PERSPECTIVES OF INNOVATION IN SERBIAN FIRMS- EMPIRICAL EVIDENCE FROM AGRO-FOOD AND SOFTWARE INDUSTRY

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A B S T R A C T

Based on the available literature on theory of innovation and the data processed from the official research on innovation activities in Serbian firms, this paper shows different perspectives of usage of the innovation activities indicators. The results showed that firms involved in software sector are more innovative than firms in agro-food sector. On the basis of the research conducted in this paper, it is possible to draw conclusions which are significant to the management of enterprises in observed industries. According to these recommendations, innovative enterprises management could respond to problematic situation of business economy in the field of innovation management through adequate business strategies. Besides that, empirical research in innovative activities in Serbia in the two observed sectors yield a serious analytic framework to guide industrial policy and employ appropriate measures in order to improve national competitiveness based on knowledge.

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Introduction

The increasing attention to the phenomenon of innovation is related to various factors. Some of them are a part of the economic discipline and some of them are related to increasing empirical perception of the importance of technological factors for the competitiveness and growth (Dosi, 1988). The innovation should be viewed in two dimensions at the same time, as a conceptual and as perceptive phenomenon. In fact, successful innovation is the result of systematic analysis and studies of all sources of innovation, but, it is essential that there is recognized need for it (Drucker, 2003).

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Differences in growth rates between industries are well known and quite obvious. Also, the fact is that growth rates in some industries are steadily decreasing, while some other industries show high intensity of growth. Most industries with high R&D intensity appeared in the 20th century, and recorded extremely high growth. Quite obvious was that high growth rates were associated with level of technological innovation as well as with high rate of diffusion of innovations within the global economy. The recognition of the growing role of science and production connections, as well as their empowerment is seen as a national development priority (Lundvall, 1988).The difference between the growth rates and productivity, in different industries, is systematically related to the R&D intensity and the patterns of technical change. Industries with declining growth rates are generally characterized by low levels of R&D intensity and low rate of technological change. However, the existence of a statistical relationship between technological progress and the industries growth does not necessarily mean that only technological innovation fosters the growth (Freeman, 1982). It does not mean that firms that are operating within the low technology intensive sectors achieved lower benefits from their innovations. The result of innovation activities are in line with numerous factors: market demand, customer requirements, competition, and suppliers. Integral part of research innovation performance involves investigating innovation activities. Within the circumstances of changing environment, the innovation is seen as new driver for development not only for the firms, but for whole regions (Gotz, 2015).

"*An innovation is the introduction of a new or significantly improved product, process, organisational method, or marketing method by your enterprise. The innovation must be new to your enterprise, although it could have been originally developed by other enterprises*" (OECD, 2005).

Significantly improved products and processes represent new combination of existing knowledge. Schumpeter's explained that the new combination of existing knowledge means bringing together two aspects of the innovation: existing elements and new elements (Lundvall et al., 2002). Innovation, in this sense, also means, change of economic structure, by introduction the new things and destruction of the old. But the new combination does not just mean technological changes; it highlights the importance of research and development for economic growth and underlines the importance of market power (Tunzelmann, 1995). Through empirical studies about innovation activities in firms, it is possible to create patterns of technological change.

Progress in the analysis of innovation activities at a firm's level has been achieved in the 90s by setting up of the Oslo Manuel and Community Innovation Survey's (CIS). Based on the analysis of data obtained by CIS questionnaire, it is possible to create indicators that can be used as a framework in order to describe innovation activities (OECD, 2005). Information about innovation activities is the main innovation input and CIS data can be used to describe innovation behaviour of firms in particular industries (Franconi & Standler, 2002). Some studies explored motives and impacts of R&D collaboration (Negassi 2004; Cassiman & Veugelers, 2002). Also, some studies put attention on regional aspect as a factor of innovation activities (Copus et

al., 2008; Franconi & Stander, 2002;). Others assessed the implications of innovation activities for innovation policy (Aralica et al., 2008; Knell, 2008) while some point out organisational aspect of technological innovation (Mosurović & Kutlača, 2011). The majority of studies were oriented in order to investigate relationship between R&D and productivity (Mairesse et al., 2002; Knell, 2008).

According to the official national statistical reports (CIS reports), over the past decade, the total number of innovators in Serbia has shown a slight decline in almost all economic activities, except *electricity, gas, steam and air conditioning supply* and *administrative and support service activities*. Innovative firms are defined as those having introduced product or process innovation, innovation in organization or marketing innovation during the observed period. It has been noticed that the differences, in terms of share of innovative firms, are more perceptible between the sectors within the period, than between the observed periods themselves (*Table 1*).

