ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ECONOMIC STUDIES

Volume 28 (4), 2019

Mladen Velev[1]
Siya Veleva[2]
Anka Tsvetanova[3]

STUDY OF THE DETERMINANTS OF THE ENTERPRISE'S CAPACITY TO ABSORB NEW TECHNOLOGIES

In modern times the business success of enterprises is more and more the result of the development of science and the accelerated introduction of new advances in technology. Innovations are becoming the key to success. In these conditions the importance of technological transfer also grows and it becomes a main "strategic way of meeting the challenges of globalization in business" (Mayer and Blaas, 2002). With the growth in importance of the transfer of technologies increases the interest in the theoretical elucidation and empirical research of various aspects of the absorption capacity of enterprises and its determinants, characterizing the capability for timely recognition, acquisition and use of new advances.

In view of the above, the aim of this paper is to present, in brief, an opinion on the determinants of the absorption capacity of enterprises and the factors that affect the formation of the them as well as the findings of empirical research of their state and impact on the intensity of technological transfer, innovative activity and business results of industrial enterprises in Bulgaria.

JEL: O32

Introduction

Fast developing scientific-technical progress and the formation of "knowledge economy" have made the competition more dynamic and have posed new challenges to enterprises. Deepening globalization leads to more intensive and complicated competition between firms and states. Changes in the needs and requirements of consumers, as well as the rapid pace at which current knowledge, technics and technologies become obsolete make their competitive positions unstable. New requirements to their functioning appear, at the basis of which is the necessity for constant and rapid changes and refinement. Business success is increasingly the result

[1] *Prof. Mladen Stefanov Velev, Faculty of Management, Technical University, Sofia, Bulgaria 1000, 8 Kl. Ohridski Blvd, E-mail: mvelev@tu-sofia.bg.*
[2] *PhD Siya Stancheva Veleva, Faculty of Management, Technical University, Sofia, Bulgaria 1000, 8 Kl. Ohridski Blvd, E-mail: s.veleva@tu-sofia.bg.*
[3] *PhD Anka Ivanova Tsvetanova, Faculty of Management, Technical University, Sofia, Bulgaria 1000, 8 Kl. Ohridski Blvd, E-mail: a.cwetanova@tu-sofia.bg.*

of the development of science and the accelerated introduction of new advances. Innovations become the key to success. The relative importance of non-material assets, of the social and cultural capital, as conditions for accelerated innovation and renovation, grows. Cheap natural resources and labour can be relied on to a smaller degree.

At the same time, the development of science cannot be the doing of a single person, laboratory, research organisation, university or state. It is the collective deed of people from various nations. In these conditions the innovative activity of enterprises cannot rely on the resources of the enterprise only but on outside achievements too. The enterprise will make use of them through technological transfer, which becomes a main "strategic way of meeting the challenges of globalization in business" (Mayer and Blaas, 2002).

Through the introduction of technological transfer enterprises not only make use of knowledge, experience and technical advances of others, but they accelerate and increase the effectiveness of their own innovative activity. They acquire technological knowledge tried out in practice, which reduces mistakes and failures. Through the acquisition of new advances at the appropriate stage of their life cycle, they overcome the initial, highly risky and very expensive stages of their development. This reduces investment in innovation and guarantees success and it is not necessary to have big research and development departments. At the same time, new knowledge is accumulated in enterprises and it positively impacts not only its innovation activity but also its overall activity. The transfer of new technologies in enterprises is related to the replacement of obsolete products, increase in effectiveness through the introduction of improved technological methods, new technics, cheaper components, attracting engineers and consumers, taking into consideration the specific technological requirements of the consumers (Larson, Wall, Norstrom, Crnkovic, 2006) and others. As a result, important competitive advantages are created and maintained, and high competitiveness is achieved.

Enterprises from different sectors of industry have similar access to knowledge, experience, technological capacity and technological developments of other companies and institutions. However, hardly all manage to take equal advantage of them. Thus, a question, which needs to be answered, arises "Why do some enterprises, under certain conditions of the outside environment, manage successfully and in a timely manner to adopt and use new technological knowledge and on that basis to develop well and others do not?".

The answer to that question is that different enterprises have different readiness to adopt new advances in their environment. Thus, the theory about the capacity of enterprises to adopt new technologies has evolved. This category characterises the capability of enterprises, in a timely manner, to recognise, adopt and use innovations. Its importance has been acknowledged by all authors who have done research on the issues of technological transfer.

The greater the topicality of the issues and the importance of the transfer of technologies the higher the interest in theoretical elucidation and empirical study of

various aspects of the absorption capacity of enterprises. The number of scientific publications in these areas of research is growing. However, a number of important issues need additional research, which justifies the need to conduct new studies in certain areas. Such an area of research is the study of the determinants of the absorption capacity and the factors that affect the formation of them, of how they impact the intensity of technological transfer, the innovative activity and the business results of enterprises.

In view of the above, the aim of this paper is to present an opinion on the determinants of the absorption capacity of enterprises and the factors that affect the formation of the them, and the findings of an empirical study of their state and impact on the intensity of technological transfer, innovative activity and business results of industrial enterprises in Bulgaria. The authors hope to instigate a discussion on these issues and other similar questions related to the topic, the results of which will aid enterprises in taking managerial decisions on both streamlining innovative efforts and investment, and developing strategies for further growth.

Determinants of the absorption capacity of enterprises

For the purposes of the present study technological transfer is viewed as a complex, iterative process of conscious, purposeful, common and contractual interaction between two or more organisations for transfer and implementation of new and useful information and knowledge, methods and processes, documentation, patents, software products, design, physical objects (products, machines and equipment, components, facilities, plants etc.) in the recipient organisation, which lead to an increase in the reserve of knowledge and/or to implementation of innovation in order to achieve the company goals (Velev, Atanasova, 2013).

It is also widely accepted that the capacity of the enterprise to absorb new technologies is its internal ability to identify, acquire and use external knowledge (acccording to the definition of Cohen and Levinthal, 1989). It is the result of the implementation of corporate strategies for success. In other words, the actions of the enterprises to form and develop the internal conditions for the acquisition of new knowledge is the key to success. The success comes to those enterprises, which persist and invariably create and develop the conditions needed to take advantage of the outside environment. Thus, they gain significant competitive advantages over other enterprises. That is why another important question is: "Which actions of the enterprise will lead to increasing its capacity to adopt new knowledge? That is to say, in conditions of resources limitation, where should the efforts be focused so that the results are best? This is the important question to be answered by determining the relative importance of each of the factors.

