Absorptive capacity constituents in knowledge-intensive industries in Serbia*

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Abstract

The aim of this paper was to explore the determining constituents of absorptive capacity and their influence on the overall absorptive capacity level in the organizations from knowledge-intensive industries in the Republic of Serbia. The research was conducted in order to analyze how does the capability of the organizations from Serbian knowledge-intensive industries to acquire external knowledge, develop their knowledge base, communicate and exploit the absorbed knowledge affect their absorptive capacity. The methodology included quantitative and qualitative research method based on a questionnaire. The data collected were analyzed with the absorptive capacity evaluation model and by applying discriminant function analysis as a statistical method. The basic result shows that the absorptive capacity of organizations from knowledge-intensive industries in Serbia is clearly dependent on the scope of the available relevant knowledge. The fundamental conclusion as the result of this research indicates that the enrichment of the organizational knowledge bases with the relevant new content strongly enhances the absorptive capacity of organizations from knowledge-intensive industries in Serbia. Further research on this topic should be directed towards investigating the relationship between the existing knowledge base and the innovation capability in organizations from knowledge-intensive industries.

Key words: absorptive capacity, relevant knowledge, innovation capability, knowledge dissemination, knowledge-intensive industries

JEL classification: D83; M15; O32

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1. Introduction

The concept of the absorptive capacity was formalized in macroeconomics and it was used to define the economic ability to absorb and use external information and resources (Adler, 1965). Cohen and Levinthal (1989) adjusted this concept and defined absorptive capacity as an ability of an individual or an organization to identify, assimilate and exploit knowledge, emphasizing its influence on a firm's ability to innovate. Many researchers used this definition as a starting point for their research on the nature of absorptive capacity. As the absorptive capacity is a dynamic phenomenon, its characteristics influence knowledge base in the organization. Knowledge base contains knowledge which is embedded in products, methods, practices, experiences, skills, ideas, etc, and which can come from internal and external sources. Internal knowledge sources primarily include scientific research, new product development, new processes, skills development, experiences and organizational structure, while external sources include external scientific research, other firms' products and processes, lead-users, inter-organizational networks and other (Argote et al., 2003, Vega-Jurado et al., 2008).

Absorptive capacity is influenced by the existing knowledge depth in the organization, having in mind that the learning process normally relies on already established learning routine. This means that new knowledge could be more easily absorbed in case it is related to the knowledge already learned by the organization (Cohen and Levinthal, 1989), which is why organizational learning is an important absorptive capacity activator. Absorptive capacity represents a result of the cumulative effect of continual learning (Cohen and Levinthal, 1990). Learning organization nurtures knowledge sharing process among its' employees and experiences continual transformation (Pedler et al., 1997), and uses the absorptive capacity as a signposting tool for its research efforts (Tu et al., 2006). If there is a big difference between the prior knowledge, or the existing knowledge stock, and the knowledge which the organization tends to absorb, the uncertainty of the transformation of new knowledge into new products and technologies is increased (Cohen and Levinthal, 1989). Organizational theorists claim that, by the contingency theory, characteristics of the environment are one of the key factors of organizational performance (Scott, 1981; Betts, 2003; Morgan, 2007). By establishing wide knowledge base, organization becomes more sensitive to outside information and knowledge, which can ultimately result in making new knowledge from the environment more attractable. The firms cannot benefit from external knowledge flows merely by being exposed to them (Cohen and Levinthal, 1989, 1990). Instead, they have to develop the ability to recognize the value of new external knowledge, and then assimilate and utilize such knowledge for commercial ends. An open and supportive communication climate and a knowledge-sharing culture that nurtures knowledge sharing in the organization have a positive impact on the knowledge flow and innovation (Levi-Jakšić, 1995; Van den Bosch et al.,

1999; Tu et al., 2006; Gomez et al., 2010). Some authors suggest that the process of acquiring external knowledge depends on the degree of similarity of cognitive structures, knowledge base, skills and shared languages between an organization and the environment (Escribano et al., 2006).

Having in mind that most of the researchers in the area of absorptive capacity identify four dimensions which characterize this phenomenon: acquisition, assimilation, transformation and exploitation of knowledge, and based on the findings that the main components of absorptive capacity in organizations are prior related knowledge, communication network, communication climate and knowledge scanning mechanism (Cohen and Levinthal, 1990; Brown, 1997; Zahra and George, 2002; Tu et al., 2006), we propose a model for determining the level of absorptive capacity in organizations, which encompasses these absorptive capacity dimensions and components. Based on this model, a research has been conducted with the aim of identifying and exploring the most important determinants of absorptive capacity in knowledge-intensive industries in the Republic of Serbia.

This subject is of the utmost importance for organizations from knowledge-intensive industries, where rapid changes in technology force firms to respond to shortened technological cycles, to absorb critical knowledge and to predict the nature of future technological advances with more accuracy. Peltoniemi (2007) suggested that knowledge-intensive industries differ from other industries based on the continuous search for new knowledge. Tödtling et al. (2004) added that the rate of product and process innovations, notably of a radical nature, is high in such industries, and that the R&D efforts are typically strongly focused on generating radical innovations. Such environments have higher potential for reshaping organizations in pursuing operational excellence (Scott, 1981; Morgan, 2007). Also, the topic is relevant to Serbia, which tends to build a competitive economy based on knowledge (National Strategy of Sustainable Development of Serbia 2008-2017). So far, no studies have been undertaken with the aim of exploring key determinants of the absorptive capacity in the organizations in Serbia. Knowledge-intensive industries sectors have been classified and analyzed according to the 2005 Classification of the Organization for Economic Cooperation and Development (OECD) and grouped into four main industry groups: 1) high-tech industries, 2) knowledge and innovation based services, 3) research firms, and 4) traditional medium-tech manufacturing (OECD, 2005). For the purpose of this research, 256 organizations from knowledge-intensive industries in Serbia have been identified.

