The Influence of Organizational Absorptive Capacity on Product and Process Innovation

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The innovativeness of an organization has an important impact on its profitability as well as on the competitiveness of a country's economy as a whole. Since the innovativeness of Slovenian organizations is low, it is important that managers and industrial policy makers know which factors influence an organizations' innovation. One of these factors is supposed to be the organizational absorptive capacity. Absorptive capacity is one of the most important concepts that have emerged in the field of organizational research in the past years. Absorptive capacity is defined as the set of organizational routines and processes through which an organization identifies and values new external information, and then acquires it, assimilates it and applies it to commercial ends. The results of this research confirm the strong and positive impact of Slovenian organizations' absorptive capacity on process innovation and the even bigger positive influence on the organizations' product innovation.

Key words: absorptive capacity, innovation, structural equation modelling

1 Introduction

In order for Slovenia to achieve a breakthrough into the group of most developed EU countries, the fostering of innovation on the part of the organizations is essential. The level of innovation activity in Slovenian organizations is low (Damijan et al., 2005:17), which is one of the main reasons for the reduced competitiveness of the entire Slovenian economy. Innovation is the basis for the creation of a higher value added and subsequently, a better prospect for the country and for each individual. Therefore, innovativeness is one of the key values that needs to be fostered in Slovenia.

Innovation is not just of great importance for the economy as a whole but is also a key success factor in the organizations. Changes in the market, technology and competitive advantages on the part of the competitors force organizations to monitor all these changes and to try to keep pace through innovation. While they may follow different strategies, and not all of them aim to be offensive innovators, they can hardly avoid being defensive innovators or imitators at least (Freeman, 1982). Research shows that innovative organizations that are capable of differentiating their products or services through innovation, are twice as profitable as the others on average (Tidd et al., 1997:9).

Innovation is mainly perceived as the introduction of new products or new technologies. Despite that, it is a widely acknowledged fact that the process of innovation encompasses much more than just technological innovation. The process of innovation is a comprehensive process and knowledge flow, therefore it is not appropriate to focus merely on an activities' sequence and outputs (Chesbrough, 2003). Knowledge and innovation are intertwined; innovation is always based on the application of new knowledge and, at the same time, the application of new knowledge leads to innovation. Knowledge is the key to innovation, and therefore it is of great importance for an organization to be able to absorb knowledge from all available sources. The idea about the impact of knowledge spillovers on an organization's productivity and growth is by no means new. Marshal (1891) emphasized that knowledge and technology spillovers play a major role in industrial development. The extent of the external knowledge that an organization can implement, however, depends on its absorptive capacity (Becker and Peters, 2000). Cantner and Pyka (1998) established that building up the absorptive capacity is a superior strategy for acquiring external knowledge for product and process innovation.

Absorptive capacity has been one of the most important constructs to emerge in the field of organizational research in the past decades. In Slovenia, however, the first

studies of absorptive capacity only appeared recently (for example Damijan et al., 2003; Mulej, 2006).

Several researchers acknowledge the importance of absorptive capacity in the process of innovation but there are still only few studies that deal empirically with the relationship between the absorptive capacity and innovation. Therefore, the purpose of this paper is to study the influence of organizational absorptive capacity on product and process innovation, using empirical data for Slovenia.

2 The concept of organizational absorptive capacity

The concept of absorptive capacity originates in the field of macroeconomics, where it represents the ability of an economy to utilize and absorb external information and resources (Adler, 1965). Cohen and Levinthal (1990:128) adjusted this concept to the organizational level and defined absorptive capacity as "the ability of a firm to recognize the value of new, external information, assimilate it and apply it to commercial ends". According to Cohen and Levinthal, absorptive capacity mainly depends on an organization's existing base of related knowledge and it is the key to organizational innovation. The concept of absorptive capacity has been used in many different research fields, such as strategic management, international business, technological management and industrial policy. Also, the use of the concept has not been limited to a specific level of study. Rather, it extends from the individual level (Cohen and Levinthal, 1990), to the business unit level (Szulanski, 1996), to the organizational level (Cohen and Levinthal, 1990), to the dyad level (Lane and Lubatkin, 1998), to the cluster level (Giuliani and Bell, 2005), to the industrial district level (Aage, 2003a, b) up to the county level (Dahlman and Nelson, 1995; Crisculo and Narula, 2002).