In the specialised literature there is a great variety of determinants (internal conditions) and factors that determine the absorption capacity of enterprises and affect it. According to Cohen and Levinthal (Cohen, Levithal, 1990) the absorption capacity is formed by the already accumulated knowledge in the enterprise and its staff and is the by-product of its research and innovation activities. For this reason they believe that it depends on the

individual absorption capacity of each member of staff (qualifications and knowledge staff have already acquired), it develops cumulatively through experience and depends also on the ability of the organisation to disseminate knowledge and to have communication between the members of staff. On that basis they build up a model of the absorption capacity (Cohen, Levinthal, 1990) showing the factors, which impact the amount of the allocated resources and efforts for research and innovation and the absorption capacity is the result from them. These factors are: a) technological capabilities of the environment – the quantity of available technological knowledge, potential refinements in technologies; b) characteristics of external knowledge that determine the ease with which it will be acquired by the firm – similarity with the internal needs, complexity, development; c) possibility for free dissemination of knowledge in the industry – as opposed to the degree of protection of intellectual property; d) competitiveness of the firm; e) demand – increasing demand and revenue elasticity; f) price elasticity.

The main limitations of this model are that it does not reflect capacity, as a process, which evolves and can be controlled, but looks at it as the by-product of the research and innovation activities of firms and ignores other important internal and external factors. It is focused only on the recognition of external technological knowledge but ignores its adoption and use.

The validity of the model is supported by a lot of authors (see Lane, Koka, Pathak, 2006). Other authors make an attempt to develop it further. Thus Hasan, S. et al. (Hasan, Othman, Mustafa, Wahab, Ismail, 2011) share the opinion that the absorption capacity is a function of knowledge accumulated in the enterprise through training, research and innovation and add the following determinants: a) capability of the employed in the firm, i.e. the ability of the staff to discover and acquire new information. It depends on their education, qualifications and experience; b) the ability of the firm to disseminate knowledge among its members of staff; c) corporate culture oriented at seeking for new opportunities; d) capability in the field of research and innovation. The intensity of research and innovation in the enterprise lead to the accumulation of knowledge and experience, generate a search for new technological opportunities and build up its absorption capacity; e) communication opportunities in the enterprise. They refer to the possibility to share information among the individuals and the departments in the enterprise in order to have common understanding of the assessment of new knowledge and action points.

In the specialised literature there are models of the enterprise's absorption capacity, which reflect the dynamic character of the process evolving under the supervision of the management. Thus, for example, (Volbersa, Foss, Lyles, 2009) points out the following main determinants: a) the conditions of the environment – dynamics, competition, characterisitcs of the knowledge available, mode of its dissemination; b) amount and structure of the knowledge the firm has; c) management – managerial knowledge, combinatory ability, development and dissemination of individual knowledge; d) organisation of the firm – form of organisation, system of stimuls used; information network, internal communication; e) intercompany interaction – generation and dissemination of knowledge, system of managing cooperation, network for the generation and transfer of knowledge, similarity between organisations.

The view of Lane P. et al. (Lane, Koka, Pathak, 2006), demonstrated in the model suggested by them, is similar. According to them the main factors forming the absorption capacity of the firms are: a) the conditions of the environment – they stimulate building up the absorption capacity; b) the characteristics of the available internal and external knowledge – they create conditions for broad and in-depth understanding; c) the characteristics of the relationships – they facilitate mutual understanding; d) corporate structure – it ensures focus on the recognition, understanding, acquisition and use of knowledge; e) the characteristics of the mindset model of the members of staff in the firm – it facilitates recognition, acquisition and use of knowledge; f) characteristics of the corporate structures and processes – they stimulate the efficiency and effectiveness of acquisition and use of knowledge.

As it can be seen in the specialised literature there is no unanimous position on the factors and determinants forming and developing the absorption capacity of firms. Even in cases when similar impact factors are given, their content is quite different. What is common for the models that have been developed is that they do not lay the stress on capacity as an object of management, i.e. as a category, which should be managed through the actions of the managers of the firms. Thus, they do not contribute much to defining ways for its improvement.

The variety of viewpoints on the essence and content of absorption capacity leave a stamp on the understanding of the results of its use, including the impact of the various determinative factors. Authors, who relate it mainly to the knowledge already accumulated in the enterprise and its staff, define them as accumulated new knowledge or view them as equal to the results from the research and innovation activities (Cohen, Levinthal, 1990; Nicholls-Nixon, 1993 -1; Rosenkopf and Almeida, 2003). Other authors expand the coverage of these results with increasing the competitiveness of firms. Thus, for example, Volbersa, H. et al. (Volbersa, Foss, Lyles, 2009) in their model point out that the results of the increase of the absorption capacity of the firm can be: attained competitive advantage, accelerated research and innovation activities, acquired new knowledge, improved exploitation of knowledge and assets and improved activities of the firm. In a similar way Lane P.et al. (Lane, Koka, Pathak, 2006) describes possible results, such as 1) related to the accumulation of knowledge (general, scientific, technical and organisational) and 2) commercial results (products, services and intellectual property).