In this research we will provide the analysis of the ACAP elements by applying the ACAP (absorptive capacity) evaluation model. It is expected that the results of this research will contribute to better understanding of the factors which shape absorptive capacity in organizations from knowledge-intensive industries in Serbia. The findings should provide support to management in designing their own model for monitoring and managing key ACAP elements.

The hypothesis of this paper is that the scope of the relevant knowledge available internally is the most important parameter for determining the level of absorptive capacity in the organizations from knowledge-intensive industries in Serbia. Following the recommendations from the available literature on the use of internal IT knowledge networks (Yakhlef, 2002; Wellman, 2009; Kumar and Ganesh, 2009, and Senapathi, 2011), we used the organizations' intranet systems as knowledge bases for the application of the proposed model.

The structure of this paper is as follows. Firstly, we will analyze the dimensions and elements of absorptive capacity with the aim of establishing a foundation for the development of the model. In the second step, the methodology and the constructed variables will be presented. We shall then present the results of the data collection and the empirical analysis, followed by the presentation of the methods which were used in the statistical analysis. Finally, we shall present the results and the main conclusions of this research.

2. Literature review

Absorptive capacity may influence the potential of an organization to react to new market demands, adjust to new environment, and to use information and be ahead of competitors, because it may enhance effectiveness of its activities, contribute to the creation of new opportunities for competitive edge, reinforce their knowledge base and increase accuracy for the prediction of future market developments (Cohen and Levinthal, 1990; Teece et al., 1997; Van den Bosch et al., 1999; Zahra and George, 2002; Tu et al., 2006; Camison and Fores, 2010). In order to fully realize the role of ACAP in providing support to the fulfillment of strategic goals of organizations, we need to analyze characteristics of the individual elements and factors that frame the absorptive capacity concept. Having the focus on the knowledge dynamics, the division of absorptive capacity into four dimensions is often cited. These four dimensions of the absorptive capacity are acquisition, assimilation, transformation and exploitation of knowledge (Zahra and George, 2002; Tu et al., 2006). Each dimension plays an important role in the flow of knowledge from its original source to its utilization in the organization. According to the often cited model of Zahra and George (2002), the process of converting knowledge into the actions which produce competitive advantage consist of acquisition, assimilation, transformation and exploitation capabilities. *Acquisition* refers to a organization's capability to identify and acquire externally generated that is critical to its operations (Zahra and George, 2002). The intensity and speed of the process can determine the quality of acquisition capabilities of the firm. *Assimilation* refers to the routines and processes of organizations that allow them to analyze, process, interpret and understand the information from external sources (Kim, 1997a,b; Szulanski, 1996). Teece (1981)

stipulated that the process of comprehension is very difficult when the value of knowledge depends on the existence of complementary assets that may not be available to the recipient. *Transformation* dimension represents a capability of firms to develop and refine the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge (Zahra and George, 2002). Finally, *exploitation*, as a fourth ACAP dimension, was incorporated by Zahra and George (2002) on the basis of the definition of ACAP by Cohen and Levinthal (1990), which emphasized the application of knowledge.

However, the effectiveness of the knowledge flow through these absorptive capacity dimensions depends on the organizational elements which influence each dimension. According to Cohen and Levinthal (1990), Brown (1997), Tu et al (2006) and Camison and Fores (2010) these elements are related to the organizational potential to facilitate efficient inflow, communication and use of knowledge, and, as such, constitute absorptive capacity of organizations. These are: prior-related knowledge, communication climate, communication network and knowledge scanning mechanism.

Prior-related knowledge has been identified as a major constituent of absorptive capacity, next to effective organizational routines and communication processes (Cohen and Levinthal, 1990; Brown, 1997; Zahra and George, 2002; Escribano et al., 2006). Prior-related or relevant knowledge represents understanding of job skills, products, technologies, markets and other business relevant factors, possessed by the workers and managers in the organization (Brown, 1997). It consists of facts and ideas that individuals in the organization have that can influence the process of implementing innovation. Cohen and Levinthal (1990, 1994) suggested that organizations with an adequate base of prior relevant knowledge have the ability to more efficiently evaluate and utilize outside knowledge and proactively envisage future technological advances, thus improving absorptive capacity. On the other hand, firms where such knowledge is limited may be uncertain about the future direction of knowledge and technology development, and they may be discouraged from further investigation. Boynton et al. (1994) claim that a firm's ability to absorb information technology is determined, in part, by its existing knowledge in that area. Also, some studies of international joint ventures confirm that the existence of an appropriate knowledge base is important for achieving success (Shenkar and Li, 1999; Lane et al., 2001). However, not all knowledge can be equally important to different organizations. Absence of the relevance in knowledge may lead into unclear innovation outcome, which is in line with the findings of Audretch and Keilbach (2008), who emphasized that the uncertainty of transforming new knowledge into viable products or technologies increases with the increase of difference between the prior relevant knowledge and the new one. In addition, if an organization is at one point exposed to a vast amount of diverse knowledge, this may lead to a limited possibility of determining relevance of certain forms

of knowledge or its components and, subsequently, to a slower pace of achieving desired results.