Table 1. Innovation in Serbian firms by NACE classification (2008-2016)

Indicators	Innovation (%)			
	2008-2010	2010-2012	2012-2014	2014-2016
Total	47,9	44,6	40,5	41.2
Agriculture, forestry and fishing	43,2	30,3	22,9	41.9
Mining and quarrying	40,7	37,0	19,3	27.1
Manufacturing	57,6	50,5	42,7	47.9
Electricity, gas, steam and air conditioning supply	42,7	46,2	53,2	53.7
Water supply; sewerage, waste management and remediation activities	38,6	32,5	35,1	31.1
Construction	37,7	40,6	36,2	36.7
Wholesale and retail trade; repair of motor vehicles and motorcycles	43,7	42,0	40,7	31
Transportation and storage	37,9	34,4	31,7	37.3
Accommodation and food service activities	37,5	42,6	46,2	30.8
Information and communication	56,5	53,7	47,6	40.2
Financial and insurance activities	66,9	72,1	36,3	38.1
Real estate activities	36,1	24,4	26,9	8.5
Professional, scientific and technical activities	51,0	50,6	37,5	47.3
Administrative and support service activities	39,0	37,7	43,4	53.1

Source: Statistical Office of the Republic of Serbia (2017). *Indicators of Innovative Activities in the Republic of Serbia, 2014-2016*, Release number 197. Statistical Office of the Republic of Serbia (2015). *Indicators of Innovative Activities in the Republic of Serbia, 2012-2014*, Release number 276. Statistical Office of the Republic of Serbia (2013). *Indicators of Innovative Activities in the Republic of Serbia, 2010-2012*, Release number 285. Statistical Office of the Republic of Serbia (2011). *Indicators of Innovative Activities in the Republic of Serbia, 2008-2010*, Release number 347.

In this paper software industry and agro-food were chosen to be analysed further as areas with high potential for Serbian economic development. The period 2008- 2010 is observed because the complete data base was provided for this period. Innovation is seen as driver for agro-food sector in many industrialized countries that increase competitiveness of the whole sector (Adenle et al., 2017). It can be noted that the agro-food sector is gaining more and more importance in governmental policies which causes some improvements within its own area (strengthening legislation, sustainability, globalization, competition, climate change, public opinion, networking and collaboration, technological innovation) (Mulder, 2008). This sector is very wide and diversified, with different levels of R&D intensity. Agro-food sector is seen as a sector with great potential for development in Serbian economy. But, in terms of sustainable growth rate, Serbia "does not sufficiently use all competitive advantage it has in agriculture and food industry" (Jović et al., 2016).

The software industry has been indicated as the most dynamic and fastest growing sector in Serbia in the last ten years (Živković et.al, 2018). The main specificity of the software sector is mostly shaped by its generic characteristics, which is an important feature that contributes to the rapid and wide diffusion of technologies in almost all industries, and thus the whole economy of certain countries. Evaluation of the innovation potential of companies in the software is a very challenging task because of the character of the software in terms of relatively low cost of production, so that the marginal cost of production is a bad starting point in assessing the revenue of the software (Lippoldt & Stryszowski, 2009).

Information about innovation indicators received on the basis of CIS questionnaires are valuable for decision-makers both on a national economy level and on management level of innovative enterprises. Decision-makers on a national level can gain a better insight into developing innovative process in an enterprise, as well as the innovating influence on the growth of the economy. Furthermore, items of information obtained in this way are possible to be compared among countries, in addition this enables benchmarking of national economic performances. Information received on the basis of CIS reports can serve to construct different models for assessing innovative enterprise capacity and, lastly, to define recommendations for the enterprise management.

Materials and methods

Methodology that was used in empirical part of the research is based on European statistical monitoring of innovation activities at the firm level since 1992- Community Innovation Survey (CIS). CIS methodology is based on Oslo manual created by OECD and contributes to better understanding of innovation processes because at the same time it analyzes the impacts of the innovation on the economy: the impact of innovation on competitiveness, employment, economic growth, and society at whole (Mosurović Ružičić, 2012). Having in mind that most of the empirical researches on innovation activities are closely connected to the data obtained by Community Innovation Survey, this paper examines the information obtained for Serbia, regarding the period 2008-2010.

The survey was conducted on a sample of 3982 firms. Statistical Office of the Republic of Serbia provided the authors with a complete data base (without identification data). This paper further explores connections between numerous CIS questionnaire variables that were not mentioned in the official documents. This enabled a comprehensive analysis of innovation indicators that overcomes the national official reports. The aforementioned data provided the possibility of exploring the type, the scope and the quality of the innovation in two representative sectors: agro-food and software. The aim of the paper is to emphasize the difference between the industries in terms of innovation indicators. The differences are shown through a detailed statistical analysis of the data obtained on a large sample. In addition, the purpose of the obtained results is to be of practical help for decision-makers at the national economy level, as well as at the level of the innovative enterprises in order to improve perspectives of the innovation in Serbian firms. That way, it will be possible to analyze firm's policy towards innovation activities, in terms of informing the companies about the need and effects of innovation, the company's current capacity, and the extent in which some factors accelerate or slow down this type of activity.

For the purposes of the analysis in this paper from the total number of firms, two groups of firms were selected according to NACE classification (NACE Rev. 2): Software industry (SI), 62-64; Agro-food (AF), 10-12. Firms from software and agro-food sectors which have presented technological innovation (product and process innovation) are compared by using: Chi-square test and t- test. The statistical data analysis was done in SPSS program (Statistical Package for the Social Sciences) with intent to determine the (non) existence of statistical differences between firms from software and agro-food sectors, by using Chi-square test and t-test for independent samples, in terms of innovation. This analysis will show in which case there is the statistical difference between observed industries. Frequencies were used for explanation of those differences with aim to determine which industry is more innovative.

Results

The results of the conducted statistical analyses were presented according to chapters of the CIS questionnaire: Technological innovation (product and process innovation), Innovation activities, Sources of information and co-operation for innovation activities, Innovation objectives, Factors hampering innovation activities.