The definitions and the use of the concept differ extensively. Some researchers have even used the concept without defining it (for example Glass and Saggi, 1998; Keller, 1996). Most authors, however, propose only slight modifications to the definition proposed by Cohen and Levinthal (1990). Mowery and Oxley (1995) suggested a definition of absorptive capacity as the wide range of skills necessary to deal with the tacit component of transferred knowledge, and the need to modify this imported external knowledge. Kim (1997, 1998) defined absorptive capacity as the capacity to learn and solve problems. Zahra and George (2002:186) further expanded on the most commonly used definition by Cohen and Levinthal, defining absorptive capacity as "a set of organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capability", which is "pertaining to knowledge creation and utilization, which enhances a firm's ability to gain and sustain a competitive advantage". By defining absorptive capacity as a dynamic capability they emphasized its strategic nature. Zahra and George's definition is also incorporated into the present paper.

An organization that aims to be successful in innovation therefore needs to posses sufficient absorptive capacity to be able to exploit external knowledge from all existing sources and make the most use of it for innovation. Researchers who studied the possibilities for increasing organizational absorptive capacity most commonly suggest research and development as a determinant of absorptive capacity (Escribano et al., 2005; Mancusi, 2004; Grünfeld, 2004; Kneller and Stevens, 2002; Knudsen et al., 2001; Kamien and Zang, 2000; Griffith et al., 2000; Rocha, 1999). However, not all of the empirical research supported this assumption. The results show that R&D is not equally significant in all the different circumstances and for all kinds of knowledge (Grünfeld, 2004; Schmidt, 2005). R&D is least likely to influence the absorptive capacity of small organizations (Jones and Craven, 2001). Therefore, some researchers have lately shifted their focus away from this traditional indicator and focused on human resources, involved in the process, instead (for example Mangematin and Nesta, 1999; Vinding, 2006; Kneller and Stevens, 2002). Other frequently mentioned determinants of absorptive capacity are different organizational aspects such as the organizational structure, communication and the ability to combine knowledge (Cohen in Levinthal, 1990; Lane in Lubatkih, 1998; Van den Bosch et al., 1999; Jones in Craven, 2001).

Since the empirical research did not confirm the influence of these determinants on an undisputed way, measuring absorptive capacity through its determinants is questionable, although commonly performed. It is more appropriate to measure absorptive capacity through its results (Schmidt, 2005:3). Even though there also exists no absolute agreement on the definition of absorptive capacity, we can simplify and say that absorptive capacity is basically the capability of an organization to deal with external knowledge in a way that enables its commercial use. Therefore, if an organization uses different external sources of knowledge for innovation, it can be assumed that it possesses a certain absorptive capacity. Moreover, it is a reasonable assumption that an organization that has the ability to use external knowledge, also has the ability to identify and assimilate this knowledge. We also based this paper on that assumption.

3 The influence of organizational absorptive capacity on innovation

Schumpeter was the first to put external information side by side with internal information (Freeman, 1982:213) in his proposed model of innovation. Still, for many years, researchers have mainly been focused on internal knowledge creation. It was not until recently that it became clear that internal knowledge is not sufficient and that the use of information from all the available sources is the key to successful innovation. The closed innovation model has therefore been replaced by the open innovation mo-

del (Chesbrough, 2003), which puts the emphasis on external knowledge. The importance of external knowledge is further demonstrated by the fact that the biggest share of innovation is presented by imitations, not inventions (Cohen and Levinthal, 1990:128). The capability of an organization to exploit external information – absorptive capacity – is therefore a key component of innovation capability. Absorptive capacity is supposed to increase the speed, frequency and magnitude of innovation while, at the same time, innovation produces knowledge, which becomes a part of the organizational absorptive capacity (Lane et al., 2002:3).