Communications climate is the atmosphere within the organization that defines accepted communication behavior, which may facilitate or hinder the communication processes (Brown, 1997). There are many findings which support the view that the open and supportive climate can improve sharing, diffusion and use of knowledge (e.g. Nevis et al., 1995; Levinson and Asahi, 1995; Thompson et al., 2006; Bolfiková et al., 2010). The aspect of interaction that takes place among employees is a crucial element of organizational learning (Wellman, 2009). Institutionalization of organizational learning is more likely to happen in the open and supportive organizational climate. For that purpose, organization should facilitate communication with as less barriers as possible (Crossan et al., 1999). This is where organizational leaders play an important role. It is the leaders who should send the signal throughout organization that the sharing of knowledge provides employees with better insight into knowledge and information relevance, eases their work, increases their chances of being innovative and thus receive compensation for it, but also upgrades capability of organization to cope with new challenges in the environment (Vera and Crossan, 2004). Organizations can also consider an appropriate incentive system related to the use of existing knowledge base for innovativeness, especially in situations where there is much work overload in general. In relation to this, Kim and Lee (2010) propose that the level of performance-based reward system is positively related with employee knowledge acquisition and application capability. Several researchers (Argote and Epple, 1990; Levi-Jakšić et al., 1995; O'Dell and Grayson, 1998; Yahya and Goh, 2002) have noted the utility of incentive systems for motivating employees to generate new knowledge, to share existing one, and to help employees in other divisions or departments. General notion is that performance-based reward systems should increase involvement of all employees in knowledge base utilization.

Communications network is the scope and strength of structural connections that brings flows of information and knowledge to different organizational units (Brown, 1997). Firms require an improved communication network among their employees in order to improve the internal knowledge flows which foster learning (Campo et al., 2008). Berlo (1960) emphasized the role of interaction for effective communication. Meško Štok et al. (2010) concluded that an appropriate communication structure, interpersonal relationships, motivation, stimulation and values as part of organizational culture positively affect business excellence in enterprises. Effective communication binds the organization and is essential for enhancing ACAP as well as integrating functional units (Cohen and Levinthal, 1990). According to many researchers, this dimension of the absorptive capacity relies to a significant extent on the type of organizational structure, which may influence processes of knowledge assimilation, sharing and exploitation in a

positive or negative way (Van den Bosch et al., 1999; Chen and Huang, 2007). There are numerous findings which support the view that less formalized, project oriented organizational type is more favorable than other forms in terms of knowledge processes in an organization. Galbraith (1973) stated that less formal and decentralized coordination of teams allows flexible coordination during task execution and can deal with ad hoc communication and information needs. Teams, project or product groups and similar kinds of horizontal coordination allow high levels of integration (Lawrence and Lorsch, 1967). They can be composed whenever a need for knowledge sharing arises (Grant, 1996; Van den Bosch et al, 1999; Ayas and Zeniuk, 2001). The study by Chen and Small (1994) shows that the use of multi-disciplinary implementation teams is the most significant factor distinguishing successful from unsuccessful adopters of manufacturing technology. Van den Bosch et al. (1999) stressed the positive connection between a matrix-based organizational structure and the absorptive capacity. Based on the assumption that both scope and flexibility have a positive influence on the level of absorptive capacity, while efficiency has a negative impact, the impact on absorptive capacity has been determined as negative with facilitation of the functional form, moderate with the divisional and positive with the matrix form. Another important aspect in relation to the dimension of communication network is the availability of skills and knowledge possessed by experienced employees (often called as "old pros" or "grey hairs") within the organizational network. Wellman (2009) stresses that these experienced employees are a repository of valuable tacit knowledge. Organizations often suffer loss of critical knowledge with the departure of such knowledgeable employees, whose work or actions were not, in part or in total, saved in the organizational brain.

Absorptive capacity also depends of the organizational capability to capture relevant knowledge and technology, or of its *knowledge scanning mechanism* (Tu et al., 2006). This is being done by various activities, such as market tracking, benchmarking, research and development, technology assessments and similar. Cohen and Levinthal (1990) stressed the importance of R&D collaborations for the generation of new knowledge, which often emerges as a byproduct. The findings from the study by Kostopoulos et al. (2011) show that firms' involvement in innovation collaborations with various external parties enriches their knowledge base and develops a better ability to assimilate and exploit external knowledge. Cooperation between organizations in sharing best practices and putting their efforts into inter-organizational learning contributes to knowledge scanning activities (Levinson and Asahi, 1995). It is important to notice that scanning for new knowledge should yield better results in environments where the technological development is obvious, as they provide better conditions for establishing cooperation in technology development, and a fertile ground for knowledge spillovers. Being proactive in such environments, the organization will tend to use possibilities for absorbing knowledge from all available sources (Cohen and

Levinthal, 1990). Vega-Jurado et al. (2008) stressed the importance of connections with scientific institutions in such environments, noting that, when the firm's internal competences are not taken into account, the technological opportunities derived from universities or public research organizations, constitute a key element in the development of products with a high degree of novelty and the only source of relevant external knowledge in high technology sectors. On the other hand, Cohen and Levinthal (1990) and Vega-Jurado et al. (2008) suggest that a firm does not require a high level of internal technological competences for easily accessing and exploiting the knowledge generated by suppliers, competitors and customers. Also, decreased ACAP will force organization to be more reactive and to look for other alternatives as responses to market or profitability failures (Cohen and Levinthal, 1990). The scope of mentioned arrangements, alliances, market and technology intelligence and other knowledge scanning drivers increases the capability of organization to assimilate and utilize knowledge from various external sources.

