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INFLUENCE OF QUALITY INFRASTRUCTURE ON REGIONAL DEVELOPMENT

Abstract: *Quality infrastructure is developed on state level and covers standardization, accreditation, metrology and certification. It is a “hard” part of quality infrastructure. On the regional level there are “soft” factors such as quality level in organizations, education and training level, state support and so on. The key role of quality infrastructure is to be a basis for all quality improvement actions on lower i.e. organizational levels. It is also a basis for regional development. The influence of quality infrastructure on regional development has not been investigated enough, especially in transition states. That serves as motivation to the authors trying to define an integrative model of quality infrastructure and regional development. This model is partially verified in Bosnia and Hercegovina, being an example of transition economy. A part of the research has been presented in the paper.*

Keywords: *model quality infrastructure, regional development, transition economy*

1. Introduction

Quality, as a paradigm of the 20th and the beginning of the 21st century has a great influence to many aspects of life and business. At the beginning of its development, this paradigm had been referring to the quality of products, but later it also included the quality of services, total quality and, finally, the quality of life. For each aspect of the quality paradigm it is necessary to meet the requirements for its further development and enabling of the realization of the goal - a higher level of quality, observed in the broadest sense. All the participants taking part in that create a quality infrastructure (Wipplinger *et al.*,

2006), which can be decomposed to:

- Chain of value creation through processes and products;
- National quality infrastructure and
- International institutions which support the quality infrastructure.

In the value creation chain, quality is realised through:

- Influence on regional priorities for the purpose of supporting and directing of business reforms in a business environment;
- Management of the process of business environment reforms at regional, national and macro-regional levels,
- Providing of sustainability of enterprises in the value creation chain,

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- Reforming of the business environment in specific sectors of industry and other sectors.

At the national level, the quality infrastructure consists of national bodies for:

- Accreditation,
- Certification,
- Standardization,
- Metrology and
- Testing.

These bodies make the “hard” part of national quality infrastructure.

The other, “soft” part, in the author’s opinion, consists of:

- Education system for quality,
- Consulting organizations
- Quality infrastructure in enterprises (laboratories, engineers and quality managers, organizational units for quality, level of knowledge and skills for quality etc.).

The third, international component of quality infrastructure includes the international companies for:

- Standardization (e. g. pursuant to *ISO, DIN*, etc.),
- Accreditation (e. g. *ATS, ATCG, ATBiH*),
- Metrology (e. g. the Institute of Metrology),
- Certification (e. g. notified bodies for product safety).

From the previous text, it can be concluded that quality infrastructure is structured at many levels. By now, it has mostly been analysed at the state level, such as, for example, the EU project of the development of “quality infrastructure in Serbia and Montenegro”, with the list of all entities, quality infrastructure and description of their participation in quality infrastructure.

It gives a good basis for further research at regional level, where region is the area within a state in which it is desired to improve quality and thus realise a sustainable success. Quality infrastructure

research at a regional level is more complex, because it is necessary, starting from the level of enterprises (or, better to say, in the spirit of standards – organization), via the region to come to the state level.

The other possible path is a combination:

- *bottom-up* (from enterprises to the region) and
- *top down* (from the state to the region).

It required the investigation of all quality stakeholders at regional level, determining of their requirements and assessment of the realised level of quality. On the basis of the mentioned, a model of influence of organization quality level and organization (enterprise) sustainability to the regional level of infrastructure development and sustainability of the region.

This model is based on the basis of the theory of modelling of complex dynamical systems of hierarchical type. Besides the methods of modelling, statistical methods and simulation methods have been used as well.

The application of the model has been tested in a region, i.e. Sarajevo – Romanija area, by applying a statistical software and tools for simulation.

The results of modelling have been analysed in a key phase. It has been proved that the zero hypothesis on the influence of quality and quality infrastructure to the sustainability of enterprises and region is valid.

The paper is organised in five chapters. After the introductory considerations, the basics of quality infrastructure and the model of quality infrastructure are given in the second chapter. There is a special analysis of key participants in the operation of bodies for standardization, accreditation, certification, metrology, metrological metrologies and organizations for the support to quality infrastructure.

