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INFLUENCE OF TECHNOLOGICAL DEVELOPMENT ON ENCOURAGING INNOVATIVENESS OF DOMESTIC INDUSTRIAL ENTERPRISES*

Uticaj tehnološkog razvoja na podsticanje inovativnosti domaćih industrijskih preduzeća

Abstract

Technology and technological development are the key factors of contemporary socio-economic development, and the application of the latest technological achievements is the developed countries' most powerful means of competitiveness. Intensive technological changes produce an influence on increasing the dynamics of the business conditions, making them uncertain, unpredictable and discontinued, while forcing business entities to adapt constantly. In this paper, the influence of technological development on the enhancement of innovativeness of domestic industrial enterprises is studied, given the fact that today, as well, industry is the branch of economy which the prosperity of the majority of the developed countries rests on. Study on the subject is divided into four parts. In the first part, the mutual dependency of technological and economic development is examined, with special attention to the strategic aspects of technological development. The second part of the paper is dedicated to observing innovativeness as the basis for technological development. The analysis of certain indicators of innovativeness in domestic enterprises is presented in the third part, whereas in the last part, analysis of the data obtained by conducting research into the influence of technological development on encouraging innovativeness of domestic industrial enterprises was carried out by investigating the role of graduate engineers in this process. The aim of this paper is to indicate the significance and complexity of the influence of technological development on contemporary business conditions, and also to conduct an analysis of the influence of technological development on encouraging innovativeness in domestic industrial enterprises. The ultimate goal of the paper is to define certain measures that are to be taken so as to improve the existing, highly unfavorable, situation in this field.

Keywords: *technology, innovativeness, development, business entities, industry, human resources.*

Sažetak

Tehnologija i tehnološki razvoj predstavljaju ključne faktore savremenog društveno-ekonomskog razvoja, a primena najnovijih tehnoloških dostignuća čini najmoćnije sredstvo konkurentnosti razvijenih zemalja. Intenzivne tehnološke promene utiču na povećanje dinamičnosti uslova poslovanja, čineći ih neizvesnim, nepredvidivim i diskontinuiranim, i primoravajući privredne subjekte da im se stalno prilagođavaju. U ovom radu proučava se uticaj tehnološkog razvoja na pospešivanje inovativnosti domaćih industrijskih preduzeća, budući da je industrija i danas privredna grana na kojoj počiva prosperitet većine razvijenih zemalja. Proučavanje predmetne problematike podeljeno je na četiri dela. U prvom delu rada proučava se međusobna uslovljenost tehnološkog i privrednog razvoja, sa posebnim osvrtom na nužnost strategijskog pristupa u ovoj oblasti. Drugi deo rada posvećen je proučavanju inovativnosti kao osnove tehnološkog razvoja. Analiza određenih pokazatelja inovativnosti domaćih privrednih subjekata izneta je u trećem delu rada, dok je u poslednjem delu rada izvršena analiza podataka dobijenih istraživanjem uticaja tehnološkog razvoja na podsticanje inovativnosti domaćih industrijskih preduzeća, kroz proučavanje uloge diplomiranih inženjera u ovom procesu. Cilj rada je da se ukaže na značaj i kompleksnost uticaja tehnološkog razvoja na savremene uslove poslovanja, kao i da se na osnovu podataka dobijenih sprovedenim istraživanjem izvrši analiza uticaja tehnološkog razvoja na podsticanje inovativnosti u domaćim industrijskim preduzećima. Krajnji cilj rada jeste da se definišu određene mere koje bi trebalo preduzeti kako bi se postojeća, veoma nepovoljna, situacija u ovoj oblasti poboljšala.

Ključne reči: *tehnologija, inovativnost, razvoj, privredni subjekti, industrija, ljudski resursi.*

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Introduction

Contemporary technological achievements are among the most significant development factors and the most powerful means of competitiveness of the developed countries. Very intensive technical-technological progress has an influence on permanent changes in the conditions of doing business, the increasing severity of competition, as well as on the increase in the pressure on business entities to intensify their development. The development and application of the latest technological achievements imply a permanent increase in the quantum of knowledge of the economy and its entities; therefore, the developed economies are prevalently based on knowledge. Human resources are knowledge bearers, simultaneously being the bearers of intellectual capital, as the most important element of economic resources. Given the influence of technological development on business entities' corporate success, the paper shall study the most important features of the influence of technological development on business entities' development and business operations, then the strategic approach to the process of technological development, as well as the characteristics of innovativeness as the basis for technological development. In the final part of the paper, analysis of certain indicators of domestic economy's innovativeness is carried out, as well as an analysis of the data obtained through conducting research into domestic industrial enterprises, demonstrating the extent to which technological development influences the encouragement of the given enterprises' innovativeness.