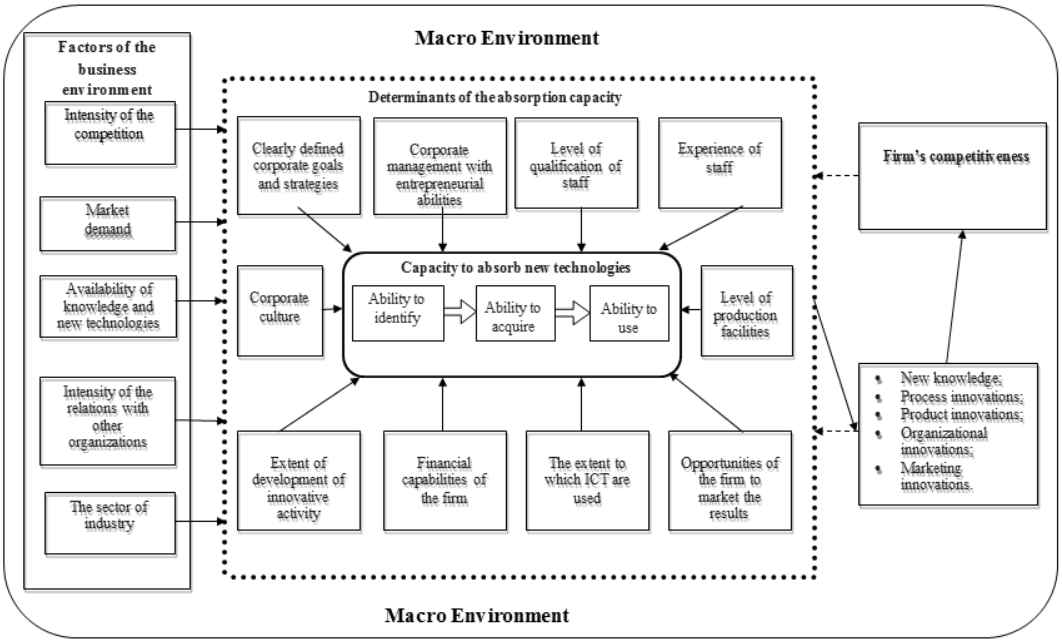
Practically, the main result of increasing the absorption capacity of a firm is the accelerated technological transfer and results achieved by making it. Moreover, each transfer has a particular purpose and way of making it and that is why it has a specific result. However, it can be said that as a whole technological transfers are carried out for the purpose of introducing novelties, i.e. for the introduction of innovation and as a result of it for achieving competitive advantages and higher competitiveness. At the same time, the knowledge of the individuals and of the firm as a whole is increased. Thus, in our opinion, the results of increasing the absorption capacity and its determinants need to be observed in three stages – increase of corporate knowledge, results of the introduced innovation, enhanced competitiveness of the firm.

As a result of the analysis of the opinions of a number of authors, regarding the model of the absorption capacity of enterprises and their varying understanding of its components

and the factors, which determine it, the authors of the present publication propose the following model, developed in accordance with the definition of Cohen and Levinthal (Cohen and Levinthal, 1989).

Figure 1

Model of the capacity of enterprises to absorb new technologies



The determinants of the capacity of enterprises to absorb new technologies are internal for the enterprise factors, which create a potential for absorbing new technologies. The higher degree of their development facilitates the prompt acquisition of novelties in the enterprise and vice versa. The level of development of these factors is to a great extent the result of the development of the enterprise itself. It is a consequence of the efforts managers have made. The model uses the following system of key determinants of the absorption capacity of enterprises:

1. Clearly defined corporate goals and innovative strategies

In the first place, the clear objectives accepted by the staff, the developed innovative corporate strategies and structures guide and mobilize the staff to seek, acquire and apply the new knowledge and technologies needed to achieve them. Secondly, they are the basis for directing investment for technological transfer. Thirdly, with the defined priorities and the organisational structures, they facilitate the acquisition of knowledge and the fast effective dissemination and application of novel ideas and developments in the enterprise. In the fourth place, they are the basis for furthering the qualifications of the staff – an important condition for the acquisition of novel ideas and developments. In the fifth place,

they are the basis for establishing a mechanism for overcoming resistance and for motivating staff to acquire novel ideas and developments.

2. *Availability of corporate management with entrepreneurial abilities.*

It is the company management that bears responsibility for achieving the company goals and for the prosperity of the enterprise. Because of this it actively looks for ways to implement the strategies and is most sensitive to the arising opportunities for the enterprise including technological advances. To a great extent it depends on them which novel ideas and developments will be accepted and used. In order to these responsibilities company management must be highly qualified and possess entrepreneurial abilities – it must promptly recognize opportunities, take advantage of them, take the risk to implement them in the enterprise, motivate staff and bring the implementation of the technological advances to the desired end.

3. *Level of qualification of staff*

The acquisition of new knowledge is the result of the knowledge and qualifications of the individuals within the enterprise. The better qualified staff keeps track of novel ideas and developments, is interested in them, has ideas about how to introduce them in the enterprise, has the capability of participating actively in their successful implementation and use. It is for this very reason that the level of qualification of staff is widely accepted as one of the most important determinants of the capacity of enterprises to acquire new technologies.

4. *Experience of staff*

The experience of staff in the activity it performs, in innovation and the acquisition of novel ideas and developments is an indicator of the knowledge and skills accumulated in the enterprise. The more experienced the staff the more successful the introduction of new technologies.

5. *Corporate culture facilitating the search for and the introduction of novel ideas and developments.*

The corporate culture of the enterprise includes the practices, the expectations, the assessment, the principles and norms of behavior and activity of the staff. It affects their thoughts, feelings and interaction. It impacts the commitment, loyalty and the degree of satisfaction of staff. It influences the activity of seeking and their commitment in the acquisition of novel ideas and developments. Thus, it is of great importance for forming the absorption capacity of enterprise.

6. *Level of production facilities.*

The degree of development of the production facilities makes the enterprise face tasks of different complexity and forms different needs for new knowledge and technologies. It is believed that the more modern and developed these facilities are, the higher the needs for novel ideas and developments, on-going development, furthering the qualifications of staff, etc. It all positively impacts the capacity of the enterprise to acquire novel ideas and developments.

7. Extent of development of innovative activity.

Transfer of technologies leads to innovation, an innovative activity creates a need for and searches for new knowledge and technologies. Through their research and innovation companies practically acquire new knowledge and technologies. They accumulate and enhance the individual and collective reserve of knowledge of staff, which is of particular importance for the formation of absorption capacity.

8. Financial capabilities of the enterprise.

The good financial state of the enterprise provides opportunities to look for new ways of improving its activities and competitiveness. In such a situation it invests more and more resources in research and innovation and the introduction of new technologies. It brings about search for new knowledge and technological opportunities, highly qualified staff is recruited, the systems for motivating staff and furthering their qualifications are improved. That also leads to enhancement of the absorption capacity.

