technology leaders – to create new knowledge and to promote new technologies. The followers, on the other hand, develop indigenous technology learning capacity or in other words the abilities to use existing technological solutions in a more efficient manner. It is therefore characteristic that technologically advanced companies introduce new products, which are new for the market, by using new technologies and by transforming existing technological solutions into new ideas. Being a technology leader demands substantial investments that are risky due to their large likelihood of failure. The followers tend to rely more on incremental than on radical innovation based on basic and applicative research as well as on industrial design that provides these firms with an opportunity to supply market niches and achieve high value added.

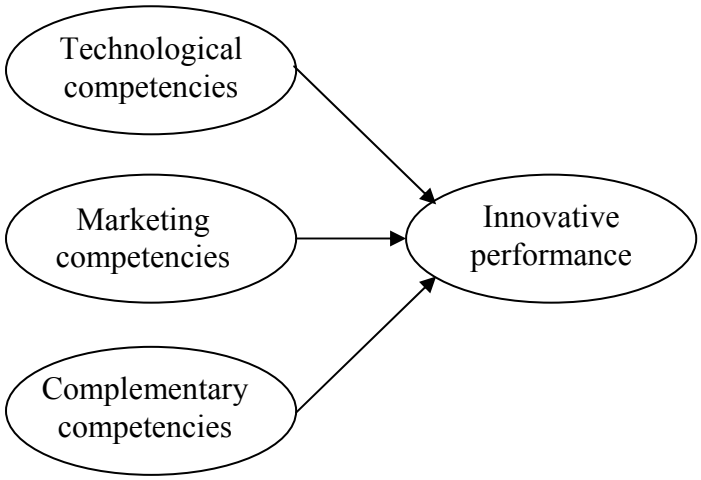
How managers perceive the environment will also reflect in their actions and innovative strategy they choose to pursue. It is important that firms recognize environmental changes and adapt accordingly (Leonard-Barton, 1992). Technological and market turbulence are those two moderating effects that influence new product development strategy planning (Calantone et al., 2003). Technological turbulence refers to the perception whether a firm is able to accurately predict and thoroughly understand specific aspect of the technological

environment. Technological and complementary competencies are key for addressing changes and achieving superior performance in environments with high technological turbulence (Wang et al., 2004). Market turbulence, on the other hand, reflects rapidly changing buyer preferences, wide-ranging needs and wants, competition intensity and constant emphasis on offering new products (Hult et al., 2004). Firms operating in high market turbulence therefore tend to constantly produce innovations in order to respond to the changes in demand and strong competition. They need to develop superior marketing competencies together with strong complementary competencies.

A successful new product development process contributes to financial success of the product and consequently to overall business success of a firm via two paths (Brown and Eisenhardt, 1995). A productive process lowers costs and enables lower and more competitive prices. A faster process further ensures strategic flexibility and shorter lead times. Product effectiveness, on the other hand, is demonstrated through product characteristics, among them low-cost, unique benefits and fit with firm competencies. Products with these characteristics are also more appealing to the consumers (Zirger and Maidique, 1990). Empirical studies provide evidence that both radical and incremental innovations contribute to firm's survival, growth and profitability (Varadarajan, 2008).

On the basis of the conceptual framework on the influence of technological, marketing and complementary competencies on the innovative performance, the following operational model can be constructed (see Figure 1).

Figure 1 Operational model on the influence of technological, marketing and complementary competencies on innovative performance



Sample and data collection

The study is based on a cross-industry survey carried out among medium sized and large Croatian manufacturing firms. The population targeted in the survey was obtained from the databases of legal entities registered in each of the respective countries. Included were firms that have not been registered later than by the years 2002 and have been operating through the whole period 2002-2006 with products under code D (manufactured products) without codes that refer to product related industrial services. For problems arising from product finishing industries such as production of clothing items, several further product codes were excluded. This is to avoid the confusions stemming from aligning the design function in these companies with the definition of the traditional R&D function and related activities in manufacturing firms. The target population thus consisted of 512. The study is carried out on valid responses received by 89 firms. 34% of Croatian firms in the sample are in majority foreign ownership.

Respondents were management level employees in charge of company R&D. The questionnaire was initially tested in 12 firms. Its main segments referred to firm competencies and innovative performance. As especially big firms try to take advantage of synergies and economies of scale and scope, many diversify into different businesses. The firms were thus asked to provide data for individual product lines where applicable, yielding a sample of 105 product lines.

Variables

Variables to simulate the proposed theoretical concepts were selected on the basis of economic, organization and management literature. In devising indicators of competencies we predominantly relied on surveys used in related studies (Chang, 1996; Wang et al., 2004; Song et al., 2005). The selected indicators of the concepts included in the model, enable a multi-industry analysis of the manufacturing sector.