Mutual dependency of technological and economic development

Technology (from Greek τέχνη (techne) – a skill, an art, knowledge, a means, a tool; and –λογία (logos) – science) could be defined more broadly as a science dealing with research into the production processes, or more narrowly, as a concrete system of production of a certain product by applying a determined procedure, while simultaneously using appropriate materials, tools, professional workforce and knowledge [8], [18]. In the contemporary conditions of doing business, technology has become one of the most important factors of economic and social prosperity. Whether it is the objectified (*hardware*) or non-objectified (*software*) technological knowledge, the influence of technology on contemporary economic and business processes is great and significant. Unlike the previous stages of socio-economic development, when technology was developing separately from science, in the contemporary conditions a systematic link has been established between the development of science and the development of technology. As an activity tasked to broaden the boundaries of one's perception of reality and attain new knowledge, science creates a basis for development and technology aimed at application of scientific knowledge in practice. By doing so, science has become the basis for contemporary technological development, since it enables the complete technical equipping of production, as well as a decrease in the workforce's participation in the direct process of production, strengthening the role of creativeness of human resources in value creation [16, p. 171]. Tight connection between science and technology and the application of their joint results represent necessary conditions for a more rapid development of each national economy and its present-day business entities.

Although technology and technological development are as old as the human society, the qualitative changes in their significance were intensified in the process of the first industrial revolution and have continued to date, when we are becoming aware of the fourth industrial revolution. The significance of the influence of technology is also supported by the fact that contemporary technological achievements are the most powerful means of competitiveness in the highly developed countries and the basis of their monopolistic position in many fields of international economic and political relations.

Technological progress may result in the creation of new processes and new products and services, as well as in the creation of novelties in marketing and organization [22, p. 15], [10, p. 72]. Technological changes contribute to a significant extent to an increase in the dynamic quality of the environment and conditions of doing business, bringing about their greater uncertainty and unpredictability. All this makes the conditions of doing business discontinuous, leading to the need for

globalization of the market and the world economy, and intensifying the need for permanent diversification of production programs and quick changes thereof. Those who are the quickest in adapting to changes will survive in such changeable conditions. "In industrial revolution 4.0, adaptation means adequate speed" [7, p. 34]. The new technological revolution and the informatics revolution as its integral part have also led to the economic revolution.

The influence of technological development on the achieved economic growth and development of countries is very significant. Research studies show that the share of technological in the total economic development may be within the range from 40% to up to 90% [4, p. 4]. Technological development is not only the basis, but also the imperative of development of each country and its business entities, because the said process contributes to a higher rate of economic growth, influences the increase in the productivity of business entities, improves the position of a country in the international distribution of work and contributes to a more complete satisfaction of the needs of the population, which, combined, results in higher living and social standards in general. Due to that, the countries and the business entities that do not achieve adequate technological development, permanently make their competitive position worse, which leads to a substantial slowdown in their development. In the value chain of a business entity, technology permeates all its activities, starting from the inbound logistics, all kinds of operational activities, marketing, sales, all types of management, all the way to the outbound logistics, technological development and the overall infrastructure of the enterprise [6, p. 682].

Developed countries are leaders in the sphere of technological progress, which is how they acquired their competitive advantage, and frequently a monopolistic position, on the global technology market. On the other hand, there are undeveloped countries characterized by a pronounced technological backwardness which they aspire to overcome while accelerating their developmental flows. Technology transfer appears as one of the instruments of their technological and economic development, and frequently also as the only one way for them to obtain certain more advanced technological solutions. Technology transfer, however, apart from its undoubted positive effects (such as quicker attainment of technological solutions, employment of domestic resources, revival of the national economy, increase in employment and competitiveness), produces numerous negative effects, as well, one of the most unfavorable being these countries falling into permanent technological dependency [25, p. 281].

The development and application of the latest technological achievements is also implicative of a permanent increase in the quantum of knowledge of the economy and its business entities, causing that contemporary economies are referred to as the economies of knowledge or knowledge-based economies. The economy of knowledge implies an economy that bases its development on production, distribution and use of knowledge [9, p. 22]. Knowledge-based economies employ knowledge in all their economic operations and activities. The employment of numerous innovations and new technologies has, to a significant extent, contributed to the change in the economic structure of the developed countries and the widening thereof, resulting in the self-transformation of knowledge-based economies into knowledge-driven economies. A high level of science development and an educated population are an adequate basis for a more rapid technological development. Given the fact that the application of new technologies implies continuous education of employees, a relationship of tight interdependency is formed between knowledge, education, science, technology and economic development.

So far, experience has shown that in knowledge-driven economies there is an expansion of development possibilities, as well as a change in the conditions of doing business. According to a research study conducted by the Foundation for Information Technologies and Innovations, Singapore was the most developed country according to the applied criteria – 38% of Singapore's population is highly educated, there are 9.7 researchers per 1,000 workers, and 1.4% of GDP is invested in research and company development, whereas 0.9% of GDP is invested in public institutions [2, p. 43].

Contemporary enterprises must struggle to improve their competitive position by strengthening their technological basis and innovation potential. In order for an innovation to be successfully placed in the market, it is necessary

that appropriate efforts are made not only in the field of technology, but also in the fields of engineering and marketing, which are implicative of the very application of adequate knowledge. In order to respond to the said requirements, business entities must dispose of appropriate human, financial and material resources, they should develop cooperation with other entities and also build an appropriate organizational structure so as to establish an adequate link between the technological and economic spheres of their business [25, p. 270].