Technological innovation represent *product innovation* and *process innovation*. It can be noticed that firms in both industries were more prone to present a new product than services. But, detailed statistical analysis, conducted by using Chi-square test, indicated a statistically significant difference between software and agro-food sector only in terms of services (in software 47.8%, in agro-food 12%, *Table 2.*). New goods and services in both observed groups are developed mainly by firms themselves (in software 59.4%, in agro-food 70.6%, *Table 2.*). Deeper statistical analysis conducted by using Chi-square test showed that difference between agro-food and software sector was not statistically significant in terms of who developed product innovations (*Table 2.*). In

software industry 69.6% of firms presented technological innovation which was new for their market, while in agro-food sector such innovation was significantly lower, at 29.3%. In terms of innovations that are new only to the firm, the situation turned to be quite the opposite. In agro-food sector, 83.7% firms presented new goods or services that have already been placed on the market by their competitors, while in software sector there were 64.1%. Detailed statistical analysis conducted by using Chi-square test shows that in both cases there are statistically significant difference in the share of the above types of innovation among the analyzed sectors (*Table 2.*).

Process innovation is very important for firms due to its impact on reducing production unit costs and the improvement of good/ service quality. Process innovation includes transformation of the technological knowledge into product-related knowledge (Von Tunzelmann, 1995). In the presented research definition from Oslo Manual (OECD, 2005) was used. According to this, process innovation means *„implementation or adoption of new or significantly improved production or delivery methods. It may involve changes in equipment, human resources, working methods or combination of these* (OECD, 2005). *"*

Based on the data analysis in Firms in software sector assessed that the process innovation are a result of supporting activities for process, such as new or significantly improved supporting activities for processes (84.7%). In agro-food sector, the most important activity of process innovation is new or significantly improved methods of manufacturing or producing goods or services (85.3%, *Table 2.*). Detailed statistical analysis, conducted by using Chi-square test indicated a statistically significant difference between observed sectors, in terms of new or significantly improved logistics, delivery or distribution methods, goods or services in favour of agro-food sector, and supporting activities for process, such as new or significantly improved logistics, delivery or distribution methods for inputs, goods or services in favour of software (*Table 2.*). New processes and products can be introduced as a result of firm's independent and/ or its cooperation with other companies and institutions. The cooperation of the firm with other institutions may be realized as cooperation in the innovation process as well as change and adaptation of process developed by another business entity or institution. In the sector of software the process innovation is developed as a result of joint work of the firm with other firms and/or institutions (84.1%, *Table 2*). In the agro-food sector situation is somewhat different, the process innovation was seen to the greatest extent as a consequence of firm's work itself (66.9%, *Table 2*). A detailed statistical analysis, conducted by Chi-square test, has shown the existence of statistically significant differences between the observed sectors, depending on the innovator*: a firm in cooperation with other firms or institutions; a firm, by adapting or modifying processes originally developed by others; other enterprises or institutions.* Detailed statistical analysis by Chi-square test showed that there are statistically significant differences in the share of the process innovation which were new to the market among the analyzed sectors. Process innovations, new to market were, in software sector 46.2%, while in agro-food sector were 25.3% (*Table 2.*).

Table 2. Testing differences in proportion of technological innovation in AF and SI

Questions		M	SI (%)	AF (%)	χ2- test	(p)	(α)	R
Your firm introduce:	New or significantly improved goods	Yes	77.6	86.9	3.172	0.075	0.05	=
		No	22.4	13.1				
	New or significantly improved services	Yes	47.8	12.0	55.625	0.000	0.05	≠
		No	52.2	88.0				
Who developed product innovation?	Your firm by itself		59.4	70.6	3.612	0.164	0.05	=
	Your firm with other firms or institutions		29.7	19.4				
	Your firm by adapting or modifying processes originally developed by other		10.9	10.0				
Were any of your product innovation?	New to your market	Yes	69.6	29.3	36.673	0.000	0.05	≠
		No	30.4	70.7				
	New to your firm	Yes	64.1	83.7	12.820	0.000	0.05	≠
		No	35.9	16.3				
Did your firm introduce:	New or significantly improved methods of manufacturing or producing goods/services	Yes	83.4	85.3	0.084	0.772	0.05	=
		No	16.6	14.7				
	New or significantly improved logistics, delivery or distribution methods for your inputs, goods or services	Yes	31.7	47.5	5.719	0.017	0.05	≠
		No	68.3	52.5				
	New or significantly improved supporting activities for your processes	Yes	84.7	67.5	8.949	0.003	0.05	≠
		No	15.3	32.5				
Who developed process innovation	Your firm by itself	Yes	68.1	66.9	0.016	0.901	0.05	=
		No	31.9	33.1				
	Your firm with other firms or institutions	Yes	84.1	48.5	22.753	0	0.05	≠
		No	15.9	51.5				
	Your firm by adapting or modifying processes originally developed by others	Yes	44.3	21.3	12.784	0	0.05	≠
		No	55.7	78.7				
	Other enterprises or institutions	Yes	16.6	14.2	0.194	0.659	0.05	=
		No	83.4	85.3				
Process innovations new to your market?	Yes		46.2	25.3	15.946	0	0.05	≠
	No		18.6	40.7				
	Don't know		35.3	34.1				

Source: Authors' calculations, *M- modality of the answer, p-realised level of significance, α- given level of significance, R- test results*