3. Methodology

For the purpose of analyzing the absorptive capacity parameters in the knowledge-intensive industries in Serbia, we have constructed *the absorptive capacity evaluation model* which observes the knowledge from its availability in the organization to its final utilization. The purpose of the constructed model was to evaluate the overall absorptive capacity and its elements. The absorptive capacity evaluation model encompasses four dimensions of ACAP and it is in accordance with the division of ACAP into components, based on the available findings (Cohen and Levinthal, 1990; Brown, 1997; Zahra and George, 2002; Tu et al., 2006). With the application of the proposed model, the absorptive capacity can be evaluated based on the following variables: *available relevant knowledge*, *knowledge base exploitation*, *potential for the external knowledge inflow*, *knowledge dissemination capacity*, and *innovation capability*. The prior-related knowledge component is represented in the model by the *available relevant knowledge* variable. The communication climate and communication network components are integrated into the *knowledge dissemination capacity* variable, based on their mutual influence on the dissemination of knowledge within the organization. The knowledge scanning mechanism was represented by the *potential for external knowledge inflow* variable in the proposed model. Finally, for the purpose of the model applicability and for the research goal, two new variables were developed: *knowledge base exploitation* and *innovation capability*, which are explained in more details further in the text.

For the purpose of the research and following the recommendations by Yakhlef (2002), Wellman (2009), Kumar and Ganesh (2009), and Senapathi (2011), we used *intranet systems*, as internal IT knowledge networks of organizations, in the role of the knowledge base. Intranet represents an internal IT system or network,

which offers many ways of communicating knowledge (Kim, 2003). On the intranet, the knowledge can be added, retrieved, modified, used or deleted. Mphidi and Snyman (2004) emphasized existence of strong awareness of the value of the intranet as a knowledge management tool. By presenting findings from Siemens' IT system ShareNet, Ciabuschi (2003) proposed that there is a positive relation between deploying an IT system for knowledge sharing and direct interaction between corporate units. In general, knowledge management has revolutionized the intranet as a knowledge base, giving it the task of providing knowledge, not just information or data, which means that it had to communicate both explicit and tacit resources to the user. However, not all information and especially knowledge can be stored and retrieved in its original way. Relevance of content alteration in such actions has been subject to debates (Yakhlef, 2002; Wellman, 2009). The more the knowledge is tacit, the greater is the likelihood that it may be distorted in the storage and retrieval process. Wellman (2009) added that huge human effort is needed in order to transfer tacit knowledge in an effective way (e.g. by communities of practice, teamwork, process experts). An organization can do its best to minimize the knowledge distortion tendency by focusing on the optimization of knowledge recording, retrieving and understanding processes (e.g. by codification or conceptualization). In order not to overload its intranet, but also comprehending all relevant information and knowledge, an organization needs to consider the best intranet content which will suit its business goals. Too much information and knowledge can cause problems for employees who use intranet. Edenius and Borgerson (2003) compared uncontrolled loading and structuring of information on an intranet with a chaotic situation in a room where one can get all information at the same time. There can hardly be an optimal intranet content that suits all organizations. However, based on the available findings and research recommendations in this area (Kumar and Ganesh 2009; Senapathi 2011; Radovanović, 2012), and also considering characteristics of explicit and tacit knowledge and the underlined absorptive capacity framework, we have proposed the content, as a list of identified elements of relevant knowledge to be stored, retrieved and used, which organizations should facilitate on their intranet. According to these findings and for the purpose of the research, the proposed intranet content should include: information on products, technologies, management and various external parties, reports on market analysis and past and current researches; material for „replicating" or transforming valuable knowledge, such as online training modules, idea base, best practice cases and information on how to avoid pitfalls; procedures, templates and other documents related to internal processes; news; newsletters and various publications; and platforms for internal and discussion with external parties. In regard to the already mentioned knowledge distortion potential, companies often use a variety of multimedia applications (such as audio or video demonstration) to preserve the tacit characteristics as much as possible (Wellman, 2009). Therefore, video and audio forms of knowledge were incorporated into desired intranet content next to the required textual forms. It

should be, however, noted that video or audio forms are not required for the content whose nature is rather explicit, such as templates or reports.

Considering the role of intranet as a knowledge management tool, another important factor is the volume of use of the material stored on the intranet, as its specific purpose is to store what the organization has learned and to make it available for retrieving when it can be useful. The effect of the existence of knowledge on internal IT network to the achievement of organizational goals is largely influenced by the possibility to retrieve and share such knowledge (Wellman, 2009). For the goal of monitoring the use of internal IT network, Wellman suggests that the organization needs to deploy a set of metrics to periodically assess the performance of the intranet. Suggested metrics should address utilization of the knowledge material on the intranet and availability of the system to employees of the organization. The scope of use of the intranet content by employees in organizations is represented in the model by the variable *knowledge base exploitation*.

Final stage of the knowledge absorption process is the exploitation of knowledge. The dimension of knowledge exploitation determines the organizational capability to use what it has learned in order to enhance its competitive power. Therefore, it strongly relies on the entrepreneurship of knowledge, which has been defined as an organizational ability to recognize knowledge acquired through organizational learning as valuable, and then to adopt innovative behavior in order to realize that value (McDonald, 2002). McDonald also emphasized that increased levels of knowledge entrepreneurship are found to lead to increased levels of innovativeness, which in turn leads to increased rates of adoption of innovations. Escribano et al. (2006) point out that the drivers of absorptive capacity are highly correlated with the inputs from the innovation process and a firm's innovation ability. Efficiency of knowledge utilization in innovations may be increased if an organization has a strategic approach to knowledge and technology management. For higher performances, management must be concerned with achieving alignments and good fits between the characteristics of the environment and the organization (Betts, 2003; Morgan, 2007). Management should also ensure that internal needs are satisfied and that environmental circumstances are adapted to. By a contingency theory, such fit ultimately leads to higher performance (Betts, 2003). Betts (2003) added that management of technology is an important factor of organizational performance. Strategic approach to technology management also leads to the increase in licensing activities and collaborations in research and development efforts, which are important external sources of new knowledge (Fosfuri and Tribo, 2008). Luo (2013) stressed that a firm must invest in R&D to improve its absorptive capacity, in order to exploit external R&D spillovers. In-house R&D activities are important because they not only generate new knowledge, but also promote the use of external sources of scientific knowledge (Vega-Jurado et al., 2008). Vega-Jurado et al. (2008) also marked the R&D intensity and technological competences

derived from the in-house R&D as key determinants of product innovation. Another factor of the exploitation of knowledge is the structure of employees. The share of scientists and researchers in the total number of employees may influence the ability of an organization to engage in research and development activities (Mowery and Oxley, 1995; Escribano et al., 2006). For encompassing the abovementioned factors of knowledge exploitation, we have constructed a variable named *innovation capability*, which is used in the proposed model to determine the organizational ability to transform and exploit knowledge.