As it is not inherent in technology to spontaneously develop itself, it is necessary that the technology development process be managed, but managed systematically, in a planned manner and for the long term, which requires a strategic approach. The technological strategy, in a broader sense, is an element of the economic development strategy related to the long-term exploitation, development and maintenance of the total knowledge and capacity of an economy and its entities.

The significance of strategic approach to technological development has been more and more pronounced over time, because the level of technological development is essentially significant for an enterprise. Therefore, the level of technological development is the key factor in an enterprise's environment, while technology is the primary resource of an enterprise's competitive advantage. Technology's strategic influence may change the structure of the market and industry, and technological development permeates all segments of business. High technology also requires an appropriate level of culture, an appropriate style of management and organization of doing business [30, p. 10].

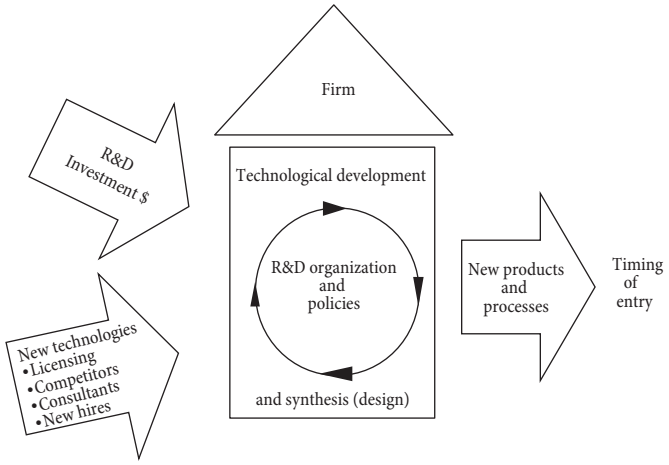
When formulating a technology strategy, business entities must be mindful of choosing between different technologies and available resources, as well as of the successfulness of application of the said technologies. Technology strategy permeates all business functions of an enterprise, starting from production, marketing, R&D, all the way to resource allocation and management (Fig. 1) [3, p. 234].

From a global viewpoint, technology strategy should encompass the following four segments: technology acquisition, usage, development and sales [25, p. 278]. Technology strategy is a means by which an enterprise can achieve each one of the three generic strategies: the lowest cost strategy, the differentiation strategy and the strategy of being focused [6, p. 688]. Given the fact that technology develops quickly, the once-defined technology strategy is not final – it must be subjected to revision and adjusted to current changes from time to time.

Innovativeness as the basis of technological development

Innovations and innovativeness (from Latin *innovatio* – a novelty, designing novelties, change) [31] represent the basis for contemporary technological development. The meaning, the role and the significance of innovativeness have changed as time passed, following technological and social changes. In the beginning, the innovative process

Figure 1: Technological policy framework



Source: [3, p. 234]

was performed mainly spontaneously and was a result of isolated activities of talented individuals who aspired to reach new solutions. Today, innovativeness covers a broad field and is a means, a manner of thinking and a tool in the struggle to survive. Innovativeness can be understood as entrepreneurs' specific tool and a means that helps them to employ change as a possibility for performing different production and service activities [5, p. 95]. It is also possible to understand innovation as an inspiration and a creation, renaissance and pressure exerted on changes in the learning process, representing a path to discoveries [20, p. 87]. The European Commission defined innovation as the renewal and extension of the product assortment and the markets related to them; the establishment of new methods of production, supply and distribution; the introduction of changes in the management and organization of labor and conditions and employees' skills [9, p. 12], whereas according to the OECD's definition, technological innovation is the transformation of an idea into a new or improved product or an operational process in industry or trade [11, p. 15]. Unlike invention, innovation is, as a rule of thumb, associated with practical application and can represent a process in which potential is turned into a new idea and its wide practical use [27, p. 67].

Constant changes in the business environment bring about permanent relativization of the position of business entities which are forced to incessantly adapt themselves to the respective changes. Adaption is, in general, much more successful if it is based on a strategic approach and planning. In the given circumstances, it is necessary that business entities integrate all their business functions and direct them toward creating, improving and maintaining competitiveness which is based on innovativeness. Business entities' innovation space is very broad and consists of four elements: the product, the process, the paradigm and the position [28, p. 76]. Enterprises must take care of all the elements of their innovation space, because the process of innovativeness and the process of technological development have become quite complex. For that reason, developed countries devote much attention to the process of innovativeness in the form of long-term, planned investments of resources in this field, through the implementation of innovative solutions, permanent improvement of the process of innovativeness itself, as well as through the development of innovativeness in all spheres of doing business. Business entities generate their process of innovativeness on the basis of three factors: the organization's capabilities, the needs of the market and the science and technology basis [29, p. 45].