Innovation activities were divided into eight types: in-house R&D, external R&D, acquisition of machinery, equipment and software, acquisition of external knowledge, training for innovative activities, and market introduction of innovations, design and

other. These activities can be also observed as investments whose return will be in the future (OECD, 2005). In the software sector the strongest influence on innovation behaviour of the firm was realized by innovation activity- *training for innovative activities*, and the least effect was associated with *external R&D*. Firms in agro-food sector usually performed *acquisition of machinery, equipment and software* and at least in the area of *acquisition of external knowledge*. It can be seen that in both sectors *acquisition of machinery, equipment and software* and *design* were carried out at almost same level of intensity. Data have shown that the intensity of innovation activities is higher in software sector than in agro-food for selected innovation activities: *in-house R&D, external R&D, acquisition of external knowledge, training for innovative activities, market introduction of innovations, and other* (*Table 3*.). There is statistical significance between observed industries.

Table 3. Testing differences in the proportion of innovation activities for AF and SI

	Frequencies (%)		Rang		Test results
	SI	AF	SI	AF	
Training for innovative activities	93,2	49	1	2	≠
Other	82,2	30	2	6	≠
Acquisition of machinery, equipment and software	73,7	75,4	3	1	=
Market introduction of innovations	70,6	45,8	4	5	≠
In-house R&D	65	49	5	3	≠
Acquisition of external knowledge	56,4	14,1	6	8	≠
Design	55,9	48,1	7	4	=
External R&D	43	25,9	8	7	≠

Source: Authors' calculations

Table 4. Testing differences in the proportion of public financial support for innovation activities in SI and AF

			Industrial area (%)		χ^2 test	(p)	(a)	R
			SI	AF				
Did your enterprise receive any public financial support for innovation activities?	Local or regional authorities	Yes	9.6	5.3	2.248	0.134	0.05	=
		No	90.4	94.7				
	Central government	Yes	27.7	28.9	0.44	0.833	0.05	=
		No	72.3	71.1				
	European Union (EU)	Yes	6.1	1.00	9.484	0.02	0.05	≠
		No	93.9	99				

Source: Authors' calculations, ,p-realised level of significance, α- given level of significance, R- test results

Chi-square test indicated statistically significant difference in terms of receiving financial support for innovation activities from external funds among sectors only in the case of using EU funds in favour of software sector (*Table 4.*).

On the other hand, there was no statistically significant difference between firms that used support of *local or regional authorities* as well as *central government* in

the observed sectors. It indicates non-discriminatory approach to the availability of financial support, in terms of the sectors mentioned.

Innovation sources are very important for selected firms. The firms, in both observed sectors, ranked information provided within the business entity, as the most important for conducting innovation activities. The reason for concern is the fact that the information received from *government or public research institutes* was identified as being the least significant. But, the information obtained from *the university or other higher education institutions* was ranked as extremely important for companies in the agro-food sector, while the firms in software ranked it as irrelevant (*Table 6.*).

Table 5. Test of Equality of Means values of the importance of each source of information among SI and AF

Independent Samples Test						
		Levene's Test		t-test		
		F	Sig.	t	df	Sig.
Within your enterprise or enterprise group	Equal variances assumed	68.090	.000	-7.456	475	.000
	Equal variances not assumed			-11.951	281.059	.000
Suppliers of equipment, materials, components	Equal variances assumed	2.973	.085	-2.271	475	.024
	Equal variances not assumed			-2.278	118.449	.025
Clients or customers	Equal variances assumed	.177	.675	-2.237	475	.026
	Equal variances not assumed			-2.260	119.328	.026
Competitors or other enterprises in your sector	Equal variances assumed	1.953	.163	-3.806	475	.000
	Equal variances not assumed			-3.637	113.140	.000
Consultants, commercial labs, or private R&D	Equal variances assumed	2.541	.112	-.739	475	.461
	Equal variances not assumed			-.825	134.087	.411
Universities and HE institutions	Equal variances assumed	2.403	.122	.311	475	.756
	Equal variances not assumed			.330	125.995	.742
Government or public research institutes	Equal variances assumed	.001	.981	-.450	475	.653
	Equal variances not assumed			-.467	122.682	.641
Conferences, trade fairs, exhibitions	Equal variances assumed	.056	.813	-.410	475	.682
	Equal variances not assumed			-.403	116.233	.687
Scientific journals and trade/technical publication	Equal variances assumed	4.240	.040	-3.590	475	.000
	Equal variances not assumed			-3.708	122.147	.000

Source: Authors' calculations

Table 6. The importance of sources of information for technological innovation in SI and AF

	Software (SI)		Agro-food (AF)	
	Rang	Mean	Rang	Mean
Within your enterprise or enterprise group	1	1.21	1	2.15
Suppliers of equipment, materials, components, or software	3	2.16	4	2.44
Clients or customers	2	2.13	3	2.38
Competitors or other enterprises in your sector	5	2.47	7	2.93
Consultants, commercial labs, or private R&D	7	2.87	8	2.97
Universities or other higher education institutions	9	3.38	2	3.35
Government or public research institutes	10	3.54	10	3.58
Conferences, trade fairs, exhibitions	6	2.54	5	2.59
Scientific journals and trade/technical publication	4	2.30	6	2.72
Professional and industry associations	8	3.12	9	3.11

Source: Authors' calculations

Table 7.Testing differences in proportion of co-operation for technological innovation