Research shows that technological competencies usually encompass three categories: 1) how advanced research and development is; 2) number of available technological capabilities

inside the firm or through strategic partnerships, and 3) how good the company is at predicting technological trends (Eisenhardt and Martin 200; Wang et al., 2004).

Marketing competencies capture marketing research as well as other marketing activities (Paul and Peter, 1994). To include marketing research and forecast competencies, the indicator "obtaining information about changes of customer preferences and needs" was applied. The competitors' patterns of activities are illustrated with "acquisition of real time information about competitors", customer relationship management with "establishing and managing long-term customer relations" and supplier relations using an indicator "establishing and managing long-term relations with suppliers". Selected indicators to some degree reflect Porter's competitive forces.

Complementary competencies represent the congruence between technological and marketing competencies. The internal environment is measured with "good transfer of technological and marketing knowledge among business units". Indicator "the intensity, quality and extent of research and development knowledge transfer in co-operation with strategic partners" evaluates dynamic perspective and competence acquisition through strategic partnerships. The efficiency of economic utilization of technological and marketing resources engaged in the product development is evaluated through "cost efficiency of product development". Organizational focus is measured with indicator "how clearly are defined the activities of the business units in the corporate strategy of the firm".

The general extent of innovative performance was measured by “number of modified, improved and new products” representing new product variety or level of innovation. Technical performance was added and included by variable “quality of products”. A number of studies in the operations management literature, namely, confirm the relations between product development and product innovation and quality, whereby high levels of innovation are associated with high levels of product quality (Dumaine, 1989; Clark and Fujimoto, 1991; Koufteros and Marcoulides, 2006). While product innovation as such refers to competence responsible for introducing new products and features, product quality or technical performance stands for respective competence of a firm to produce products that would satisfy customer needs for quality and performance (Hall et al., 1991; Kim et al., 2005).

The indicator "time needed to develop an improved product" was applied to determine effectiveness of improving existing products (incremental innovation). Time refers to the

development project lead time and not to the array of products developed as with general indicator number of changed products. Similarly, the effectiveness of new product development referring to radical innovation is measured by "time needed to develop a completely new product".[1] The role of innovativeness of the firm in the industry was represented by indicator "firm's substantial contribution to world trends in the industry«. With this indicator we assume for the market pioneers with innovations their competitors find worth imitating. Additionally, the variable of the extent of imitation and innovation was used to represent the innovative strategy firms tend to pursue in new product development.

The success of innovations mirrored in the price premium the firm is able to attain for its new products on the market was assessed by the indicator value added which in accounting sense represents the difference between revenues and costs of goods/services sold (Treacy and Wiersima, 1993). Respondents ranked this indicator the same way as competencies. While cost efficiency of the firm stands for the efficiency the company tries to increase by exploiting all of the resources at its disposal (Ravald and Grönroos, 1996) it was included as a self assessment indicator of the overall cost efficiency of the firm.

The interviewees evaluated their competencies on a five-point scale relative to their main competitors and thus estimated the competitiveness of their individual competencies within the industry (Song et al., 2005). The scale has five values: 1 - considerably worse than the main competitors, 2 - worse than the main competitors, 3 - same as main competitors, 4 - better than the main competitors, 5 - considerably better than the main competitors. This scale was used also for the variables of new product development characteristics, with the exception of innovation strategy (imitation versus innovation), for added value of products and overall cost efficiency of the firm. Variable depicting to what extent the firms are pursuing the strategy of imitation versus innovation was captured by a five-point scale with the following ranks: 1 – only imitation, 2 – predominantly imitation, 3 – balanced, 4 – predominantly innovation, 5 – only innovation. The time frame for data gathering (data for competencies, innovations and R&D activities) is a three-year period from 2004 to 2006.[2]

Four different indicators were applied to each category of the environmental turbulences (Calantone et al., 2003; Wang et al., 2004; Song et al., 2005). In the case of technological

[1] Indicators correspond to the strategic factors applied by the Strategic Planning Institute in the PIMS database (Chang, 1996).
[2] This is in compliance with OECD classification innovation activity methodology (OECD, 1997).

turbulence were measured speed of change in technology, opportunities arising due to new technologies, ability to predict technological change and extent of technological change in the industry. Question regarding market turbulence referred to market uncertainty, predictability of changes in demand, predictability of competitors' activities and competition intensity.[3]

Segmentation

In order to obtain segments of firms' products lines based on their innovative performance, we carried out a clustering procedure[4] on variables number of changed products and quality of products. We identified three distinct segments which we further compared through competencies to obtain a deeper understanding of the differences between them.[5] In Table 1 pluses (+ in the table) below the average values of variables for segments denote if the differences between segments are statistically significant. If they are not, the same number of pluses is given to the segments. If differences are established, segments are given different number of pluses, the one with the most pluses being the segment with the highest mean value. Looking at the variable number of changed products we can conclude that there are no statistically significant differences observed regarding this variable between the first and the second segment (both denoted by one plus [+]). However, there are differences between the first two segments on one side and the third segment, which is denoted by two pluses [++], on the other.