In the third chapter, the basic characteristics of regional development are presents, and

then an analysis of the characteristics of the development of the selected region is performed, and the quality stakeholders at the regional level are analysed as well. It is followed by the presentation of results of the research of the level of quality infrastructure development in the selected region and, at the end. The evaluation of the quality of organizations in the observed region is given.

The fourth, key part of the paper presents the model testing results and the evaluation of these results, and the fifth part is a discussion.

2. Influence of quality infrastructure on regional development

2.1. Basic model of quality infrastructure

Quality infrastructure is a vital aspect of a business environment, which, pursuant to Hillner (2004), includes: (1) key markets, (2) markets for support to services and (3) creation of a business environment. The last two elements define the level of transaction costs at a key market.

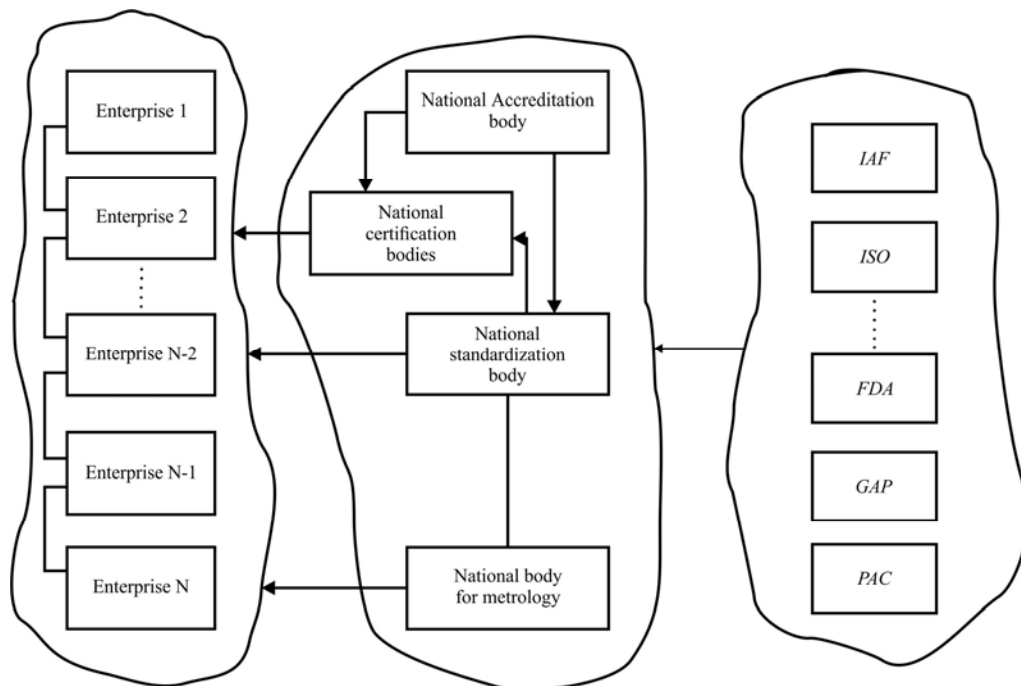


Figure 1. Basic structure of quality infrastructure

The transactions at the market are realised when a supplier and a buyer agree on the characteristics of products/services. The problem of uncertainty related to the accomplishment of these characteristics is what remains. It is provided through adequate infrastructure.

Pursuant to Schowohnke (2005), quality infrastructure covers the added value creation chain as an output, national infrastructure and international bodies for support to quality (Figure 1). At the left side, there are the companies in the value creation chain, and at the right side there are international institutions for support to

quality in the region and the country. In the middle of the figure, the national bodies of quality infrastructure are presented.

This basic quality infrastructure is, pursuant

to GTZ terminology (Humphrey, 2005), complemented with the role of regulatory bodies and standards (Figure 2).