The financial state of the firm determines not only the amount of the expenditure for research and innovation. It is of great importance for the overall potential of the enterprise, for the scale of its activities, for its goals, guidelines and strategies for its development, etc.

9. The extent to which information and communications technologies are used.

The high degree of use of modern information and communications technologies is of critical importance for the fast acquisition, systematizing, acquisition, processing and use of external and internal information. Through them the fast dissemination and exchange of information within the enterprise is carried out. They assist in doing research and in the coordination of innovative activities. For these reasons, it is an essential determinant of the capacity of the enterprise to acquire new technologies.

10. Opportunities of the enterprise to market the results of the introduced new technologies.

The opportunities of the enterprise to market the results of the introduced new technologies aid their commercialization and the achievement of the desired economic effectiveness. Without the existence of that condition the enterprise would lose the economic interest from the introduction of new technologies and would diminish the extent to which it looks for them and acquires them. The aspiration to improve the marketing of the results itself brings about a search for new marketing methods and marketing strategies and also enhances the absorption capacity of the enterprise.

The enlisted determinants are factors, which create the potential of the enterprise to absorb new technologies, but they themselves are under the impact of some factors within the company, which also need to be taken into consideration. These are:

1. The size of the firm. The size of the firm is related to the different degree of provision with resources (human, financial, material, information resources) needed to carry out technological transfer and innovation. The lack of enough resources makes the research activity and the creation of novel ideas and developments difficult. At the same time, however, fewer bureaucratic obstacles and the flexibility of smaller enterprises are

favourable for the faster and easier acquisition and adaptation of the novel ideas and developments of others.

2. The degree of diversification of the activities of the enterprise. The degree of diversification of the activities of the enterprise – product diversification (assessed by means of the products/services provided) and customer diversification (assessed by means of the customer groups, markets, which the firm serves), without doubt complicates the activities of the enterprise. It affects the search for new opportunities for development, as well as the intensity of technological transfer and innovative activity.

3. Combination of various types of innovation. Normally, the innovative activities of enterprises are of complex nature, i.e. they simultaneously introduce several types of innovations. This is so because combining various types of innovation leads to better results. To put it in a different way there is a correlation and interdependence between them. Implementing one type of innovation brings about the introduction of yet another. That entails a search for varied new technological possibilities and leads to an increase in the absorption capacity of the enterprise.

4. Ownership of the enterprise. This is a factor of importance for countries like Bulgaria. The ownership of enterprises (Bulgarian or foreign) impacts their technological readiness and innovative activity. We can assume that foreign participation in the capital is a prerequisite for facilitated transfer of knowledge and technologies and leads to accelerated innovation.

5. Planning horizon of enterprises. Technological transfer, absorption capacity and innovative activity require clearly formulated goals and long-term mobilization of the resources and the efforts of enterprises. Quite often the results of the technological transfer and innovation are not expected immediately but after some time. In this respect it is logical to assume that enterprises which plan their activities over a long period of time are more innovative and have higher absorption capacity.

The factors of the environment impact mainly the corporate determinants of the absorption capacity and thus to a great extent create conditions for its enhancement or diminishing. Some of these are elements of the business environment and directly affect the determinants while others are elements of the macroenvironment (economic conditions, legal conditions, demographic conditions, scientific-technical progress, etc.) and directly impact the determinants and the factors of the business environment. The main factors of the business environment are:

1. Availability of knowledge and new technologies

The availability of the needed base of knowledge and new technologies for the development of the enterprises from a particular industry as well as their correspondence with the needs of the enterprises is of key importance for carrying out a technological transfer. As a source of novel ideas and developments, it is an important factor for the capacity of enterprises to absorb new technologies. It brings about an accumulation of knowledge, aspiration to identify the needed novel ideas and developments and their final implementation. This knowledge is formed at universities, research institutes and organisations, statistical institutes, in scientific literature, through results from research, etc.

The national base of scientific, technical and market knowledge is of importance but with the development of communications the worldwide base of knowledge grows in importance.

2. The sector of industry in which the enterprise operates.

The sector of industry in which the enterprise operates, influences its innovation activity mainly through the duration of the life cycle of the products it produces and the technologies it uses. The so-called "new" highly technological sectors have quite shortened cycles both of the products made and the technologies used. This necessitates the constant renewal of all aspects of their activities, i.e. the adoption of technological novel ideas and developments as well as making their innovative activity more intensive. For the opposite reasons it can be expected that the so-called "old" sectors will have a lower transfer of technology and innovation. It is logical to expect that the level of the capacity to acquire new technologies and the results of the introduced innovations due to the technological transfer are higher in the "new" sectors of industry.

3. Intensity of the competition on the markets where the firm sells.

Competition acts as an outside enforcement for enterprises to constantly perfect all aspects of their activities. In such conditions, the accelerated acquisition of novel ideas and developments and the implementation of innovation becomes the key for high competitiveness and market success. It can be assumed that the more intensive the competition, the stronger the outside push to increase the susceptibility of the enterprise to new technologies and as a result the higher the absorption capacity will be.

4. Market on which the enterprise operates.

Its export status and the market on which the enterprise operates influence its innovative activity mainly with the characteristics of the demand on the different markets. The size and the quality of the demand are of great importance for its competitiveness because they determine how enterprises accept, interpret and respond to customer needs. Demand applies pressure on firms for faster introduction of novel ideas and developments and thus creates competitive advantages.

5. Participation in professional unions and associations.

The participation of the enterprise in professional unions and associations is a prerequisite for facilitated transfer of knowledge and technologies and results in high absorption capacity and accelerated innovation. This fact has been confirmed by almost all authors, who have studied the issues of technological transfer and through a number of empirical research studies.

6. Partnership in the field of technological transfer with other firms.

Partnership with other firms is a factor of a strong impact in accelerating activity in the field of technological transfer and innovation. A number of research studies prove that the capacity of enterprises to absorb new technologies, when they have worked in partnership in the field of technological transfer with other firms, is higher than the average one for the

industry. Of course, partnerships with foreign enterprises, with Bulgarian or simultaneously with Bulgarian and foreign enterprises carry different importance.

7. Partnership in the field of technological transfer with universities.

Universities and scientific-research organisations are the main sources of new knowledge and technologies. It is expected for the absorption capacity of enterprises, which have worked in partnership with universities in the field of technological transfer, to be higher than the average one for the industry.