The setting of relationships between variables in the model is based on the division of absorptive capacity into dimensions of acquisition, assimilation, transformation and exploitation, which cover knowledge dynamics in the organization. In other words, the model (Figure 1) covers the flow of knowledge from its existence in the knowledge base (available relevant knowledge variable), influenced by the scope of knowledge base utilization (knowledge base exploitation variable), to its exploitation (innovation capability variable). The potential for external knowledge inflow variable affects the knowledge exploitation process. Therefore, the model also covers knowledge flow from this source. By encompassing communication climate and network, the knowledge dissemination capacity variable affects knowledge assimilation and transformation processes, which is why in the model it influences the knowledge flow in two places.

Figure 1: The absorptive capacity evaluation model
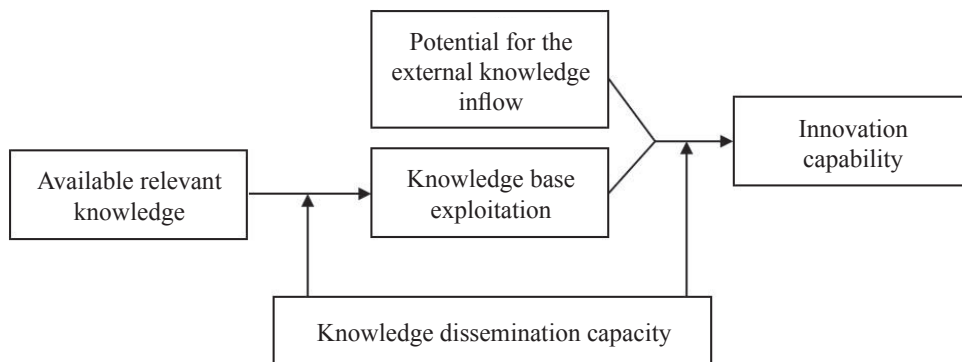
Source: Authors

A questionnaire has been developed for the purpose of the research. The questionnaire included 15 questions, divided into five sets in accordance with the model variables: 1) available relevant knowledge, 2) knowledge base exploitation, 3) potential for the external knowledge inflow, 4) knowledge dissemination capacity, and 5) innovation capability.

The available relevant knowledge section in the questionnaire was based on the characteristics of the prior-related knowledge component and included questions which aimed at getting information whether the elements of the proposed intranet content presented in this paper exist on the organization's intranet. Organizations were asked to confirm or deny existence of such elements and also of other forms of knowledge (such as video and audio) on their intranet structures. Regarding the knowledge base exploitation, questions were designed based on the findings by Wellman (2009), who suggested that metrics in this area should include the percentage of employees with the intranet access, the percentage of the employees entering or seeking information and the frequency of visits by employees, among others. The section of the external knowledge inflow potential intended to reflect the possibilities for organization to acquire relevant knowledge from the environment, i.e. external parties. We used R&D collaborations, strategic alliances, cooperation agreements on new product development, other contracts and arrangements with external sources, customer surveys and client management facilities and services as sources for potential use of external knowledge, as determinants of this dimension, because they provide information on how institutionalized knowledge inflow from those sources may be. Tu et al. (2006) stressed the importance of monitoring patents, patent portfolios, scientific papers and internet as knowledge scanning instruments and an important part of absorptive capacity, because they identify new knowledge from the environment that may impact the firm. These were, therefore, added to the questionnaire regarding the potential for external knowledge inflow variable. We used this variable to evaluate the knowledge scanning mechanism component.

The analysis of the knowledge dissemination capacity variable was based on questions regarding the prevailing organizational form in the organization, organizing in-house training held by experienced employees in the organization, and the existence of a reward system for employees' innovative efforts. The selection of the questions was based on the influence of these factors on the organizational knowledge flow and the absorptive capacity in the findings by Levi-Jakšić (1995), Van den Bosch et al., (1999), Wellman (2009) and Gebauer et al. (2012). This constructed variable was used to evaluate both communication network and climate components.

At the end, the level of innovation capability needed to be determined by the set of questions aiming at analyzing knowledge entrepreneurship, R&D potential, innovation output and technological cooperation utilization. Organizations were asked to provide data on the number of patented and non-patented new products and services, as well as on the number of initialized research and development projects by the organization. This section of the questionnaire also included questions regarding the application of strategies for knowledge and technology management and technology forecasting, number of cooperation contracts involving licensing and research and development, employees education structure and the ratio of scientists and researchers to total number of employees. The selection of the

questions for determining the level of innovation capability was based by findings and recommendations by Cohen and Levinthal, 1990, 1994; Tu et al., 2006; Vega-Jurado et at, 2008; Escribano et al., 2009 and Levi-Jakšić, 2011.