The influence of the absorptive capacity on innovation has been studied empirically by several researchers (for example Cohen and Levinthal, 1990; Knudsen et al., 2001; Mancusi, 2004; Schmidt, 2005; Vinding, 2006). Despite that, most of them did not measure the direct influence of the absorptive capacity on innovation, rather the influence of specific absorptive capacity determinants. Since no consensus has yet been reached on which the determinants of absorptive capacity are, their approaches and the subsequent results vary a lot. Besides that, this kind of approach also raises the question of whether the specific alleged determinant really influences innovation through its influence on absorptive capacity or whether it simply influences innovation directly. For that reason, we decided to further investigate the influence of absorptive capacity on innovation. As this is quite common in studies of innovation (for example Utterback and Abernathy, 1975; Gopalakrishnan and Damanpour, 1997; Arundel in Kabla, 1998), we also distinguished between product and process innovation. Since the existing studies of absorptive capacity mainly take just general innovation activity in to account, we wanted to verify the influence of absorptive capacity on product and process innovation. Therefore, the following hypotheses are postulated:

Hypothesis 1: The extent of the absorptive capacity will be positively related to the extent of product innovation.

Hypotheses 2: The extent of the absorptive capacity will be positively related to the extent of process innovation.

4 Methodology

4.1 Sample and data analysis

This research is based on micro data gathered with the survey on "Innovation activity in the manufacturing sectors and selected service sectors", which is carried out by SURS (the Statistical Office of the Republic of Slovenia) every two years. SURS collects the data in accordance with the international OECD (Organisation for Economic Co-operation and Development) methodology and the Eurostat (the Statistical Office of the European Communities) recommendations. In this research, data from 2003 was used.

2564 organizations with 10 or more employees have filled out the questionnaire about their innovation activity. From those, we selected 548 organizations for further analysis. These were the organizations that engaged in the innovation activities in the period of 2001-2002, meaning that they: 1) introduced new or significantly improved products or services; or 2) introduced new or significantly improved production methods or service delivery methods; or 3) engaged in the development of new or significantly improved products, services or procedures that was not completed by the end of 2002; or 4) engaged in the development of new or significantly improved products, services or procedures that were abandoned.

The empirical data was analyzed using both exploratory factor analysis using the SPSS 13 statistical program and confirmatory factor analysis and structural equation modelling using EQS 6.1 (Bentler and Wu, 2005). The structural equation modelling method was selected as the most appropriate method, since it provides the most appropriate and efficient estimation technique for a series of separate multiple regression equations estimated simultaneously (Hair et al., 1998:17). Due to the fact that the distribution of most variables deviate slightly from the normal distribution, the ERLS (elliptical reweighted least squares) method was used, which minimizes problems rising from data skewness and kurtosis and is otherwise comparable with the ML (maximum likelihood) method (Sharma et al., 1989). Following common practice, the fit of the model was assessed using multiple indices: chi-square (which was not given major consideration because this index is highly sensitive to sample size and to the number of items in the model (Bentler in Bonett, 1980)), NFI (normed fit index), NNFI (non-normed fit index), CFI (comparative fit index), GFI (Lisrel goodness of fit index), SRMR (standardized root mean square residual) and RMSEA (root mean square error of approximation). NFI, NNFI and CFI are not sensitive to sample size (Bentler, 1990). NFI, NNFI, CFI and GFI values equal to or greater than 0.90 are considered to represent a well-fitting model, while values greater than 0.80 present a reasonably well-fitting model. RMSEA and SRMR values equal to or less than 0.05 indicate a good model fit, while values of up to 0.10 present an average model fit (Byrne, 2006).

4.2 Measurement instruments

Innovation was measured using seven different variables that measure the effects of the innovation activity. The respondents indicated the degree of impact the effects of different innovation activities had on the organization on a four level scale. To verify the accuracy of the distinction between product and process innovation, we performed an exploratory factor analysis using the SPSS 13 statistical program. The results (shown in Table 1) confirmed the existence of two innovation factors. To further verify the findings of the exploratory factor analysis, we carried out a confirmatory factor analysis in EQS 6.1. Again, the results show that a two factor innovation model is more ap-

Table 1: The factor loadings for product and process innovation

Variables	*Factor*	
	Product innovation	Process innovation
Product innovation		
Increased range of goods or services	0.74	
Increased market or market share	0.79	
Improved quality of goods or services	0.43	
Process innovation		
Increased flexibility in production or service delivery		0.59
Increased capacity in production or service delivery		0.71
Reduced labour costs per unit/transaction produced		0.67
Reduced materials or energy per unit/transaction produced		0.63
Cronbach alfa	*0.71*	*0.75*