8. Location of the firm.

The location of the firm influences the transfer of technologies and its innovation activity mainly through the opportunity for easy and fast access to information about novel ideas and developments, through facilitated transfer of knowledge and technologies, the result of the proximity to enterprises from the same sector of industry, to suppliers or to enterprises from the servicing or supporting industries. The location also has an impact because the dwemand characteristics of the local market, etc.

The capacity of the enterprise to absorb new technologies and the technological transfers made on the basis of it lead to a number of positive results. In the first place, the innovative activity grows. The acquired new knowledge and the introduced innovations positively affect the business results of the enterprise and increase its competitiveness. They enhance its absorption capacity, which again leads to facilited acquisition of novel ideas and developments from the envronment.

Methodology

As it has been pointed out the aim of the empirical study was to 1) determine the state of the determinants of the absorption capacity of studied enterprises in Bulgaria and the factors which influence them; 2) to assess their impact on the intensity of technological transfer and the innovative activity of enterprises; 3) to assess their impact on the business results of enterprises. The findings of this research would facilitate the taking of management decisions about directing innovation efforts and investment as well as the drawing up of starategies for further development.

The approach adopted in the research is based on the collection, processing and analysis of considerable amount of empirical information from industrial enterprises in Bulgaria by means of a specially developed methodology of research and statistical methods and specialized software for processing and analysis of the information. The study was conducted with Bulgarian enterprises and covers a period of two years (2015-2016). It was carried out using the method of survey, the respondents being company managers. A specially prepared questionnaire was used and it was sent by post and e-mail to a large number of industrial enterprises. Unfortunately, because of the low percentage of returned questionnaires the chosen method had to be complemented with interviews at the workplace. The respondents shared their opinion on each of the questions using a grade system. The grade for each indicator is within the interval from 1 to 7. The lowest grade of

1 shows a very low level or importance, and the highest one of 7 – excellent state or maximal significance. The IBM SPSS Statistics 19 software product was used to process the results of the study.

The preliminary study of the literature gave us grounds to formulate the following research hypotheses: 1/ in the present stage of economic development of the country the level of the determinants of the absorption capacity of the studied enterprises is not high; 2/ there is a positive correlation between the level of the determinants and the intensity of technological transfer, innovative activity and the business results of enterprises.

In order to prove Hypothesis 1 we have studied the opinion of managers both of the level of development of the corporate determinants of the absorption capacity in their enterprises and the importance of the internal and external for the firms factors for forming them. To assess the determinant "Level of qualifications of staff" we used indicators "Part of staff with high education" and "Part of staff with technical education (secondary and tertiary)". The availability of such specialists is of importance for the introduction of new technologies in enterprises.

In order to prove Hypothesis 2, on the basis of the opinions of the respondent managers, first we assessed the importance of the determinants for making the technological transfer. It was recorded that they are of different importance for creating opportunities for enterprises to absorb various kinds of new technologies. In view of this, it was assessed separately for the following types of technological transfer (represented with T): Transfer of knowledge of importance for improving the activities of the enterprise but not directly leading to the introduction of innovation – T1; Transfer of technologies, leading to the introduction of product innovations – T2; Transfer of technologies, leading to the introduction of process innovations – T3; Transfer of technologies, leading to the introduction of organisational innovations – T4; Transfer of technologies, leading to the introduction of marketing innovations – T5.

In order to prove the positive effect of the level of the determinants of the absorption capacity on the technological transfer, innovation and business results, the enterprises in the survey were divided into two groups according to the level of development of their determinants: Group 1 – enterprises with a level below the average one for the survey and Group 2 – enterprises with a level over the average one. The aim was to compare them in terms of technological transfer and the achieved business results and on that basis to carry out a logical analysis and interpretation of the results.

Findings

The findings presented here are for 100 industrial enterprises from the whole country. The studied enterprises are not representative of the Bulgarian economy, but the results are interesting and indicative of the state of the factors affecting the absorption capacity and their impact on the corporate results. They can be discussed and serve as a basis for directing the efforts of the enterprises to improve their competitiveness.

Limitation of the size of the present paper does not make it possible to present the results of the conducted study. That is why we present only the summarized results for the whole number of studied enterprises.

Out of all the industrial enterprises in the study 60% are located in Sofia, 20% – in big cities and 20% in small settlements. The percentage of small and medium-sized enterprises in the study is 80. It was found out that in 2015 48% of the studied enterprises implemented innovation and in 2016 – 62%. This percentage is higher than the data about innovative enterprises in the industry given in the official statistics of the country (Statistical yearbook. 2016). This is mainly due to the lack of representativeness of the present research. It was found out that most of introduced innovations by enterprises resulted from technological transfer, i.e. they were introduced on the basis of acquired external knowledge, methods and processes, documentation, patents, software products, design, physical objects. Over the research period technological transfer was made by 44 of the studied enterprises in 2015 and 60 in 2016. Only a small part of the innovations are introduced from their own means and they are at a low level of novelty and importance of change.

According to the managers interviewed, the innovations introduced by their enterprises (and the technological transfers which caused them) were not at a high level of novelty and significance of change. What should be noted is that during the research period the number and the level of the marketing innovations rise. A drop in the level is observed with product innovations. The grades for the level of innovation demonstrated that in the enterprises there were usually small, insignificant changes with a low level of novelty, which require less expenditure and lead to lower effectiveness. It is logical to expect that it affected the economic results.

We can suppose that the comparatively not high level of innovation and technological transfer, assessed as a degree of novelty and significance of the change is due to the not very level of the absorption capacity and the determinants forming it. The study confirmed that supposition. The grades of the managers, who participated in the survey, when summarized for the whole study, and defined within the range from 1 (very low level) to 7 – the highest level, are shown in Table 1.

The average level of all determinants of the absorption capacity for all the studied enterprises is 3.71 for 2015 and 3.91 for 2016. For the two years, it is slightly over the average level of the assessment scale and is certainly not enough to conduct intensive and qualitative technological transfer. The major part of the determinants are not well developed in the enterprises and the efforts of the managers need to be focused on their improvement. Still there is some improvement in 2016.