Questions	Modality	Industrial area (%)		χ^2 test	(p)	(a)	R
		SI	AF				
Did your firm co-operate on any of innovation activities with others?	Yes	46.3	22.5	19.705	0.000	0.05	≠
	No	53.7	77.5				
Which type of co-operation partner did you find the most valuable for your firm's innovation activities?	Other firms within your group	53.7	77.5	40.201	0.000	0.05	≠
	Suppliers of equipment, materials	13.4	2.8				
	Clients or customers	19.5	9.9				
	Competitors or firms in sector	8.5	1.8				
	Consultants, commercial labs, or private R&D	n<5	2.5				
	Higher education institutions	n<5	4.8				
	Government or public research institutes	n<5	n<5				

Source: Authors' calculations*, p-realised level of significance, α- given level of significance, R- test results*

Detailed statistical analysis conducted by T-test showed that the difference between agro-food and software sector was statistically significant in terms of some innovation sources. Firms in software sector mostly identified market information (*suppliers of equipment, materials, components, or software; clients or customers; competitors; scientific journals and trade/technical publications*) as valuable sources for innovation (*Table 5.*). It is very important to establish cooperation on innovation in order to ensure the smooth flow of information between all actors in national innovation system. This cooperation promotes the sharing and usage of knowledge as between firms themselves

as well as between firms and research institutions. This collaboration also involves the formatting of closer ties with market sources of information for innovation. The firms in the software sector cooperate with other entities and institutions on innovation activities (46.3%, *Table 7.*) to a greater extent than those in agro-food (22.5%, see *Table 7.*). Analysis of responses depending on industry activity of the firms, conducted by using Chi-square test, showed that this difference is statistically significant. The highest level of cooperation on innovation activities in both observed sectors was established within the group to which the firm belongs (software sector 53.7%; agro-food sector 77.5%, *Table 7*). Also, the observed firms established cooperation with clients and customers on innovation activities, but significantly less (software sector 19.9%; agro-food sector 9.9%). Detailed statistical analysis conducted by Chi-square test showed the existence of statistically significant differences between the observed sectors.

Cooperation on development of the innovation in technology based industries records increasing tendency. The level of cooperation with other innovation stakeholders is more significant in firms in software than in agro-food (*Table 7.*). *Innovation objectives* should be considered in the wider context of the introduction of new products or processes.

Table 8. The importance of objectives for technological innovation in SI and AF

Objectives for technological innovation	Software		Agro-food	
	rang	Mean	rang	Mean
Increase range of goods or services	6	2.05	2	2.25
Replace outdated products or processes	4	1.98	3	2.44
Enter new markets or increase market share	3	1.89	10	2.73
Improve quality of goods or services	1	1.52	1	2.00
Improve *flexibility* for producing goods or services	2	1.68	6	2.49
Increase *capacity* for producing goods or services	5	2.02	5	2.48
Reduce labor costs per unit output	7	2.24	7	2.54
Reduce material and energy costs per unit output	8	2.99	8	2.56
Reduce environmental impacts	10	3.50	9	2.57
Improve health or safety of your employees	9	3.35	4	2.46

Source: Authors' calculations

The most significant business objective in agro-food sector was the *penetration into new markets*, while for the software sector; it was the *reduction of harmful environmental impacts* (*Table 8.*).

Table 9. Test of Equality of Means values of the importance of each objective for technological innovation among SI and AF

Independent Samples Test						
		Levene's Test		t-test		
		F	Sig.	t	df	
Increase range of goods or services	Equal variances assumed	4.622	.032	-1.551	475	.122
	Equal variances not assumed			-1.698	130.634	.092
Replace outdated products or processes	Equal variances assumed	9.968	.002	-3.610	475	.000
	Equal variances not assumed			-3.734	122.321	.000
Enter new markets or increase market share	Equal variances assumed	3.675	.056	-6.325	475	.000
	Equal variances not assumed			-6.510	121.691	.000
Improve quality of goods or services	Equal variances assumed	.197	.657	-3.867	475	.000
	Equal variances not assumed			-4.065	124.536	.000
Improve *flexibility* for producing goods/services	Equal variances assumed	2.254	.134	-6.192	475	.000
	Equal variances not assumed			-6.348	121.181	.000
Increase *capacity* for producing goods/services	Equal variances assumed	9.542	.002	-3.308	475	.001
	Equal variances not assumed			-3.548	127.447	.001
Reduce labor costs per unit output	Equal variances assumed	2.026	.155	-2.170	475	.030
	Equal variances not assumed			-2.054	112.164	.042
Reduce material and energy costs/ unit output	Equal variances assumed	1.074	.301	3.208	475	.001
	Equal variances not assumed			2.976	110.254	.004
Reduce material and energy costs/unit/output	Equal variances assumed	46.063	.000	7.003	475	.000
	Equal variances not assumed			8.856	161.751	.000
Improve health or safety of your employees	Equal variances assumed	11.936	.001	6.932	475	.000
	Equal variances not assumed			7.745	134.063	.000

Source: Authors' calculations

Detailed statistical analysis conducted by T-test indicated that there were statistically significant differences between the observed sectors regarding almost all objectives of innovation, with the exception of *range of goods /services incensement* (*Table 9.*). The high importance of process related objectives was identified in sectors. But, in software sector these objectives were a result of improving flexibility for producing goods or services, while in agro-food sector they were indicated as a result of process innovation. According to the CIS methodology, innovative objectives of the firm are divided into three groups (OECD, 2005): (1)objectives related to the product (*increase range of goods or services, replace out-dated products or processes, enter new markets or increase market share , improve quality of goods or services*); (2)objectives related to processes (*increase production flexibility, increase production capacity, reduced labour costs, reduced material consumption*); (3) other objectives (*relating to regulations and standards, improve environmental protection or health and safety at work*). The observed enterprises have marked the *improvement of good/ service quality* as the most important effect of the technological innovation Table 8.).