We identified the following three segments (Table 1):

I. Technology followers with weak competencies

II. Technology followers with strong marketing competencies

III. Innovating technology followers with strong competencies / (Technology leaders)

[3] Indicators of environmental turbulence were evaluated on a five-point Likert scale.
[4] Applied was agglomerative hierarchical clustering procedure using Ward's procedure with Squared Euclidian Distance.
[5] Segments were compared using ANOVA and »post-hoc Duncan test« (equal variances assumed), $P<0,05$ (see Table 1).

Table 1: Product lines segments described by innovative performance, competencies and NPD characteristics

Variables	Segments		
	Technology followers – weak	**Technology followers – strong**	**Technology leaders**
No. of product lines	38	34	30
No. of different companies	32	31	30
Innovative performance			
Number of modified, improved and completely new products in period 2004-2006	2,71 +	2,71 +	4,23 ++
Quality of products	2,92 +	4,32 ++	4,43 ++
Technological competencies			
Advancement of R&D	2,61 +	2,88 +	3,62 ++
Number of quality technological capabilities inside the firm or through strategic partnerships	2,63 +	2,97 +	3,90 ++
Prediction of technological trends	3,11 +	3,18 +	4,03 ++
Marketing competencies			
Obtaining information about changes of customer preferences and needs	2,74 +	3,15 ++	3,73 +++
Acquisition of real time information about competitors	2,94 +	2,97 +	3,60 ++
Establishing and managing long-term customer relations	3,08 +	3,68 ++	4,10 +++
Establishing and managing long-term relations with suppliers	3,24 +	3,71 ++	4,03 ++
Complementary competencies			
Good transfer of technological and marketing knowledge among business units	2,95 +	3,03 +	3,67 ++
The intensity, quality and extent of R&D knowledge transfer in co-operation with strategic partners	2,97 +	3,19 +	3,60 ++
Cost efficiency of product development	2,76 +	3,15 ++	3,60 +++
Clearly defined activities of business units in the corporate strategy of our firm	3,05 +	3,31 ++/+	3,67 ++
New product development			
Time needed to develop an improved product	2,89 +	3,12 +	3,60 ++
Time needed to develop a new generation product	2,85 +	2,89 +	3,60 ++
Contribution of the firm to industry trends	2,25 +	2,47 +	3,21 ++
Imitation VS innovation strategy	2,19 +	2,44 +	3,10 ++
Other			
Added value of products	2,61 +	3,21 ++	3,77 +++
Overall cost efficiency of the firm	2,83 +	3,21 +	3,70 ++

Note: For each variable a segment is described by a mean value (except numbers of product lines and firms counted from the sample). Pluses denote segments with statistically significant differences. Applied was ANOVA, »post-hoc Duncan test«, $P<0,05$.

Technologically most advanced segment is comprised of the so called innovating technology followers. They are very competitive with regard to innovative performance and possess the most developed competencies. However, they balance the strategies of imitation and innovation in new product development (value 3,10), therefore they could hardly be described as technology leaders. With respect to the competitors they regard as their main competitors, they do outperform them but only slightly (values close to 4 or below but above 3). They do especially well at forecasting technological trends. Out of marketing competencies they are the strongest when it comes to establishing and managing long-term relationship with customers and suppliers. Similarly, none of their complementary competencies particularly stand out, the same can be said about the new product development lead times and trend-setting. Out of the three identified segments, they achieve the highest added value for their products and are most cost efficient in their operations.

The opposite are the technology followers with weak competencies. Their innovative performance and majority of competencies are below the level of their competitors and therefore not a means of achieving competitive advantage. Imitation is their strategy in new product development. Among technological competencies, they are the strongest at forecasting technological trends, however, the remaining two technological competencies are their weakest. Establishing and managing relationships with customers and suppliers are their most competitive marketing competencies, they are also doing quite well in obtaining information on competitors (value close to 3), while clarity of their strategy is their strongest complementary competence. However, they are doing quite well also with respect to integrating marketing and technological knowledge as well as taking part in strategic technological partnerships.