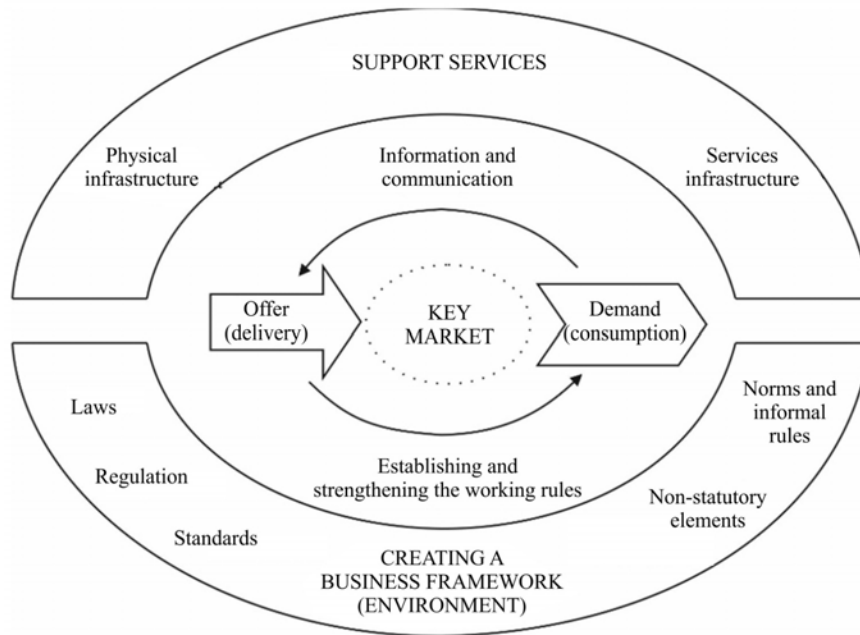


Figure 2. Quality infrastructure as a support to the realization of products/services at the key market

The basic approach of every country and region is reduced to the best way of providing a supply for the key market and to the providing of demand at it. The precondition for that is to provide support services and adequate business environment at the level of the state or the region.

Because of that, the first thing to analyse is:

- outcome sustainability, through:
 - knowledge of market needs and measurement of applications at the market,
 - knowledge of services by which market and non-market barriers can be overcome,
 - knowledge of entities which can participate in value creation chain in a sustainable manner and

- knowledge of the way of realizing the partner relationships among the buyer, deliverer and regulatory bodies;
- set in the focus of analysis the added value creation chain through the following steps:
 - selection of sub-sectors which satisfy the criteria,
 - determine the competitiveness of entities in the value creation chain,
 - development of strategy for the improvement of competitiveness of sub-sectors,
 - development and establishment of changes in the added value creation chain,
 - verification and validation of solutions.

It is obvious that the infrastructure shown in Figure 1 cannot support all this. In accordance with the concept suggested in

Figure 2, the authors suggest the quality infrastructure as in Figure 3.