Factors that hamper product and process innovation activities according to CIS are divided into: *cost factors, knowledge factors, market factors, and other reasons not to innovate*.

Cost factors are related to direct cost of financing innovation activities which are often high. They are closely connected to uncertainty and risk that follow innovation activities. The analysis of responses in on observed sectors, conducted by Chi-square test indicated statistically significant difference in the cost factors in the case of lack of financial resources from its own funds (the highest rank in software 40.9%, the highest rank in agro-food 55.4%, *Table 10.*), as well as in the case of direct innovation costs (the highest rank in software 32.6%, the highest rank in agro-food 35.4%, *Table 10.*) in favour of agro-food sector. On the other hand, there was no statistically significant difference among the firms from observed sectors in terms of lack of funding from outside the firm.

Knowledge factors are closely related to expertise of employees and management. Detailed statistical analysis conducted by using Chi-square test showed that there were statistically significant differences among observed sectors in terms of knowledge factors as limiting factors for innovation activities in these cases*: lack of qualified personnel* (the highest rank in software 3.2%, the highest rank in agro-food 9.0%, *Table 10.*) in favour of agro-food sector; *lack of information on technology* (the highest rank in software 3.2%, the highest rank in agro-food 2.8%, *Table 10.*); more evident in software sector; *lack of information on markets* (the highest rank in software 2.7 %, the highest rank in agro-food 2.8%, *Table 10.*); more evident in agro-food sector.

There were no statistical differences among the observed groups of firms regarding *difficulties in finding cooperation partners for innovation*. Respectively, firms from software sector (11.1%), as well as, firms from agro-food sector (15.4%), have marked difficulty to find adequate cooperation partners as important obstacles.

Market factors are determined by market impacts where technology innovations take place.

Table 10. Testing proportion differences in factors that hamper innovation in AF I SI

Hampering factors		Modality (%)				χ^2 test	(p)	(a)	R
		high	med	low	not expec.				
Lack of funds within your enterprise or group	SI	40.9	42.7	9.8	6.6	16.503	0.001	0.05	≠
	AF	55.4	28.1		13.3				
Lack of finance from sources outside firm	SI	32.1	27.7	17.0	23.2	1.529	0.676	0.05	=
	AF	35.4	24.2	14.4	27.0				
Innovation costs too high	SI	32.6	47.0	4.2	16.2	10.108	0.018	0.05	≠
	AF	47.7	33.5	8.7	10.0				
Lack of qualified personnel	SI	3.2	23.8	43.0	30.0	21.273	0.000	0.05	≠
	AF	9.0	35.8	19.3	36.0				
Lack of information on technology	SI	3.2	43.4	17.4	75.0	38.776	0.000	0.05	≠
	AF	2.8	29.6	28.2	39.4				
Lack of information on markets	SI	2.7	16.7	21.4	59.2	20.131	0.000	0.05	≠
	AF	2.8	19.8	43.6	33.8				

Hampering factors		Modality (%)				χ^2 test	(p)	(a)	R
		high	med	low	not expec.				
Difficulty to find cooperation partners	SI	11.1	30.4	13.6	45.0	5.062	0.167	0.05	=
	AF	15.4	25.9	21.8	36.8				
Market dominated by established firms	SI	25.3	41.2	25.7	7.8	14.012	0.003	0.05	≠
	AF	21.1	31.1	21.6	26.2				
Uncertain demand for innovative products	SI	29.2	51.2	18.4	1.2	23.394	0.000	0.05	≠
	AF	16.5	40.0	23.0	20.4				
No need due to prior innovations by firm	SI	1.7	29.5	13.7	46.8	5.576	0.134	0.05	=
	AF	5.3	21.4	26.0	47.3				
No need because of no demand for innovations	SI	10.1	29.5	13.7	46.8	19.498	0.000	0.05	≠
	AF	3.3	18.5	33.5	44.6				

Source: Authors' calculations, p-realised level of significance, α- given level of significance, R- test results

Dipper statistical analysis conducted by Chi-square test eventually indicated statistically significant difference between observed industries in terms of market factors as factors that hampered innovation activities: market dominated by established enterprises (software 25.3%, agro-food 21.1%, *Table 10.*); uncertain demand for innovative goods or services (software 29.2%, agro-food 16.5%, *Table 10.*). These factors were more important for software sector. Reasons that influence not to innovate are in close relationship with other hampering factors. They depend on market demand as well as the firm's innovation capability. A statistically significant difference was indicated by using Chi-square test, in terms of reasons not to innovate: no need because of any demand for innovations (software 10.1%, agro-food 3.3%, *Table 10.*) in favour of software. This means that the firms involved in software industry respected market's own lack of reason to innovate to a greater extent than the firms involved in agro-food industry did.