Between these two segments are technology followers with strong marketing competencies. While they are lagging behind in introducing new products, their products are very competitive through quality. They are foremost imitators. From the viewpoint of technological competencies, they are at the level of followers with weak competencies. Their advantage lies with marketing competencies, they are particularly competitive at establishing and managing long-term relationship with customers and suppliers. They are surpassing weak followers in obtaining information about customers, however, they are not outperforming their main competitors. When it comes to obtaining information on competitors, they are doing well but performing at the level of week followers. Their complementary competencies

are, too, at the level of weak followers, with the exception of cost efficiency in R&D and also to some extent clarity of strategy.

Table 2: Product lines segments described by environmental effects

Variables	Segments		
	Technology followers - weak	**Technology followers – strong**	**Technology Leaders**
Technological turbulence			
Rapid change of technology in the industry	3,11 +	2,97 +	3,00 +
High impact of new technologies on business operations and competition bringing about big opportunities	3,86 +	3,47 +	4,00 +
Difficulty of predicting technological changes in the next 2 to 3 years	3,49 +	3,00 +	2,83 +
Smaller technological changes represent technological advances in the industry	3,50 +	3,61 +	3,53 +
Market turbulence			
Extremely high market uncertainty	3,97 +	3,76 +	3,57 +
Almost impossible to predict accurately the rapidly changing tastes and demands of consumers	3,11 +	3,03 +	3,03 +
Unpredictability of activities of major competitors	3,08 +	3,06 +	3,03 +
High intensity of the competition in the industry	4,32 ++/+	4,59 ++	4,07 +

Note: For each variable a segment is described by a mean value (except numbers of product lines and firms counted from the sample). Pluses denote segments with statistically significant differences. Applied was ANOVA, »post-hoc Duncan test«, $P<0,05$.

When environmental turbulences are observed (Table 2), it is interesting to note that statistically significant differences have been observed only in the case of one effect of market turbulence which is the intensity of the competition within the industry. Followers with weak competencies and followers with strong competencies report the highest levels of competition, although the level reported by innovating followers is also high. This still does imply that innovation is a way to use differentiation as a strategy to deal with strong competition. It can also be observed that all three segments expressed a very high level of agreements with the statement that new technologies are expected to have high impact on business operations and competition bringing about big opportunities. It could namely be assumed that maturity of industries within the segments could be a decisive factor, however, it appears not to be. Similarly, all segments report high market uncertainty. That all segments fall in to the category of followers can be also seen by them reporting that small technological changes momentarily represent technological advances in the industry.

Conclusion

In our study we have identified three distinct segments of Croatian firms (more precisely their product lines) according to their innovative performance. We found that the segments significantly differ in their competencies, while in terms of innovative strategy they are hardly affected by the perceptions of environmental turbulence. The most innovative firms simultaneously develop all three types of competencies. To some extent firms can compensate weaker technological competencies with strong marketing and complementary competencies. Based on innovative performance and other traits of new product development of the firms in the sample we can also conclude that even firms with well established and competitive competencies seem to have developed their own competence centers, but they can be hardly denoted as technology leaders successfully producing radical innovation. They are typically followers that intensively follow technological and marketing trends and build their market position through inventions, often based on independent design, or imitation.

Our results can help firms understand what competencies they need to develop in order to pursue an innovation strategy of their choice or to examine their existing competencies and identify possible gaps. Technological firms may pay less attention to marketing and complementary competencies than to technological competencies but it can be a great disadvantage if they are not all systematically being developed along the way.

The question that remains is how should a technology follower country approach its growth strategy, narrow the gap with technology leaders and increase its competitiveness. The Lisbon strategy as an action and development plan for the European Union proposes increasing public and private investments in R&D as well as developing innovative climate and entrepreneurship (Commission of the EC, 2005). By focusing on quantative goals such as share of R&D expenditure in GDP, there exists a danger that investments will not effectively translate in concrete actions.

Based on our findings we are able to make several conclusions that support strategies proposed by the Agenda. Namely for technology follower countries technological competencies may be costly and time consuming to acquire. Yet marketing and complementary competencies can successfully facilitate the process of catching up via incremental innovation. Firms can thus choose imitation as a strategy for developing technological capabilities and bridging the gap to a certain extent. Furthermore, incentives for firm cooperation in new product development can help firms overcome the limitations

imposed by their in-house competencies. Encouraged should be innovations based on good market expertise, meaning they respond to concrete market needs and are positioned with a solid understanding of competitors' strategies. Building relationships with customers and competitors should also be encouraged.

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