N= 548
Method: Principal axis factoring
Rotation: Oblimin with Kaiser normalization (factor loadings that are equal to or higher than 0.25 are shown)
Bartlett's test of sphericity: Chi-square 1028.0, 21 degrees of freedom, sig. 0.0000
Kaiser-Meyer-Olkin measure of sampling adequacy = 0.75
Variance explained = 61.1%

propriate. The construct validity assessment revealed the adequate validity of both constructs: both Cronbach's alpha reliability indices exceed the threshold of 0.70 (Hair et al., 1998).

Absorptive capacity (as an independent variable) is measured with seven sources of information: 1) information from the suppliers of equipment, materials, components or software; 2) information from clients or customers; 3) information from competitors within the same industry; 4) information from universities or other higher education institutions; 5) information from government or private non-profit research institutes; 6) information from conferences, meetings and journals; 7) information from fairs and exhibitions. The respondents indicated the degree of importance of a specific source on a four level scale. The construct validity assessment points to an adequate validity (with Cronbach's alpha at 0.73).

5 Results

The model of the influence of absorptive capacity on product and process innovation, together with the regression coefficients and the variance explained, is shown in Figure 1. All the calculated model fit indices point to a reasonably good model (Chi-square 503.8, 75 degrees of freedom, sig. 0.000; NFI 0.86; NNFI 0.85; CFI 0.88; GFI 0.88; SRMR 0.08; RMSEA 0.10).

5.1 Hypotheses testing

Two hypotheses were tested in this research. Within the *first hypothesis*, the influence of the extent of the absorptive capacity on the extent of product innovation was tested. As shown in Figure 1, there is a strong positive and statistically significant relationship between the extent of the absorptive capacity and the extent of product innovation (standardized coefficient 0.74). Therefore, we can accept the first research hypothesis and conclude that the extent of the absorptive capacity is positively related to the extent of product innovation. With the *second research hypothesis*, the influence of the extent of the absorptive capacity on the extent of process innovation was tested. Based on the empirical results, the second hypothesis can also be accepted (with a positive and statistically significant standardized coefficient of 0.54; see Figure 1). Therefore we can conclude that the extent of the absorptive capacity is positively related to the extent of process innovation.

6 Conclusion

The results of this research shows that absorptive capacity has a strong, statistically significant, positive influence on product and process innovation in the Slovenian organizations that are engaged in innovation activity. The influence of absorptive capacity on product innovation is even greater than its influence on process innovation. Absorptive capacity also explains a greater share of product innovation variance (R^2=0.55) than process innovation variance (R^2=0.30). An organization that is capable of utilizing knowledge from different external sources of information will therefore be more successful in increasing flexibility in production or service delivery and capacity and reducing labour costs and materials or the energy per produced unit or transaction. Such an organization will be