Discussions

A detailed statistical analysis has shown a statistical difference within the agro-food and software firms, concerning certain innovation indicators in the observed period. Innovation activities are more frequent in software than in agro-food sector (*Table 11.*).

Table 11. Innovation intensity in software vs. agro-food (- higher, ¯- lower)

Description	SI	AF	Table
New or significantly improved services		¯	2
Product Innovation- new to your market		¯	2
Product Innovation- Only new to your firm	¯		2
New or significantly improved logistics, delivery or distribution methods	¯		2
New or significantly improved supporting activities for your processes, such as maintenance systems, etc.		¯	2
Process innovation development- with other firm or institutions		¯	2
Process innovation development by adapting		¯	2
Process innovations introduced new to market?		¯	2

Description	**SI**	**AF**	**Table**
Innovation activities - Training for innovative activities		–	3
Innovation activities - Other		–	3
Innovation activities - Market introduction of innovations		–	3
Innovation activities - In-house R&D		–	3
Innovation activities - Acquisition of external knowledge		–	3
Innovation activities - External R&D		–	3
Financial support from EU		–	4
Sources of information for technological innovation			
Within your enterprise or enterprise group		–	5,6
Suppliers of equipment, materials, components, or software		–	5,6
Clients or customers		–	5,6
Competitors or other enterprises in your sector		–	5,6
Scientific journals and trade/technical publication		–	5,6
Co-operation on innovation development with firms or institutions	–		7
Partner- Other enterprises within your enterprise group		–	7
Partner- Suppliers of equipment, materials, components		–	7
Partner- Clients or customers		–	7
Partner- Competitors or other enterprises in your sector		–	7
Innovation objectives - Replace outdated products or processes		–	8,9
Innovation objectives - Enter new markets or increase market share		–	8,9
Innovation objectives - Improve quality of goods or services		–	8,9
Innovation objectives - Improve flexibility for producing goods or services		–	8,9
Innovation objectives -Increase capacity for producing goods or services		–	8,9
Innovation objectives - Reduce labor costs per unit output		–	8,9
Innovation objectives - Reduce material and energy costs per unit output	–		8,9
Innovation objectives - Reduce environmental impacts	–		8,9
Innovation objectives - Improve health or safety of your employees	–		8,9
Hampering factors- Lack of funds within your enterprise or group		–	10
Hampering factors - Innovation costs too high	–		10
Hampering factors - Lack of qualified personnel	–		10
Hampering factors - Lack of information on technology		–	10
Hampering factors - Lack of information on markets	–		10
Hampering factors- Market dominated by established enterprises		–	10
Hampering factors - Uncertain demand for innovative goods or services		–	10
Hampering factors - No need because of no demand for innovations		–	10

Source: Authors' calculations

Technological innovation within the firms in both observed sectors are mainly developed within their own research capacity. Having in mind general characteristics of observed work areas, it was expected that, in comparison to the enterprises in agro-food sector, software industry enterprises have directed their innovative efforts towards development of innovative services. Innovations developed in software sector used to be new for the market, not for the enterprises, while in the agro-food area were mostly incremental and represented a novelty solely to the enterprise itself. However, there is a question of how much the software sector innovations are competitive on an

international level (e.g. via coordination of innovative product quality with services including standards and procedures which are prescribed by the foreign market). Gaining competitive advantage on an international market is not a small task since all standards relevant to the product quality on an international scale need to be met. Furthermore, it is necessary to thoroughly explore questions concerning intellectual property rights.

Software firms were more interested in developing their innovation through collaboration with other institutions than agro-food companies. That could be a reason why the software firms achieved a better market position in the observed period. Cooperation on innovation development has not yet reached institutional size and is mostly done ad hoc, as necessary, without any specific planned approach. Namely, less than half of the observed enterprises recognized the importance of a cooperation. Partners for cooperating are mostly found in the market. This fact should be used as an advantage, in addition to this; it would be beneficial that the importance of cooperation with academic society be taken into account as well. Cooperation can be facilitated in multiple ways: franchising; mutual investments; different forms of connection between company's business (national and international initiative), procuring new products and processes, sub-negotiating, and cooperation with other stakeholders in the research and development field.

Establishing and improving collaboration on the level of innovation is possible via development of innovative infrastructure, also. This would be a recommendation mainly aimed at governmental institutions, which should support the development of innovative infrastructure that would enable successful transfer of knowledge and technology from faculties and institutes to economy, both on a national and international level. Scientific, research and developmental activities, as a frame of national innovative system, can achieve visible results only if they are globally competitive. Simultaneously, there has to be an efficient system for diffusing results of these activities in the economy, such that cycle duration from the beginning to commercialization of innovation is shortened to the level dictated by the global market. Namely, enterprises must have successful mechanisms of innovation implementation in order to realize them on the market. This process includes systematic problem solving and it works best when there is a clearly defined strategy and system of decision making, which need to help organization to stop or continue progress process (in the event of it going deteriorate).

Innovation in both observed areas turned out to be based mainly on knowledge and firm's individual research and development investments. Some research has shown that there is close connection between technical skills and R&D cooperation and technological innovation (Leiponen, 2005). Companies in software have shown that education and staff development are important factors for development of innovative enterprises. Only the continuous professional development of employees can improve innovation ability of the firm. Innovation at the firm level among the other factors is determined by formal education, improvement job skills by continuous training, experience, R&D capacity development and ability to manage technological change (Goedhuys & Veugelers, 2012).However, the improvement of the innovative capacity of a firm could

be achieved by training the personnel, providing different levels of specialization. As stated previously, the enterprises of both areas are trying to follow the demands of the market, adjusting their activities accordingly.