The level of determinants of enterprises, which did not carry out technological transfer over the research period, is lower than that of enterprises which have made one. The average level of all determinants for enterprises, which did not make a technological transfer, is 3.22 for 2015 and 3.25 for 2016, and only one 1 of these enterprises has an average level higher than the average one for the whole study over the two years. That result is indicative of the importance of the determinants.

Table 1

The level of the determinants of the absorption capacity for the studied enterprises

Determinants	Level of determinants	
	2016	2017
1. Clearly defined corporate goals and innovative strategies	3.0	3.1
2. Availability of corporate management with entrepreneurial abilities	4.2	4.3
3. Part of staff with high education	3.6	3.7
4. Part of staff with technical education (secondary and tertiary	4.2	4.0
5. Experience of staff	4.1	4.2
6. Corporate culture facilitating the search for and the introduction of novel ideas and developments	3.1	3.1
7. Level of production facilities	3.8	4.4
8. Extent of development of innovative activity	3.7	3.8
9. Financial capabilities of the enterprise	3.0	3.3
10. The extent to which information and communications technologies are used	5.3	5.9
11. Opportunities of the enterprise to market the results of the introduced new technologies	2.9	3.2

The grades are within a range from 1 – very low level, to 7 – the highest level

The specified determinants, which create the potential of the enterprise to absorb new technologies, are affected by some internal company factors, which also need to be considered and on which the efforts of the mangers need to be concentrated so that they are improved. The study demonstrated that managers appreciate the importance of these factors. The averaged results obtained are (D1 to D11 stand for the respective determinants of the absorption capacity) (Table 2).

Table 2

Importance of the internal corporate factors in forming the determinants of the capacity of enterprises to absorb new technologies

Factors in forming the determinants	Importance of the factors in forming of specific determinant											Overall importance in forming the absorption capacity
	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	
1. The size of the firm	6.0	4.2	5.1	5.2	4.0	4.3	6.2	6.1	5.8	4.8	6.3	5.27
2. The degree of diversification of the activities of the enterprise	5.2	5.7	4.2	3.3	5.1	5.3	5.4	6.0	4.8	6.2	6.0	5.20
3.Combination of various types of innovation	5.0	4.2	4.9	4.8	5.1	4.4	4.0	6.6	5.0	6.7	5.8	5.14
4. Ownership of the enterprise	6.1	4.1	3.2	3.3	4.0	4.1	6.0	4.2	5.2	5.5	6.2	4.72
5. Planning horizon	6.6	5.2	4.0	4.1	4.2	6.0	5.2	6.1	4.3	5.5	5.0	5.11
Overall importance	5.8	4.7	4.3	4.1	4.5	4.8	5.4	5.8	5.0	5.7	5.9	5.1

The grades are within a range from 1 – very low level of importance, to 7 – the highest level of importance

Managers attach greater significance to the size of the enterprise, as a factor in forming the determinants of its absorption capacity. Apparently, they relate it to better provision of big enterprises with resources and their capability to further the qualifications of staff needed for its development, technological transfer and innovations. Such is the opinion mainly of respondents from small and medium-sized enterprises, which is 80% of the study. According to them, the shortage of resources makes research activity and innovations more difficult to happen. It is explicable that diversification of activities is also of great importance for the development of the absorption capacity. It makes the activities of enterprises more complex and acts as enforcement for the management to seek ways to improve their state. The overall impact of the studied factors is different for the different determinants. The strongest impact concerns the following determinants: "Degree of development of innovation", "the possibility for the enterprise to market the results of the introduced new technologies" and "Degree of use of ICTs". The managers who participated in the study point out different positive influence of the factors of the business environment on the formation of the corporate determinants of the absorption capacity. Their average estimates are shown on Table 3.

Table 3

Importance of the factors of the business environment in forming the determinants of the capacity of enterprises to absorb new technologies

Factors of the business environment	Importance of the factors in forming of specific determinant											Overall importance in forming the absorption capacity
	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	
1. Availability of knowledge and new technologies	3.1	3.2	3.2	2.9	3.1	4.2	4.3	5.0	1.3	6.2	4.0	3.68
2. The sector of industry in which the enterprise operates	3.2	3.5	5.3	4.2	2.5	4.3	5.4	6.6	4.0	5.6	4.4	4.45
3. Intensity of the competition on the markets where the firm sells	5.5	5.6	5.3	4.1	4.2	5.9	6.3	6.5	3.2	6.4	5.9	5.35
4. Market on which the enterprise operates	4.6	5.3	5.0	3.1	4.1	6.2	5.8	6.1	4.0	6.2	5.0	5.04
5. Participation in production unions and associations	3.1	4.2	4.1	3.2	4.0	4.3	4.8	5.0	4.5	5.2	4.9	4.3
6. Partnership in the field of technological transfer with other firms	4.1	3.5	3.1	3.0	3.5	4.2	4.0	5.1	4.6	4.0	3.8	3.9
7. Partnership in the field of technological transfer with universities	4.0	3.2	4.5	4.0	3.7	4.5	4.2	5.8	4.4	5.2	3.9	4.31
8. Location of the firm	3.8	4.0	3.1	2.2	2.5	3.7	3.2	3.9	3.0	4.2	4.0	3.42
Overall importance	3.9	4.1	4.2	3.3	3.5	4.7	4.8	5.5	3.6	5.4	4.5	4.31

The grades are within a range from 1 – very low level of importance, to 7 – the highest level of importance

According to the managers the most positive influence on the absorption capacity and its determinants is the intensity of the competition and the characteristics of the demand on the different markets. They relate this fact to the pressure, which the competition and the size and quality of demand put on the firms for faster introduction of new ideas and developments. The least importance they attribute to the location of the firms and the availability of knowledge and new technologies. That can be explained with the development of communications and the free dissemination of knowledge globally, which facilitate access to them and their transfer. We should note the relatively low importance, which is given to partnership in the field of technological transfer with other firms, which is apparently due to the insufficient development of clusters and various other forms of cooperation among organisations in the country.

The assessment of the managers who participated in the study is that the overall positive impact of the studied **factors of** the business environment is the strongest one in forming the determinants "Degree of development of innovative activity" and "Degree of use of ICT". This impact is the weakest for determinants "Share of staff with technical education (secondary and tertiary)" and "Experience of staff", the formation of which is mainly a function of the managerial efforts of corporate managers.