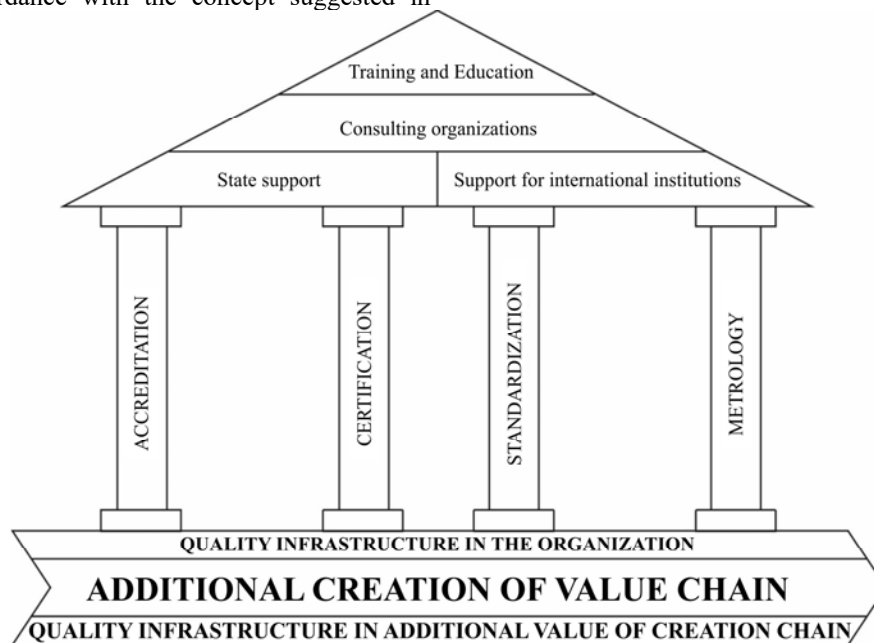


Figure 3. Expanded model of quality infrastructure

In the basis of this model of a “quality infrastructure house” there are organizations which make the value creation chain. In each of them there is an adequate quality infrastructure through the process of quality assurance and control, different management systems (i. e. *RMS*, *OHSAS*, *EMS*, *IMS*, *RM*, etc.). Besides that, at the level of added value creation chain there is an adequate infrastructure, made of special bodies, information-communication systems (*ICT*), standards, contracts, etc.

For an added value creation chain to have sustainability at the output, it is necessary to realize the trust of buyers in relation to the product quality and safety, sustainability of organizations etc. That is realised via four pillars at national level, which are supported by an international organization for standardization, accreditation, metrology etc. These “supporting” pillars at national level, which are significant for every region, are:

- Accreditations,

- Certifications
- Standardization and
- Metrology.

In every country, accreditation is realised through:

- Establishment of a national accreditation body;
- Creation of a national accreditation system and its harmonization with international norms;
- Accreditation of bodies for certification and methodology,
- Supervision of the entire national quality system etc.

Certification is a process in which certification bodies prove their harmonization with the required accreditation of the same, pursuant to appropriate standards. In that, certification bodies prove their competence and impartiality for a certain range of certification (i. e. for *QMS*, *EMS*, etc.).

Standardization is realised through national bodies for standardization, which take care of the transposition of international standards and creation of national ones.

Metrology is realised through the national body for metrology, which, pursuant to appropriate directives and standards, prescribes the fundamentals for work of metrological laboratories (test ones, control ones, etc.) in different areas (i.e. for lengths, weights, food, medical laboratories etc.).

One of the leading pillars of quality infrastructure is standardization. It can be observed even wider, as a separated scientific discipline. Pursuant to Verman (1973) it is “*an activity ancillary to engineering, industrial management, economic planning or whatever else*“. It means that there should be established the:

- *Communities of Practice - CoPs*
- *(Network of Practice – NoPs)*.

In these structures, business entities get connected, knowledge is created and determined (Nonaka and Reinmolder, 1998) and their promotion and exchange through adequate associations is performed. In the area of standardization, those are national organizations for standardization and the International Federation of Standards Users – iFAN. The goals of iFAN are:

- Uniform promotion of standards,
- Consolidation of interests of the users of standards in terms of the evaluation of harmonization and cooperation with other international and regional bodies for standardization (*ISO, IEC, ITU, CEN, CENELEC, COPANT*, etc.).
- Promotion of the network for support to standardization and harmonization evaluation, etc.

A part of quality infrastructure related to standardization are the professionals in the area of standardization (De Vries *et al.*, 2014). They are very important because of their influence to smaller processes in the area of standardization, among which the following ones stand out:

- Signalling of development trends in the area of standardization,
- Strategic analysis,
- Prioritization of goals and tasks,
- Validation of solutions and standards,
- Development of standards,
- Application of standards,
- Participation in external standardization,
- Testing of standards in practice etc.

Besides the professionals in the field of standardization, managers in organizations also have a significant role as stakeholders. Pursuant to the research Vučinić and Vojtek (2014), in 87% of cases managers are familiar with standards, and in at least 97% cases the use at least one standard. In most cases they get acquainted with standards via consulting organizations (11%), bodies for standardization (13%) and employees (15%). The significance of the role of bodies for standardization is evaluated as positive, but the only statistically significant relation is the relation between the number of employees and the satisfaction with the time of waiting for a service by a manager, on the scale from 1 (dissatisfied) to 5 (very satisfied).