Enterprises that are more dedicated to their own innovative development normally achieve much better business results in comparison to their competitors. It is particularly important to emphasize that the business entities' approach to innovativeness must be planned in the long term and must be systematically applied. Research studies show that if an enterprise is permanently dedicated to innovativeness, its innovations are by 15% more likely to be successful [19, p. 69]. Given the complexity of contemporary technology, enterprises frequently combine the introduction of innovation of both products and processes. So, for example, they start manufacturing new products by applying a new technological procedure for which an enterprise needs greater resources, knowledge, experience, special skills and so forth. Perseverance in combining different fields of the application of innovations increases the likelihood of their successfulness by 2% to 4% [19, p. 70]. It is also very important for business entities to achieve complementarity while developing different types of innovation, because it enables achievement of synergetic effects and creates the possibility of increasing the enterprise's chances for its own development and improvement of competitiveness. The enterprises which have won the battle for the leading position in a particular segment of technical development aspire to have their innovation used by at least 50% of the consumers so that the innovation could become dominant, i.e. standard [26, p. 59].

The emergence of innovation itself, however, is not a guarantee that it will be successful in the market, just as the application of the most contemporary technologies all but guarantees high profitability. Once an innovation is introduced, the process of its development can be conducted in two directions: through the adaptation of the innovation and through competitors' imitation of the innovation [21, p. 62]. An innovation can be subjected to adaptation when the buyer is ready to accept the innovation.

The adaptation of an innovation is necessary because the conditions of the application of an innovation, in general, differ from one enterprise to another in terms of the difference between knowledge, experience, personnel, organization, infrastructure thereof and so forth. The complexity of contemporary technologies makes their application more complicated. If a certain technology has the potential to be applied and adapted in a larger number of fields, it helps its further improvement, advancement, new inventions, increase in knowledge and it creates far greater commercial value, as well. In practice, it is frequently the case that a large number of enterprises are mutually connected in certain forms of cooperation so as to reduce costs, which is particularly pronounced in the field of information technologies. Through their mutual cooperation, enterprises tend to use more rationally the available resources, which are always limited. Namely, this way the available resources are directed toward innovations development in the fields in which those enterprises competently operate and in which they have competitive advantage, whereas other activities are delegated to entities outside the enterprise [26, p. 205].

Innovations begin to be imitated once competitors start making efforts, as soon as possible, to offer the market their product or service which is very similar to the innovation that has already appeared in the market. For the innovator enterprise, it is important that its technology should be adapted as much as possible, i.e. applied in as many fields as possible, and to be applied by as many other business entities as possible. The processes of adaptation and imitation of an innovation are interconnected and interwoven.

The intensive process of innovation has led to the shortening of the lifecycle of technology and the products, so that the main weapons of enterprises in their fight to survive in the market are their changes and adaptation, first of all through the capability of differentiating products and services via innovativeness. That is why the most successful enterprises are the innovative ones, which base their business operations on knowledge and which are capable of quickly responding to challenges coming from the environment. In the said conditions, speed of reacting to the newly created changes is one of the critical factors for business success. For that reason, business entities must be much quicker in their response to changes so as to achieve greater efficiency and flexibility and enhance their ability to endure discontinuity in doing business. In such circumstances, innovations are also introduced to the management modalities applied in order to achieve the greatest possible efficiency of the business systems which are organized in quite a new manner. The domain of employees must constantly be expanded so as to increase their motivation for more efficient performance of their tasks. This is also confirmed by a research study according to which the business results of the biggest world firms, such as General Electric, Du Pont, Procter & Gamble and Toyota, were contributed the most exactly by the process of innovating their management [17, p. 253]. Technical and technological progress condition the employees to face with new requirements in the future. The said requirements will be conditional upon the necessity of the development of employees' new characteristics, knowledge and skills in compliance with the new work and living conditions. The characteristics that will be esteemed the most in the future are passion in doing the work, creativity in problem solving and appropriate initiative [12, p. 127]. Creativity, as well as the employees' permanent creativity is something that will be the comparative advantage of the business entities that possess it. For that reason, the key changes in the management system should encompass the following three categories: (1) the content – which is implicative of change in the enterprise itself, its organizational structure, strategies, processes applied, technologies and so forth; (2) the people – through exerting influence on their behavior, emotions, sense, spiritual development, and (3) the process – as planned changes in the content and the employees, their projection and application [1, p. 17].

The majority of business entities do not possess sufficient resources to develop all the elements of innovative activity, which would be justified economically. Only large and economically strong enterprises can achieve the development of innovative activities in several fields. Those enterprises are technological leaders and are relatively few. The majority of the other enterprises develop only one or a few innovative fields in which they have competitive

advantage on the grounds of their knowledge, experience, personnel, tradition, the market and so forth.

Some indicators of innovativeness in the domestic economy

Innovativeness as a link between invention and its practical application stands as the basis of all developmental changes. Human knowledge, whose process of creation, expansion and application is permanent, and its influence on the overall development of the economy and society is complex, multidimensional and long-term, constitutes the basis for innovativeness [14, p. 547].