To prove or disprove hypothesis 2 of the research, we have studied the opinion of managers of the importance of the determinants of the absorption capacity of enterprises that form their capability to adopt new technologies. It was noted that they have a different impact both on the adoption of different types of technologies and on the capacity of the enterprise for technological transfer as a whole. The grades for the significance of the determinants of the absorption of new technologies are within the range from 1 to 7 (Table 4).

As it can be seen from the table the managers who participated in the study grade relatively high the importance of the determinants for carrying out quality technological transfer and innovation. The highest importance is attached to the availability of staff with higher education and use of ICT. However, what stands out is the lack of recognition to a certain degree of some of the determinants, which could reflect on the management efforts to improve them. What is more, the determinants of the absorption capacity do not act on their own but as a combination. The lower level of development of one or several of them would mean diminishing the level of the absorption capacity as a whole.

In the managers' opinion, the determinants of the absorption capacity are of the greatest importance for having technological transfers leading to successful product and process innovations in enterprises. It should be pointed out that the grades about the importance of the determinants given by managers of enterprises, which did not have a technological transfer during the research period, do not differ significantly from those of the managers of the other enterprises.

For the purposes of the present research the enterprises in the survey were divided into two groups according to the level of development of their determinants of the absorption capacity: Group 1 – enterprises with a level under the average one for the study, Group 2 – enterprises with a level over the average one. The aim was to compare them in terms of technological transfer and accomplished business results.

Table 4

The importance of the determinants of the absorption capacity of enterprises that form their capability to adopt new technologies

Determinants	Importance for the specific technology transfer					Overall importance in forming absorbtion capacity
	T1	T2	T3	T4	T5	
1. Clearly defined corporate goals and innovative strategies	6.3	6.0	5.8	4.3	4.9	5.46
2. Availability of corporate management with entrepreneurial abilities	4.2	5.8	5.0	4.1	4.6	4.74
3. Part of staff with high education	5.8	6.2	6.8	4.7	5.2	5.74
4. Part of staff with technical education (secondary and tertiary	3.2	4.6	4.9	3.0	2.2	3.58
5. Experience of staff	4.1	5.6	6.2	2.1	2.4	4.08
6. Corporate culture facilitating the search for and the introduction of novel ideas and developments	6.4	6.2	5.8	4.3	5.2	5.58
7. Level of production facilities	4.2	4.1	4.4	2.1	1.4	3.24
8. Extent of development of innovative activity	5.5	6.3	6.2	5.2	4.8	5.60
9. Financial capabilities of the enterprise	3.1	6.2	6.7	3.1	3.0	4.42
10. The extent to which information and communications technologies are used	6.3	5.4	5.2	5.8	5.6	5.66
11. Opportunities of the enterprise to market the results of the introduced new technologies	1.2	6.8	4.4	3.0	5.8	4.24
Overall importance for the specific technology transfer	4.57	5.75	5.58	3.79	4.1	4.76

The grades are within a range from 1 – very low level of importance, to 7 – the highest level of importance

It was established that the main part of innovations in the enterprises were the result of a horizontal transfer of technologies, i.e. transfer of technologies from one organisation to another within the same stage of their life cycle. A small part of the technological transfers were vertical, i.e. they were transfers of new technologies in different stages of their life cycle from research organisations to the place (organisation) of their adoption. This is indicative of the bad cooperation in the field of innovation between enterprises and universities and scientific-research organisations. In 2015 only 3 of the transfers were vertical, and all of them are in enterprises from Group 2. In 2016 they were only 7 and only one of them 1 is in an enterprise from Group 1.

According to the managers who participated in the study, the technological transfers made by their enterprises were of relatively low level in terms of the degree of novelty and significance of the change. For 2015 their average level is graded as 3.46 for Group 1 and

3.65 for Group 2, and for 2016 – 3.46 and 4.10 respectively. This is characteristic of innovations, caused by the respective transfers. There is a slight trend for a step-by-step transition from the introduction of insignificant technological transfers to having larger ones but the lagging behind of the enterprises in Group 1 is obvious. There is a difference in the technological transfers, which can be seen in Table 5.

Table 5

Number of technological transfers by group of enterprises according to the level of the determinants of the absorption capacity

№	Type of the technological transfers	Technological transfers made by the group of enterprises			
		2016		2017	
		Group 1	Group 2	Group 1	Group 2
1.	Transfer of technologies, leading to the introduction of process innovations	3	6	4	9
2.	Transfer of technologies, leading to the introduction of product innovations	5	8	6	11
3.	Transfer of technologies, leading to the introduction of organisational innovations	3	4	2	5
4.	Transfer of technologies, leading to the introduction of marketing innovations	2	5	3	8
5.	Transfer of technologies, leading to the introduction of complex innovations (simultaneously several types of innovations)	1	5	2	6
	Overall	14	28	17	39

It should be mentioned that some of the enterprises have had more than one technological transfer, and some transfers have brought about more than one innovation.

The assessment of the impact of the determinants of the absorption capacity on the business results of the enterprises is based on the understanding that they are conductive to the introduction of technological transfers and innovation, which in turn improve the overall results of enterprises. In order to determine that impact we compared the grades of the managers, from the first and the second group, about the dynamics of some indicators of their enterprises. The grades for the achieved change, as compared to those from the previous year, are within a range from 1 – no improvement has been made, to 7 – a great improvement has been made. The summarized results are presented in Table 6.

These results demonstrate a positive correlation between the level of the determinants of the absorption capacity of enterprises and the business results. It becomes obvious not only from the difference observed between the indicators of the two groups of enterprises, but also by the noticeable trend for their improvement in the second year. The better level of the determinants was conductive to the introduction of successful technological transfers and innovations, which led to the improvement of the business indicators too. However, the improvement of some of these results is also due to the improving economic situation in the country. What is more, the improvements are the result of not only the innovative efforts in the two years but also of such efforts in previous years. The results from previous years

were due to the level of the determinants then, but the results have also contributed to the improvement of the state of the determinants.