The factors, which mostly encumbered performance of innovative activities in both groups of enterprises, are related to lack of financial resources. In observed enterprises in Serbia, financial support of innovative activities is mostly based on central government and very small number of enterprises are requesting a loan to finance solely R&D activities. In both observed sectors, it is a common practice for the enterprises to expect funding of innovative activities to be provided from national funds (agencies, funds, programs etc.). Since the innovations within agro-food industry has been shown to be far more capital intensive, such enterprises are expected to recognize the direct investment costs as a main limiting factor for innovation. At the other hand, in fast-growing research–intensive industry such as software, there is no strong association between high growth and R&D cost. Beside R&D activities, other innovation activities are also important as support to them.

Changes in technology and market demands "are forcing" the innovative enterprises to apply different strategies, exploiting the available resources. The general management position and the "auspicious circumstances" are also the important factors (Freeman, 1982). Innovative enterprise strategy should be an integral part of every enterprise strategy which deals in innovative activities. Nonetheless, under the conditions of transition economy, character of the market itself needs to be investigated since it is evident that a demand for innovative products and services is still a dubious one. Process of innovation and technology diffusion is undergoing constant changes.

Development of a more efficient national innovative system is a necessity for Serbia, if it wants to establish a knowledge-based economy, which is achieved with constant state support. In the areas such as innovative policy, a gap between theory and policy practice should be as smaller as possible. Further development in this area is vital. Development of innovative policy should be molded by practical problems, without researches which are concerned with development of economic theory regarding innovations. Links between innovations and different policies are already recognized in the areas of education, competitiveness, finances, macro-economy, and labor market. Approaches to forming of innovative policy have a tendency to be decided by specific qualities of a country in question, and respond to a unique economic, social and political system of a certain country. However, lately, state and scientists emphasize strongly the trans-national approach and research of "transferable" elements of politics (Holroyd, 2007).

Conclusions

Primarily, paper stressed out the importance of statistical monitoring of innovative activities through Community Innovation Survey (CIS) of the EUROSTAT. Empirical analysis of data in two observed sectors points out that innovation activities, in Serbia, were more intensive in software sector then in agro-food. In some situation firms from agro-food should follow firms from software in order to improve their innovation

behaviour: for example, in terms of level of collaboration and connections with other innovation stakeholders; in terms of creation innovation not only for firm but also for the market like firms in software; in terms of professional development, etc. In order to establish final conclusions and recommendations for further work, one should firstly bear in mind the above mention characteristics of the software sector. Secondly, R&D intensity of agro-food sector should be taken into account and explored further.

On the basis of the research presented in this paper, it is plausible to draw conclusions which are significant to the management of enterprises in observed areas. On the basis of these conclusions, it is possible to provide recommendations for decision-makers in the area of innovative policy:

- *Innovation in accordance with requirements of the international market.* Gaining competitive advantage on an international market is demanding task since all standards relevant to the product quality on an international scale need to be. The special attention should be put on intellectual property issues.
- *Improvement of the collaboration on innovation.* The lack of an adequate cooperation between universities and research institutions with the industry should be further analysed.
- *Investing in the professional development* can improve innovation ability of the firm. Educating and training of employees should be in accordance with the needs of the market, employees and an enterprise. Developed countries increasingly apply the economy growth model based on knowledge.
- *Finding financial recourse on the market.* There are expectations that financing of innovation activities should be done from national sources by government, in both observed sectors. But firms should consider other sources of funding that can be found on international market (venture capital funds, business angels, international funds). Cooperation with foreign partners, as well as applying for various EU funds supporting innovative activities should also be taken into consideration.
- *Strategic approach for managing innovation on a national and entrepreneurial level is needed.* Data gained on the basis of CIS surveys enable insight into indicators that determine innovative capacity of an enterprise, which is significant for the management of innovative enterprises. The empirical research of innovative activities in Serbia within the observed sectors shows the necessity of a serious analytic framework guiding the industrial policy creators in order to develop general and strengthen institutional, economical and technological factors for improving the competitiveness in agro-food and software industries, as well as the industry as a whole, which is necessary if a more efficient entrance in the world market is sought. For the creators of industrial policies, the research can be useful for forming a new industrial policy model, since managing modern economy and channelling changes of

economy structure, especially under conditions of transitional economy, is no longer possible without achieving consistent innovative policy. According to these recommendations, the innovative enterprises management could respond to problems in business economy through the field of innovation management, and formulate adequate business strategies.

The presented research has opened up some topics that could be explored further. Primarily, high technologies have enabled the revitalization of traditional manufacturing industries, as well as economic re-industrialization of developed countries. Firm's productivity – both in agro-food and software sector – turned out to be highly dependent on the application of innovations that were developed in other industrial sectors. In connection to that, a further research should be conducted in order to explore the impact of software on agro-food. Secondly, technological innovations were so far mostly presented within the national market. It's highly recommended for firms in both sectors to present their technological innovation to foreign markets. Finally, it would be more than useful - concerning cooperation on innovation in software sectors - to explore types and levels of cooperation in order to achieve further improvement.

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Conflict of interests

The authors declare no conflict of interest.

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