At the level of national economy, the science and research activity of innovativeness is what constitutes its basis. The level of development of innovative activity and the level of technological and overall economic development, too, depend on the amount of resources a country invests in this field and on the qualitative structure of those resources. The data showing that the most developed countries in the field of the SRP allocate between 3% and 4% of their GDP, which is one of the most significant factors of their economic development and technological superiority, speaks in favor of this assertion. For decades, less than 0.4% of the relatively low GDP has been allocated to the field of research and development in the domestic economy, which is insufficient for initiating any kind of relevant development [23], [24]. In order to take any steps forward whatsoever in the sphere of technological development, it is necessary that the approach to this activity be significantly modified not only at the level of the economy, but also at the level of business entities. Change in the approach means that investments in this field are not to be treated as an undesired cost, but rather as a highly profitable investment in the future.

When studying the condition of the research and development activities in Serbia, the analysis can be conducted in several directions. One of them is the structure of the organizations performing this activity per particular sectors. The latest available data indicate that 42.6% of the organizations performing scientific research work in Serbia belong to the sphere of higher education. The organizations of the non-financial sector account for 30.4%; those of the state sector account for 25.3% in scientific research work, whereas the smallest number of the organizations performing this activity come from the non-profit sector, whose share is 1.7%. The stated data enable us to conclude that the field of research and development is concentrated in institutions of higher education and the non-financial sector, which account for over 70% of the organizations conducting this activity [24]. The said fact indicates that research and development in Serbia is still concentrated in the institutions which operate in the range of basic research, and that adequate connectedness between science and the economy is still lacking. Contrary to the abovementioned situation, in developed countries research and development has increasingly shifted to large corporations which also have their own research and development sectors. The respective development sectors are tasked to solve concrete developmental problems of the corporation through research. The process of the shifting R&D to enterprises contributes to an increase in their quantum of scientific and technological knowledge. For that reason, the majority of highly developed countries tends to integrate large and economically strong enterprises into the educational system of the country, while in some cases the said enterprises also have their own universities. The biggest world companies have their own scientific research laboratories, as is the case with the companies Xerox, RCA and AT/T. Given the fact that contemporary research studies are multidisciplinary, complex and as a rule of thumb quite expensive, it is implicative of the forming of an ever-increasing tighter connection between enterprises, on one hand, and universities and institutes, on the other. According to the data published in R&D Magazine in the United States in 2010, 70% of research and developmental works were performed exactly in enterprises, and merely 15% at universities, whereas one half of all the scientists in the USA were employed in industry or worked for the industry. The European Union, too, aspires to have two thirds of the R&D investments placed in in private enterprises [18, p. 192]. The reason for the said tendencies lies in the fact that contemporary technologies are very complex, that their development frequently implies specific knowledge, skills and experience, which cannot always be bought, so enterprises are forced to create and

develop them by themselves, which is particularly so when speaking about leading technology companies [13, p. 7].

Today, scientific discoveries and innovations are tightly connected to practice, in a way that both in the world and in our country, those innovations whose commercial verification is relatively certain are pressed ahead. The retention of discovery at the level of theory, deprived of the commercial application of the same, is a process considered to be unsustainable in the long run for business entities and the economy. The link between practice and scientific and research work, however, is the weakest link in the chain of the domestic economy's innovativeness. Observed in the short term, the purchase of finalized technological solutions via some forms of technology transfer contributes far more quickly to the achievement of certain developmental goals set by the business entities. Observed in the long term, the exclusive purchase of finalized technological solutions, however, may lead enterprises to a state of permanent technological dependency. For that reason, the option of combining the purchased technology with their own solutions, as well as of further developing and adapting the purchased technology to their own conditions of application and needs, is the most acceptable option for the majority of business entities.

Size and economic strength of the business entities influence their innovativeness to a substantial extent. As a rule of thumb, large enterprises have significant resources at their disposal, therefore their innovation potential is greater, together with their chances to successfully commercialize their innovations, and they also possess greater strength to endure the risk of failed research studies and attempts. Table 1 classifies business entities in the Republic of Serbia according to their size and innovativeness.

By analyzing the data presented in Table 1, it can be perceived that large enterprises have the biggest share (66.2%) in the group of innovators, which confirms the fact that innovativeness can only be attributed to the business entities which possess the necessary resources. The data introduced in Table 1 are also indicative of the fact that small enterprises, whose share in the total number of business entities is 76.4%, participate as innovators to the smallest extent (40.8%). The presented data dispute the widespread opinion that small enterprises are the bearers of the process of innovativeness in this economy of ours. In the medium-sized enterprises group, 55% are accounted for as innovators. The data in Table 1 also show that there is a greater involvement of innovators in the production rather than in the service enterprises. Such a situation is a consequence of the fact that the production process offers a much broader and much more diverse space for innovativeness than is the case with the service sector.

The innovation potential of a national economy depends both on the structure of its innovative entities and the structure of innovations implemented in it. In the domestic economy, the situation regarding this issue is also unfavorable (Table 2).