For the purpose of the research, the following step was to determine the level of absorptive capacity of all interviewed organizations, based on the proposed model. Organizations received a score for each of the five variables based on the data which they provided. The score for the available relevant knowledge variable was calculated based on the existence of elements of the proposed intranet content on the organization's intranet. For example, if an organization responded that it had all listed elements on the intranet, it received the maximum score, which equals 1. Any missing element reduced the score proportionally. Calculation of scores of other variables has been carried out in the same way. The value in percentages at indicators was also presented in scores from 0 to 1. For example, if an organization responded that 70% of its employees have access to the intranet, it received a score of 0.7 for that indicator. For every "Yes" answer in the questionnaire the organization received a score of 1, while for "No" it received 0. In relation to the question regarding organizational structure, the score structure was: 0 – functional, 0.5 – divisional and 1 – matrix. In relation to the question regarding the frequency of employees attendance at education events, the score structure was: 0 – rarely, 0.5 – sometimes and 1- often.

In the second step, the average score was calculated based on the sum of scores of all five variables, and this was interpreted as the overall score for absorptive capacity. Based on this score, the organizations were classified into groups with low (included scores from 0–0.25 points), medium low (0.26–0.50), medium high (0.51–0.75) and high absorptive capacity level (0.76–1). As a final step, we evaluated the variables in comparison to the overall level of absorptive capacity of the organizations, in order to determine which of the variables significantly affect the absorptive capacity, but also to assess the relationships between the variables.

4. Data collection and empirical analysis

The research for the needs of this study has been conducted in March 2013. In total, 256 organizations from knowledge-intensive industries in Serbia have been randomly selected and e-mails were sent to them containing questionnaire and detailed explanation of the purpose of survey and its benefits, in order to motivate them to participate. Filled-in questionnaires have been returned by 53 organizations, setting response rate to 20.7%. Based on the proposed OECD classification for knowledge-intensive industries, the structure of the respondents is as follows: organizations from high-tech industries – 35.8%, organizations providing knowledge and innovation based services – 24.5%, research firms – 22.6%, and

organizations from traditional medium-tech manufacturing industries – 17%. The structure of respondents in regard to the number of employees is: from 1 to 9 employees – 11.3%, from 10 to 49 employees – 26.4%, from 50 to 249 employees – 39.6%, from 250 to 499 employees – 11.3%, and more than 499 employees – 11.3%. The mean value for the number of employees of respondents was 876.264, while the median value was 70.000.

The results have shown that the greatest portion of respondents (84.9%) belongs to the groups with medium absorptive capacity level: 43.4% were classified in the group with medium low ACAP and 41.5% in the group with medium high ACAP (see Table no. 1). This was surprising, having in mind that the absorptive capacity is of great importance in the knowledge-intensive sectors, so it was expected that the largest share of organizations would have been classified in the group with high ACAP.

Table 1: Classification of respondents per absorptive capacity level

ACAP level	% of respondents
Low	5.7
Medium low	43.4
Medium high	41.5
High	9.4

Source: Authors' calculation

The mean and standard deviation values for the defined variables and the absorptive capacity level per ACAP group are given in the following table.

Table 2: Descriptive statistics of the model variables

Variable	Low ACAP level		Medium low ACAP level		Medium high ACAP level		High ACAP level	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
ARK	0.333	0.2082	0.360	0.1030	0.568	0.1887	0.780	0.1643
KBE	0.314	0.2493	0.501	0.2231	0.629	0.2231	0.843	0.1604
PEKI	0.233	0.0577	0.378	0.1413	0.568	0.1460	0.625	0.0957
KDC	0.250	0.2500	0.434	0.2306	0.719	0.1371	0.885	0.1140
INC	0.083	0.0707	0.440	0.1520	0.594	0.1250	0.608	0.2703
ACAP	0.200	0.0400	0.433	0.0767	0.624	0.0689	0.788	0.0268

Note: The acronyms ARK, KBE, PEKI, KDC, INC, ACAP denote: available relevant knowledge, knowledge base exploitation, potential for the external knowledge inflow, knowledge dissemination capacity, innovation capability, and absorptive capacity level.

Source: Authors' calculation

Data collected through a questionnaire were analyzed by the discriminant function analysis using the SPSS statistical software.

5. Results and discussion

The data has been statistically analyzed by the discriminant function analysis based on a minimization of Wilks' lambda. At each step of the discriminant function analysis, the variable that minimizes the overall Wilks' lambda was entered. The KDC (knowledge dissemination capacity) variable was the most appropriate discriminator and it was the first variable to enter the model. The Wilks' lambda, initially 1, decreased to 0.499 due to the contribution of the KDC variable. The table below shows how the Wilks' lambda was further reduced in four steps with adding other variables into the model. Continued contribution of each variable to the model was reassessed after adding each new variable. As a result, the Wilks' lambda was reduced to the optimally lowest level with the combination of these four steps.

Table 3: Stepwise discriminant function analysis of the variables

Step	Entered	Wilks' Lambda							
		Statistic	df1	df2	df3	F			
						Statistic	df1	df2	Sig.
1	Knowledge dissemination capacity (KDC)	.499	1	3	47.000	15.736	3	47.000	.000
2	Available relevant knowledge (ARK)	.324	2	3	47.000	11.612	6	92.000	.000
3	Knowledge base exploitation (KBE)	.227	3	3	47.000	10.211	9	109.669	.000
4	Innovation capability (INC)	.176	4	3	47.000	9.039	12	116.705	.000

Source: Authors' calculation

We then used canonical correlation to investigate the overall correlation between sets of variables and to compare the importance of each discriminant function. The first three canonical discriminant functions were used in the analysis (see Table no. 4).