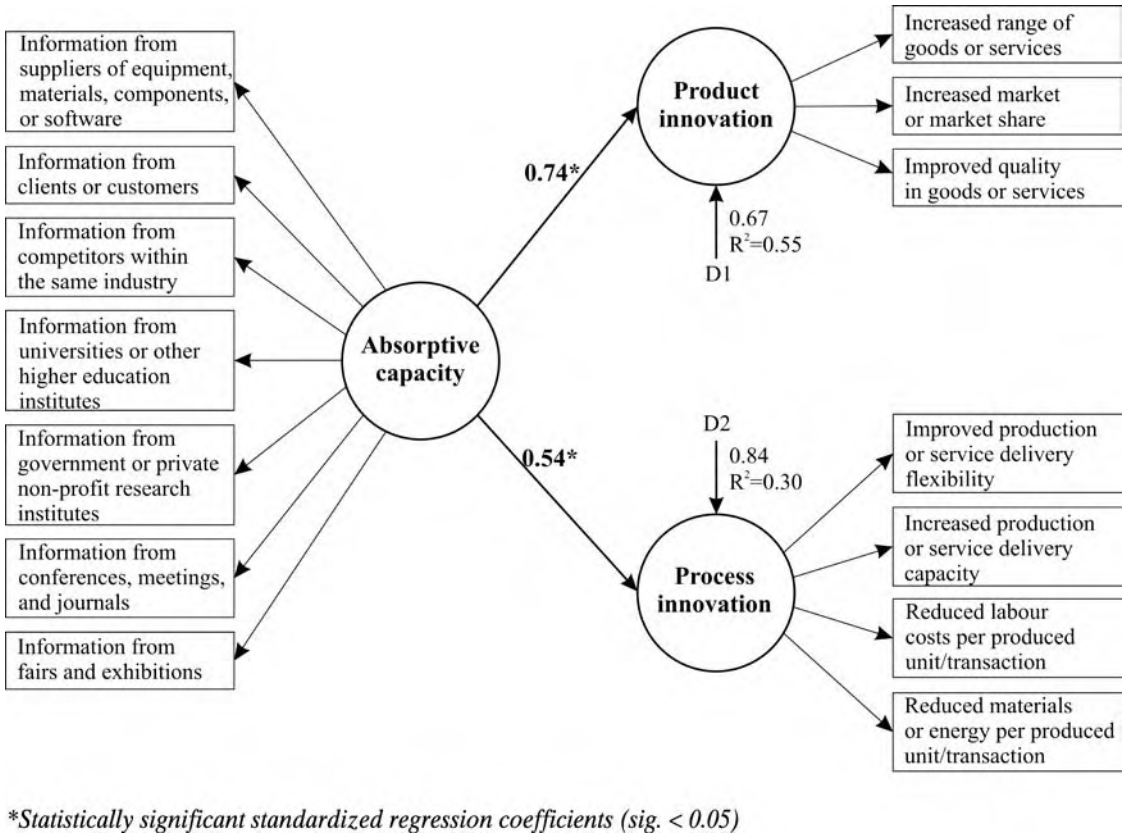

Figure 1: The model of the influence of absorptive capacity on product and process innovation

even more successful in increasing their range of goods or services, increasing their market or market share and improving the quality of their goods and services.

Since:

- the share of innovative organizations in Slovenia is much lower than in the EU-15 countries (Eurostat, 2004),
- the efficiency of R&D investments on the part of Slovenian organizations is pretty low, which is reflected in the low number of patents per unit of investment (Kos, Stanovnik, 2004:21),
- innovation activity does not just have positive effects on an organization's profitability (Tidd et al., 2001:9), but it also increases the competitiveness of the economy as a whole (IMD, 2005),

it is essential that managers and industrial policy makers are acquainted with the factors that influence innovation. Our research shows that absorptive capacity is one of the important determinants of innovation activity in Slovenia. Therefore, organizations should invest in their absorptive capacity. Since previous research has not indisputably shown what the absorptive capacity determinants are, further research is necessary to verify the importance of specific determinants for Slovenian organizations and to answer the question of how Slovenian organizations can increase their capability to identify and value new external information from different available sources, acquire it, assimilate it and apply this information for commercial ends.

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Vpliv absorpcijske sposobnosti podjetij na produktne in procesne inovacije

Inovativnost podjetij ima pomemben vpliv tako na dobičkonosnost podjetij kot tudi na konkurenčnost gospodarstva kot celote. Ker so slovenska podjetja nizko inovativna, je tako za njihove managerje kot tudi za oblikovalce in nosilce industrijske politike pomembno poznavanje dejavnikov, ki vplivajo na inovativnost podjetij. Eden izmed teh dejavnikov naj bi bila tudi absorpcijska sposobnost podjetij, ki je eden od najpomembnejših konceptov, ki so se pojavili na področju organizacijskih raziskav v zadnjih letih. Absorpcijska sposobnost je skupek organizacijskih rutin in procesov, s katerimi podjetja prepoznavajo in ovrednotijo nove zunanje informacije, jih pridobivajo, asimilirajo in aplicirajo za komercialno uporabo. Rezultati raziskave potrjujejo, da ima absorpcijska sposobnost slovenskih podjetij močan pozitiven vpliv na procesne inovacije in še večji pozitiven vpliv na produktne inovacije podjetij.

Ključne besede: absorpcijska sposobnost, inovacije, strukturni modeli