Table 6

Positive results for the enterprises

№	Results	Enterprises from group 1		Enterprises from group 2	
		2016	2017	2016	2017
1.	Increase of the production capacity	1.2	1.6	3.2	4.5
2.	Enhancement of the flexibility of the activities of enterprises	1.0	1.3	1.5	2.9
3.	Improvement of the conformity with standards	3.1	3.0	3.2	3.8
4.	Improvement in the protection of the environment	1.3	1.5	2.7	4.0
5.	Improvement of the quality of management activity	1.3	1.3	3.1	3.5
6.	Improvement of the quality of marketing activity	2.4	3.1	4.4	5.0
7.	Enhancement of the quality of products/services	3.2	3.6	4.5	5.6
8.	Increase in sales	2,1	2,9	3.7	4.8
9.	Rise in labour productivity	1.9	2.3	3.5	4.3
10.	Reduction of costs per unit of production in enterprises	3.1	3.4	4.3	4.5
11.	Improvement of the financial results of enterprises	2.9	3.2	3.8	4.1
12.	Improvement of the competitiveness of enterprises	2.3	2.5	3.6	4.5

The grades are within a range from 1 – no improvement has been made, to 7 – a great improvement has been made.

Conclusion

The paper presents an opinion on the determinants of the absorption capacity of enterprises and the factors that affect the formation of them, and the findings of an empirical study of their state and impact on the intensity of technological transfer, innovative activity and business results of industrial enterprises in Bulgaria. Due to the limited number of enterprises, which were included in the survey the obtained results are not representative for the Bulgarian industry as a whole but are interesting and indicative of the effect of the improvement of determinants of the absorption capacity and their impact on the business results. They can be the basis of discussion and can serve to direct the efforts of enterprises to improve their competitiveness.

Hypothesis 1 of the research has been proven. It was established that the average level of the determinants of the absorption capacity for all the studied enterprises is not high. For the two years of 2015 and 2016 it is slightly over the average level of the grading scale (from 1 to 7) and is definitely not enough to have an intensive and quality technological transfer. The greater parts of the determinants are not well developed in the enterprises and their improvement should be a priority for the management efforts. Regarding the improvement of the state of the determinants, it was found out that a number of internal corporate factors have considerable impact on the formation of the determinants of the absorption capacity and managers should also put in efforts to improve them. The study has

shown the different importance of the factors of the business environment. Taking them into account is important for achieving success.

The study has confirmed the second research hypothesis that there is a positive correlation between the level of the determinants and the intensity of technological transfer, innovative activity and business results of enterprises.

According to the managers, the importance of the determinants for having a quality technological transfer and innovation is relatively high. They attach the greatest importance to the availability of staff with higher education and use of ICT. According to their grades the determinants of the absorption capacity are of the highest importance for making technological transfers leading to successful product and process innovations in enterprises.

According to the experts participating in the study, the group of enterprises with an average level of determinants of the absorption capacity at or over the average level for the study have significantly more intensive activity in the field of technological transfer and innovation than the other group. That is true for the different kinds of technological transfers, but mostly for transfers, which have led to product and process innovations in the enterprises.

It also became obvious that most of introduced innovations by enterprises were the result of horizontal transfer of technologies. Only a small part of the technological transfers were vertical and they were mostly made by enterprises with a relatively higher level of determinants.

According to the managers who participated in the study, the technological transfers of their enterprises were of a relatively low level in terms of the degree of novelty and significance of change. That is characteristic also of innovation caused by the transfers. The level of novelty of enterprises with a level of determinants under the average one for the studied enterprises is also lower.

What was also confirmed was the positive correlation between the level of determinants, the absorption capacity of enterprises and their business results. There was a difference in the indicators of the two groups of enterprises (with a level of determinants over and under the average for the survey), as well as a different tendency for their improvement in the second year of the study. The better level of the determinants was favourable for the introduction of successful technological transfers and innovation, which in turn lead to the improvement and of business indicators of enterprises.

As a whole, the research findings demonstrate the great importance of determinants of the absorption capacity for the competitiveness and business success of enterprises. The study is a good base for channelling managerial efforts in the right direction in order to ensure sustainable development of enterprises.

References

Cohen, W., and Levinthal, D. (1989). Innovation and Learning: The two faces of R&D. – The Economic Journal, 99 (September).

Cohen, W., and Levinthal, D. (1990). Absorptive Capacity: A new perspective on learning and innovation. – Administrative Science Quarterly, Vol. 35.

Hasan, S., Othman, A., Mustafa, Sh., Wahab, W., and Ismail, H. (2011). Development of Absorption Capacity Attributes for Technology Transfer Performance: A Pilot Study in National Automotive Industri. International Management Conference 2011, 16-17.04.2011, University Sultan Zainal Abidin.

Lane, P., Koka, B. and Pathak, S. (2006). The Reification of Absorptive Capacity: A Critical Review and Rejuvenation of the Construct. – Academy of Management Review, Vol. 31, N 4.

Larson, M., Wall, A., Norstrom, Ch., Crnkovic, I. (2006). Technology Transfer: Why some Succeed and some don't, TT'06 – 22.05.2006, Shanghai, China.

Mayer, S. and Blaas, W. (2002). Technology transfer: an opportunity for small open economies. – Journal of Technology Transfer, 27(3), pp. 275-289.

Nicholls-Nixon, C. L. 199, Absortive Capacity and Technology Soutsing: implication for responsiveness of established firms, Ph.D. Thesis, Purdie University.

Rosenkopf and Almeida. (2003). When does tapping external sources of knowledge result in knowledge integration?, https://www.researchgate.net/publication/256921150_When_does_tapping_external_sources_of_knowledge_result_in_knowledge_integration.

Rosenkopf and Almeida. (2003). Overcoming Local Search Through Alliances and Mobility. – Journal Management science, Vol. 49, N 6, p. 751-766.

National statistical institute of Republic of Bulgaria. (2016). Statistical yearbook 2016. p. 414.

Velev, M., Atanasova, S. (2013). The technology transfer in Industrial firm. Softrejd, Sopfia.

Volbersa, H., Foss, N. and Lyles, M. (2009). Absorbing the Concept of Absorptive Capacity: How To Realize Its Potential in the Organization Field. Center for Strategic.