Standardization is in relation with the process of privatization and restructuring (Čudanov *et al.*, 2014). The authors have proved three hypotheses by means of relations between the formalization in organization and standardization. In that, formalization (Walton, 2005) is defined as the degree in which the rules, procedures, regulations and communications in organization are written and applied. It is especially important to confirm the hypothesis that the success of privatization and restructuring process is in correlation with the coefficient of formalization.

The researches in Macedonia (Čerepnalkovska and Popovska, 2014) point at the level of students’ knowledge on standardization and the teaching process quality level related to that. Most students

(about 87%) have perceived the need for knowledge in this area, especially in standards *ISO 9001* (90%), *ISO 14001* (51%) и *ISO 22000* (37%) etc. The knowledge on international bodies for standardization was relatively small, so, besides the knowledge in *ISO* (89%), other bodies were less familiar. So, for example, only 9% of the examinees were familiar with *iEC*, 6% with *CEN*, 2.2% with *CENELEC* etc. The knowledge on the national body for standardization was more emphasized in students (more than 60%).

Quality infrastructure can also be used for natural disaster risk management (Palliyaguru and Amaratunga, 2008). The authors have determined that an adequate infrastructure for that should exist, and in that they also define the quality of this infrastructure which should provide the conditions for greater robustness and adaptation ability in conditions of possible disasters. That practically leads to planning and application of reconstruction projects which decrease the risk of occurrence of accidents, in accordance with standards of quality.

Flynn (1994) has investigated the relations between the practice of quality management, infrastructure and fast product innovation. In that, the components of infrastructure are: (1) characteristics of organization, (2) human resource management and (3) level of Just-In-Time. A statistical significance was determined in terms of: (1) decentralization of authorities, (2) team work potential and (3) characteristics of product design and flexibility of JiT manufacturing. Organizations and quality infrastructure as a whole should have a greater level of resilience, as a capacity for quick recovery of performances after their collapse, and vulnerability. This aspect has been specially investigated in the papers (Aleksić *et al.*, 2013a; Aleksić *et al.*, 2013b; Tadić *et al.*, 2014; Aleksić *et al.*, 2014; Arsovski *et al.*, 2015a; Arsovski *et al.*, 2015b; Arsovski *et al.*, 2012a; Arsovski *et al.*, 2012b).

Ashauer (1989) has analysed the significance of quality infrastructure and, especially, of the quality of life. He pointed at the attributes of human life and their relation with the investment in infrastructure. He particularly emphasizes the aspects of quality of water, aesthetics and economic factors (*ROI*, productivity, etc.).

Harmes Liedtke (2010) has pointed at the influence of quality infrastructure as a support to innovation system at national level. In that, he started from key bodies for standardization, metrology and accreditation. Through service providers (certification bodies, laboratories), a connection is realised with a wider quality infrastructure, in the form of Association of buyers, academic sector, chambers of commerce, etc. At the end, the connection with the user and other interested organizations (stakeholders) is realised through QI. This paper points at the influence of standards (positive and negative) to the innovativeness at micro, mezzo, macro and meta level.

Deichmann *et al.* (2004) have analysed the relations of economic structure of productivity and infrastructure quality in south Mexico. There is an especially significant analysis of infrastructure in terms of development of human capital and acceptance of new technologies, as well as the characteristics of the location and market, characteristics of an enterprise, state regulations, training of employees etc. For the needs of this monograph, a confirmation of the hypothesis that the level of significance and skills of the employees, training programs and acceptance have a positive influence on the enterprise productivity level is especially important. It can also be said for the performances of South Mexico region, because it increases the absorption quality of the enterprise, and that, together with a greater quality of infrastructure at the state level, should enable the realization of a greater effect of quality infrastructure to the sustainability of the region.