Table 4: Summary of canonical discriminant functions (eigenvalues)

| Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	3.875	95.9	95.9	.892
2	.153	3.8	99.7	.364
3	.012	.3	100.0	.110

Source: Authors' calculation

The first discriminant function had the largest correlation with the ARK variable (.497), while the second discriminant function had the largest correlation with the INC variable (-.675). The third function is represented by the KBE and KDC variables having correlation coefficients of .349 and -.804, respectively. The first discriminant function is the most significant in the model, as it has the highest canonical correlation. Also, the ARK variable includes 95.9% of information in the given model and it is the most important differentiator of the groups. Based on the results, we can assume that the likelihood of measuring the level of organizational absorptive capacity based on the indicator of available relevant knowledge is high.

To a lesser extent, the level of absorptive capacity is also differentiated by the INC variable (3.8% of the total variance). KBE and KDC variables together make only 0.3% of the total variance. The results indicate that, in combination with the available relevant knowledge and the innovation capability, these two variables determine absorptive capacity, but to a limited extent. At the end, by not being included in the total variance, the ability to bring in knowledge from external sources, which represents the knowledge scanning mechanism dimension in the proposed model, does not significantly determine the level of the absorptive capacity in the organizations.

The figure 2 shows the clusters of organizations belonging to four groups with different ACAP level, and centroids for each group. As previously mentioned, the function 1 is represented by the ARK variable, while the function 2 is represented by the INC variable. The figure shows that the organizations with low ACAP level and organizations with high ACAP level are the most separated groups. The positions of the centroids indicate that the distance between the groups in the graph is mainly based on the available relevant knowledge variable.

Figure 2: Plot of the two canonical discriminant functions
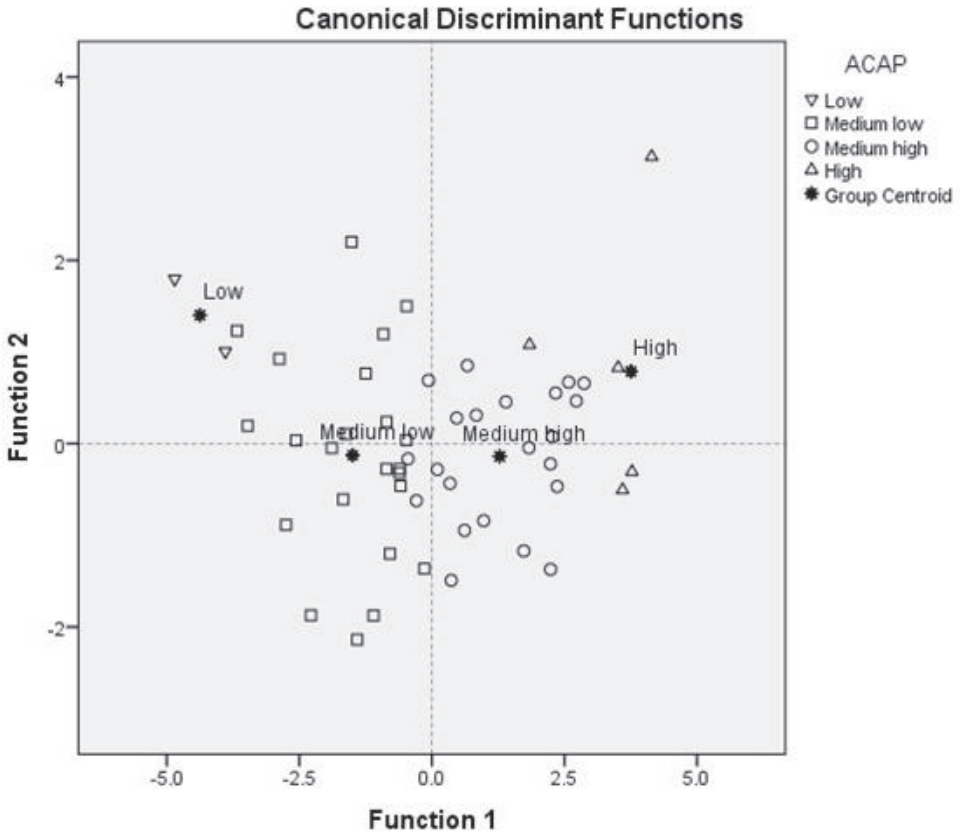
Source: Authors

The figure 2 shows that the positions of the centroids of groups with low and high ACAP are almost on the same level of the function 2, which is represented by the INC variable. It has been shown that as the ACAP level increases in the organizations which are at least at the medium low ACAP level, the importance of innovation capability decreases, whereas the significance of the available relevant knowledge remains stable. It should also be noted that the INC variable separates organizations with medium ACAP levels from group with low and high ACAP levels, which suggests that the importance of this variable is the highest for the groups of organizations with medium low and medium high absorptive capacity.

Table 5: Classification results

			Predicted Group Membership				
		The ACAP level	Low ACAP level	Medium low ACAP level	Medium high ACAP level	High ACAP level	Total
Cross-validated	%	Low ACAP level	50.0	50.0	.0	.0	100.0
		Medium low ACAP level	4.3	91.3	4.3	.0	100.0
		Medium high ACAP level	.0	13.6	81.8	4.5	100.0
		High ACAP level	.0	.0	40.0	60.0	100.0

Source: Authors' calculation

In cross-validation (Table no. 5), each case is classified by the functions derived from all cases other than that case. The level of correct classification in the model is 92.3%, while cross-validated classification results show that 82.7% of cross-validated grouped cases were correctly classified. In order to establish the quality of the discriminate analysis, the hit ratio (HR = 0.827) is computed. The hit ratio gives the correctly classified observation units divided by the number of observation units (Heinl et al., 2009). This percentage shows that the accuracy of the prediction based on this model is high. Cohen's kappa coefficient as a statistical measure of inter-rater agreement was k = 0.71. Depending on different authors, this value is considered substantial or good (Landis and Koch, 1977; Fleiss, 1981). Cohen's effect size for given F statistics with 4 covariates was f = 0.65, with $\alpha = 0.05$ and power 0.81, which can be indicated as a large value.