By analyzing the data presented in Table 2, it is possible to conclude that, out of the total number of the business entities, the innovators account for less than one half, namely 44.6%. Amongst them, the most numerous are the non-technological innovators, whose share is 39.7%. The technological innovators account for no more than 27.4%, which indicates the fact that there is a relatively small number of domestic business entities dealing with innovativeness in the sphere of technological improvement. It is a consequence of the relatively low level of technological development, as well as the cause for a

Table 1: The structure of business entities according to their size and innovativeness (2010-2012)

No.	Business entities	Total		Innovators		Non-innovators	
		Number	%	Number	%	Number	%
1.	Total	11,841	100	5,280	44.6	6,561	55.4
2.	Small	9,057	76.4	3,691	40.8	5,366	59.2
3.	Medium-sized	2,264	19.1	1,245	55.0	1,019	45.0
4.	Large	520	4.5	344	66.2	176	33.8
5.	Production	4,122	34.8	2,007	48.7	2,195	51.3
6.	Service	7,719	65.2	3,273	42.4	4,366	57.6

Source: Statistical Yearbook of the RS 2015 and the Authors' own calculations.

situation like this one. Non-technological innovations are mainly cheaper, quicker to apply and imply a smaller risk than technological innovations, for which reason the prevalent investment in these is a consequence of the poverty of the economy, as well as of the inadequate treatment of this field.

Research into innovativeness of the domestic economy can also be conducted in the direction of the analysis of the structure of the very innovative activities applied by the domestic business entities, which is provided in Table 2. As the presented data indicate, the domestic business entities are somewhat more oriented toward product innovations than process innovations (21% to 19.1%). Innovations in the business entities' organizations account for 31.4% of the innovative activities, whereas innovations in marketing make up 29.7% of the total innovations. The stated structure of the particular types of innovations is indicative of the fact that, due to the scarcity of the resources they have at their disposal, domestic business entities are more focused on innovations that incur lower costs, and these are exactly novelties in the organization of the enterprise and novelties in the field of marketing activity.

Technological development and innovativeness of domestic industrial enterprises

Due to the complexity of technological development, it is very difficult to exactly define all the indicators of any given development. Technological development and innovativeness of the domestic economy are at a relatively low level. Numerous factors have led to this, while at the same time a lack of adequate strategic approach in this field, low investment in R&D lasting for many years and inefficient privatization are just some of the most relevant ones. One of rather pronounced developmental problems of the domestic economy is also the deindustrialization process that intensifies all the existing backward processes. Even today, however, the industry is the branch of economy which supports the prosperity of the majority of the developed countries, because it has a multiplicative influence on the development of all other production and non-production activities, as well as on the overall socio-economic development. Due to the abovementioned, even in the future, the industrial sector will also play a very important role in the process of reviving and developing the domestic economy [15, p. 2]. Given the statements above, the following part of this paper introduces a research study which was conducted on domestic industrial enterprises, because technological development in the industrial sector is the basis for technological development of all other branches of economy.

One of the segments of the research study was aimed at examining the extent to which domestic industrial enterprises use their available personnel resources to encourage technological progress and innovativeness in order to strengthen their competitive position and improve their business success. In that sense, the research was conducted on a sample of industrial enterprises and on a sample of employees. The research study conducted in the Republic of Serbia in 2014 included, namely, the industrial enterprises operating in the following industries: chemical, pharmaceutical, paper, metal, mining and rubber. Within the framework of the research into the role and significance of human resources as the bearers of intellectual capital, relevance of graduate engineers was especially subjected to research, because they are the bearers of industrial enterprises' technological development and innovativeness. For that reason, this segment of the research includes those

Table 2: The structure of innovators and innovations according to the types (2010-2012) (in %)

No.	Innovators		Innovations	
	Type	Share in %	Type	Share in %
1.	Total	44.6	Products	21.0
2.	Technological innovators	27.4	Processes	19.1
3.	Non-technological innovators	39.7	In organizations	31.4
4.	All innovators	22.6	In marketing	29.7
5.	Non-innovators	55.4	Still in progress or abandoned	7.9

Source: Statistical Yearbook of the RS 2015 and the Authors' own calculations.

enterprises deemed to be representative of their activity and which, on the other hand, employ a significant number of graduate engineers. In this segment, the research study encompassed 18 enterprises and 434 graduate engineers (in mechanical engineering, electrical engineering, mining-geological and technological-metallurgical professions). According to their size, the enterprises were classified into two groups – the one consisting of small and medium-sized enterprises (of up to 250 employees) and the other consisting of large enterprises (of over 250 employees). The sample was carefully stratified following the regional principle and it included enterprises inside the entire territory of the Republic of Serbia. The research goal in the said segment was to investigate the role, significance and influence of graduate engineers in technological development and innovativeness of the industrial enterprises where they are employed, as well as to gain knowledge on the condition of the industrial enterprises in view of the level of their technological development and innovativeness on the basis of the analysis and of what should be done to improve them.