6. Implications for practice

The results suggest that the potential for acquiring, assimilating, transforming and exploiting knowledge in organizations from knowledge-intensive industries in Serbia is almost entirely driven by the relevant knowledge available. It may be therefore concluded that the enlargement of the knowledge base with relevant content would strongly enhance the ability of these organizations to learn from the environment and to produce innovations. Organizations should continually invest into acquiring relevant knowledge from various sources in order to increase their competitiveness in the constantly changing environment.

It should be also noted that the relationship between the available relevant knowledge and the innovation capability variables shows (Figure no. 2) that the importance of innovation capability for further absorptive capacity development

is higher for the organizations with low and medium ACAP levels, than for the organizations with high ACAP level. This suggests that the organizations with high ACAP level may not be able to further develop their innovation capabilities at the same pace as organizations with medium low and medium high ACAP.

7. Conclusion

For the first time, determinants of the absorptive capacity in the organizations from Serbian knowledge-intensive industries are explored in a study. The results of this research support the hypothesis, as they indicate that the scope of the relevant knowledge available internally is the most influential determinant of the absorptive capacity level in organizations from knowledge-intensive industries in Serbia. We conclude that the increase in the availability of relevant knowledge in these organizations is the primary driver of their absorptive capacity. Organizations which have the ambition of enhancing their capability to absorb new knowledge and to innovate should be, above all, focused on investing into diverse content of their own intranets or other knowledge bases. Also, the results of the analysis clearly show that the absorptive capacity level of organizations from knowledge intensive industries in Serbia can be determined primarily by the scope of the relevant knowledge availability. Interestingly, the results from our research also show that the organizational capability to scan knowledge in the environment does not significantly determine the level of the absorptive capacity in the organizations from Serbian knowledge-intensive industries. It may be stated that the objective defined at the beginning of the paper is achieved.

The results obtained in this paper contribute to the organizational theory. The absorptive capacity evaluation model presented here provides support to the further development of the absorptive capacity and organizational learning concepts. The results of this research will contribute to better understanding of the ACAP framework in sectors which are characterized by strong reliance on information and knowledge for further development. The constructed absorptive capacity evaluation model will hopefully be used as a solid foundation upon which other authors may continue to build theoretical concepts and conduct future research on this subject. This paper provides a contribution for the practitioners as well. By the application of the presented model, managers and other practitioners can have a clearer view on the organizational factors which influence learning and knowledge sharing and make the appropriate decisions in a more structured way.

This research has its limitations. Although the ACAP model which is presented in this paper has been constructed in such a way, that it observes the knowledge dynamics within the organization, it is very difficult to establish the direct connection between the prior-related knowledge which exists in an organization

and its actual exploitation. Therefore, future research in this area should be directed towards developing an optimal framework for monitoring the knowledge transformation and utilization process in knowledge-intensive industries. In relation to the conclusions in this paper, future research in this area may also be directed towards identifying and analyzing the factors which influence the downward trend of the innovation capability in the process of absorptive capacity development. Contribution to this topic may be achieved by further investigation of the relationship between the available relevant knowledge and the innovation capability in knowledge-intensive industries.

The findings of this study could be important to organizations from knowledge-intensive industries, which are in a constant search for new knowledge. The analysis of the absorptive capacity indicators can provide support to the management in promoting organizational learning and directing innovation efforts in the organization. The results of this research may contribute to policy making, having in mind that knowledge-intensive industries are important source to economies' competitiveness due to their possibility to generate radical innovations and increased possibility to affect the evolution of industries based on the continuous exchange of knowledge.

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Komponente apsorpcijskog kapaciteta u znanjem intenzivnim industrijama u Srbiji

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Sažetak

Cilj ovog rada bio je istraživanje komponenata apsorpcijskog kapaciteta i njihovog utjecaja na ukupnu razinu apsorpcijskog kapaciteta u organizacijama iz znanjem intenzivnih industrija u Republici Srbiji. Provedeno je istraživanje da bi se zaključilo na koji način sposobnost organizacija koje potiču iz znanjem intenzivnih industrija u Srbiji za stjecanjem vanjskih znanja, razvijanjem vlastitih baza znanja, kao i komuniciranjem i iskorištavanjem apsorbiranog znanja, utječe na njihov apsorpcijski kapacitet. Metodologija je obuhvatila kvantitativnu i kvalitativnu metodu istraživanja na temelju upitnika. Analiziranje prikupljenih podataka provedeno je pomoću modela za procjenu apsorpcijskog kapaciteta i uz primjenu metode diskriminantne analize. Glavni rezultat istraživanja upućuje na to da apsorpcijski kapacitet organizacija iz znanjem intenzivnih industrija jasno ovisi o opsegu dostupnog relevantnog znanja. Iz provedenog istraživanja izvodi se zaključak da obogaćivanje organizacijske baze znanja sa novim relevantnim sadržajem u velikoj mjeri povećava apsorpcijski kapacitet organizacija iz znanjem intenzivnih industrija u Srbiji. Buduća istraživanja u ovoj oblasti trebalo bi usmjeriti na promatranje odnosa između postojeće baze znanja i inovacijskih sposobnosti u organizacijama iz znanjem intenzivnih industrija.

Ključne riječi*: apsorpcijski kapacitet, relevantno znanje, inovacijska moć, širenje znanja, znanjem intenzivne industrije*

JEL klasifikacija: *D83; M15; O32*

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