The conducted research indicates that, among the industrial branches, graduate engineers account for the largest percentage share (32.9%) in the employee structure in the mining industry, which is only to be followed by the rubber industry (19.8%) and the chemical and metal industries, where graduate engineers account for 16.5% of the employees. A question, however, may be posed whether the employed engineers, as an important segment of human resources in the analyzed industrial enterprises, have the conditions needed to apply their acquired knowledge when performing their tasks. The research has shown that less than one half of the employed engineers, i.e. 42.2%, work as engineers, whereas 31.6% of the engineers are engaged in some sort of managerial or executive jobs. The majority of the engineers even declared that they are only partly engaged on the job they were professionally trained for, for the most part in the pharmaceutical industry (66%) and the paper industry (as many as 83.3% of them only partly work on jobs which pertain to their profession). The stated data allow us to conclude that domestic industrial enterprises do not rationally use their human resources, for which reason the knowledge possessed by their graduate engineers remains insufficiently used.

A very rapid and dynamic technological development implies that experts constantly innovate their existing knowledge and skills and acquire new ones. The employees who keep up with the latest achievements and trends are quite a precious resource for each business entity, because they can be the bearers of innovativeness and its development. In accordance with the abovementioned, the research was directed toward the question of the extent to which certain types of professional development opportunities for graduate engineers were available. The results of the given research segment are presented in Table 3.

The data presented in Table 3 suggest a rather unfavorable structure of professional development sessions which the engineers in the surveyed enterprises attended. Namely, a relatively small percentage of graduate engineers took part in the development sessions in the field of introduction of new technologies; namely, most of them work in the chemical and the pharmaceutical industry (26.5% and 23.1%, respectively), while the smallest percentage came from the metal and the rubber industry, where only around 10% of graduate engineers attended the development sessions in this field. Such data are the consequence of the slow introduction of new technology in domestic enterprises due to poor business results, lack of financial and other resources, loss of competitiveness and the market share, for which reason trainings in this field

Table 3: The availability of certain types of professional development opportunities for graduate engineers in domestic industrial enterprises (in %)

No.	Branch of industry	Introduction of new technologies	Introduction of new standards	Both	N/A
1.	Metal	9.1	12.7	78.2	-
2.	Rubber	10.0	36.0	42.0	12.0
3.	Paper	20.0	30.0	50.0	-
4.	Chemical	26.5	10.2	61.2	2.0
5.	Mining	19.8	12.6	55.9	11.7
6.	Pharmaceutical	23.1	12.0	61.5	2.6

are relatively rare. The development sessions in the field of introduction of new standards were not attended by a high percentage of the engineers, either. In the rubber and the paper industry, 36% and 30% of graduate engineers, respectively, attended professional development sessions in the field of introduction of new standards, whereas in all the other industrial branches only 10% to 12.7% of graduate engineers attended professional development sessions in this field. The majority of the surveyed engineers reported that their professional development sessions in the field of introduction of new technologies had been related to their development in the field of introduction of new standards, which is especially so in the metal industry (78.2%), whereas some engineers could not even say what training they had attended, which is indicative of the low quality of training, as well as of their lack of interest in training.

In order for an engineer to do his/her work efficiently, it is necessary that professionals, apart from the appropriate type and level of professional qualifications, permanently keep up with the latest achievements in all the fields of science and technology development, especially in the field they themselves are engaged in. For that reason, one of the research segments was directed toward answering the question whether graduate engineers do keep up with the development of science and technology concerning their own profession (Table 4).

The data presented in Table 4 indicate quite an unfavorable situation in terms of keeping up with the development of science and technology by the graduate engineers employed in domestic industrial enterprises. Namely, the development of science and technology is observed by less than one half of the graduate engineers, with the exception of electrical engineers, whose share accounts for 51.2%. Yet more discouraging is the data showing that only 5.7% to 16.3% of the graduate engineers keep up with the development of science and technology in their profession on a regular basis. The majority of the surveyed engineers only occasionally inform themselves about the latest trends in the field of the development of science and technology, namely as many as 50% of the engineers in mining and geology. The cause for such a relatively low interest in keeping up with the latest developments certainly lies in the fact that a large number of industrial enterprises are in an unfavorable position. In many industrial enterprises, production ceased or is only partially conducted, and the technology is obsolete. Many privatized enterprises closed their research and development sectors and observe engineers as mere performers, instead of treating them as a creative part of the human resources who should take initiative in solving current and developmental problems. Combined with relatively low salaries, this has brought about a lack of motivation in graduate engineers to implement the contemporary trends and develop their competencies. Due to the abovementioned, their interest in innovativeness and contribution to the development of their enterprise(s) is very weak.

Building on the abovementioned, a question may be posed regarding the extent to which industrial business entities in Serbia encourage and motivate their employees to constantly develop their knowledge and simultaneously contribute to the increase of the enterprise's efficiency, improvement of its business success and development. One of the manners to motivate employees to constantly develop their knowledge is to provide them with the opportunity to make progress by advancing in the employment hierarchical structure. The conducted research study has shown that the mutual dependency of continuous development of knowledge and a better job position is quite weak in domestic industrial enterprises (Table 5).

By analyzing the data presented in Table 5, one could establish the fact that almost one half of the respondents answered that there was no dependency between their

Table 4: Keeping up with the development of science and technology by graduate engineers (in %)

No.	Field of profession	Yes	Regularly	Occasionally	No	No answer
1.	Mechanical engineering	42.1	12.4	43.0	1.7	0.8
2.	Electrical engineering	51.2	16.3	32.6	-	-
3.	Mining-Geological	44.3	5.7	50.0	-	1.5
4.	Technological-Metallurgical	44.5	7.5	43.0	3.5	-

Table 5: Dependency between the engineers' position and continuous development of their knowledge (in %)

No.	Branch of industry	Yes	No	Partly	No answer available
1.	Metal	33.3	13.9	46.6	4.2
2.	Rubber	20.9	22.1	48.8	8.1
3.	Paper	25.0	41.7	33.3	-
4.	Chemical	22.5	25.4	47.9	4.2
5.	Mining	16.1	46.2	34.3	3.5
6.	Pharmaceutical	36.0	20.0	42.0	2.0

position and their continuous professional development, or if any did exist, it was only partial. The greatest mutual dependency between knowledge development and the job position is observed in the pharmaceutical and the metal industries, where 36% and 33.3% of the respondents, respectively, answered affirmatively. The link between the work position and professional development is the weakest in the mining (48.8%) and the paper (41.7%) industries, which are characterized by somewhat lower rate of technological development. In the enterprises operating in the rubber and the chemical industries, there is mainly a partial dependency between the position and permanent development, which is 48.8% and 47.9%, respectively, and it also depends on the size and competitiveness of the specific enterprise.

The problems of technological development have particularly been pronounced in the economies that have gone through a transition to the market conditions of doing business. The domestic economy also belongs to this group. Since the process of economic transition contributes to national economies opening up to other countries' economies, access to contemporary technologies should therefore be facilitated. In such a constellation of relationships, however, enterprises are faced with new requests, one of the most important being the creation and implementation of the strategy of continuous adaptation to changeable conditions of doing business, while simultaneously achieving a constant enhancement of efficiency and effectiveness criteria. The said requirements are very difficult to meet simultaneously. In order to implement these, it is necessary that all the employees be actively involved not only in the performance of operational tasks, but also in the process of solving all problems which an enterprise comes across in conducting its business operations. The conducted research has demonstrated that, in the domestic industrial entities, insufficient attention is dedicated to motivating employees to constantly develop themselves professionally, to be innovative and contribute creatively to solving problems. However, given the fact that the acceleration of technological development is one of the basic preconditions for the revival, development and improvement of its competitiveness of the domestic economy, it is necessary that certain changes be introduced to the management of limited resources, and that the rationality of their use be increased. Large layoffs in the industrial sector (in the period from 2001 to 2010, 700,000 employees were fired) are also a major issue [32]. Simultaneously with the outflow of the workforce, which is a problem in its own right, there are inevitable and far more serious consequences related to the outflow of knowledge, experience, specific skills and employees' other competencies, which have been accumulated in this sector for a longer time and are very difficult to be quickly and fully compensated for [15, p. 3]. This is why it is very important to adequately manage all available resources, the human ones in particular, since humans are the bearers of intellectual capital. In order to achieve the necessary level of technological development in such limited conditions, it is necessary that an adequate strategy for technological development be defined, and the treatment of this field and human resources as the bearers of intellectual capital be changed.

Conclusion

In contemporary conditions, technological development is not only the basis, but also the imperative for the development of each country and its business entities. In the domestic economy, which is still trapped in the process of transition

and is simultaneously characterized by a low rate of growth, structural imbalance and unemployment, the problems of technological development are quite pronounced and they frequently hinder its revival and development. The conducted research shows that the situation in the field of innovativeness and technological development of domestic business entities is quite an unfavorable one. Apart from low investments in R&D, which have been below 1% of GDP for decades, the structure of the said investments is also unfavorable. The research study indicates that, out of the total number of business entities, innovators account for less than one half, i.e. 44.6%, whereas technological innovators account for only 27.4%. The analysis of the subject matter structure is indicative of the fact that the share of product and process innovations is approximately 20%, whereas organization innovations and marketing innovations boast the largest share, 31.4% and 29.7 percent, respectively. The data obtained through the research study conducted in domestic industrial enterprises, inclusive of graduate engineers as the bearers of the innovativeness of this type of the enterprise, indicate that less than one half of the engineers (42.2%) perform works which they were not professionally trained for, whereas the majority of the engineers occupy managerial and executive positions, which is indicative of the fact that this resource is being used irrationally. Besides, a relatively small number of the engineers attended professional development sessions in the field of introduction of new technologies (9%-26%), and only about 10% of the graduate engineers keep up with the development of science and technology within the field of their profession(s) on a regular basis. The research also demonstrates that domestic industrial entities dedicate insufficient attention to their employees' motivation to continuously develop themselves professionally, to be innovative and creatively contribute to problem solving. Given the fact that intensive technological development is conducive to permanent changes in the conditions of doing business and places new requirements before the enterprises with respect to adaptation and the continuous enhancement of efficiency and effectiveness criteria, it is necessary – for the purpose of reaching a solution to the unfavorable situation – that the domestic business entities maximally rationally use all of their resources, particularly human resources, as the bearers of intellectual capital, and also apply a long-term strategic approach within the field of their technological development and innovativeness.

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