Le Prevost and Mazur (2005) have particularly analysed the improvement of quality infrastructure in companies, by the application of the *QFD* method. The goal is to distribute the limited resources optimally to a few improvement projects, to use the *QFD* method for the selection of projects and then to perform the strategic allocation of the projects by applying the *AHP* method. All projects are observed spatially: the level of complexity – the benefits of improvement projects. For the internal quality infrastructure, the projects in the area of ICT are of special importance, because they give a basis for connecting the processes within the enterprise and with the environment, especially in relation to connections with buyers and other stakeholders, all that with the aim of increasing the sustainability of the enterprise.

The influence of quality of infrastructure to the productivity of enterprises in Africa has been investigated in the paper Escribano *et al.* (2006). The authors used the model of total productivity with variables: (1) volume of selling, (2) employment, (3) total number of work hours per year, (4) total material costs, (5) total value of equipment and amortization, (6) costs of using capital for investments and (7) costs of work. For African countries, they used official data on quality of infrastructure, on the basis of variables: (1) closeness with buyers, (2) energy infrastructure, (3) water and supply costs, (4) telecommunications and *ICT* and (5) transportation. In the analysed model, the output is the volume of selling in the function of quality of infrastructure. On the basis of data in the period from 1999 to 2005, it was stated that there was a positive influence of quality of infrastructure to the volume of selling and productivity.

Porta *et al.* (1997) have pointed at the significance of trust in big enterprises for effectiveness of their business. In their model, besides the trust in people and other variables, quality of infrastructure and adequacy of infrastructure were included as variables, as well as the level of education

and adequacy of educational system. These last variables were classified in the group “Social efficiency”. By using the statistical analysis method on the samples from many countries, it was determined that there is a positive correlation of the quality of infrastructure and adequacy of infrastructure, as well as among the level of education and adequacy of educational system (dependent variable) and gross domestic product per capita and trust in people (independent variable). It indicates that the trust in institutions, both firms and international and national quality infrastructure institutions, presents a basis for establishment and development of quality infrastructure.

Aimi (2008) has analysed the effects of infrastructure quality improvement to the costs of an enterprise business. In that, he pointed at the difficulties in infrastructure quality measurement and the quality and competitiveness of an enterprise related to that. On the sample of 26 enterprises from 26 European and Central Asian countries, through the concept of infrastructure quality, some elements of quality infrastructure were determined as well. There are especially significant elements related to the variables of business in an enterprise (operating costs, volume of production, profit, price of capital and, for quality of infrastructure, the level of communication services. The last variable is in low correlation with what has been mentioned previously. The only determined correlations are the ones between the operating costs and selling (0.998), and that indicates that a certain way for increasing the output (volume of selling) is by means of the decrease of operating costs. The use of enterprise infrastructure by an enterprise can significantly help in that.

The aspect of providing quality in education has been analysed by Dickenson (2000). On the example of higher education in Russia, on the basis of interview technique, they determined the model of quality of higher education educational services in Russia, as well as an overview of institutes, companies, consulting organizations and certification

bodies on the quality infrastructure for the needs of higher education. To create the infrastructure for education in the field of quality management. That was noticed on the basis of the results of the examinees' answers. Most of them had the opinion that brief teaching units related to the field of quality should have been embedded in the curricula (63%), and 23% of them thought that it should have been conducted through master studies. The structure of courses and syllabuses, as well as their application, were also the subject of the analysis. Particularly significant results are related to the creation of institutions for education and accreditation of professionals in the field of quality through the development of a Centre of Excellence, within which the "European Quality Center" in Moscow is as well.

Education and training, including the training for quality, have a great influence, particularly with the support of modern concepts and technologies (Kalinić *et al.*, 2011; Kalinić *et al.*, 2014; Stefanović *et al.*, 2010).

Solis *et al.* (2000) have analysed the practice of quality management infrastructure in the USA and Mexico. On a great sample of enterprises, they determined that there were differences in approach to business in the USA and Mexico. It was done by using seven practices of quality management infrastructure: (1) support of top-management, (2) strategic quality business, (3) availability of information on quality, (4) training of employees, (5) quality of suppliers' deliveries, (6) orientation towards the buyer and (7) quality of relations with the environment.

The biggest correlations between the performances of quality and the practice of quality management infrastructure are related to the support of top management, strategic quality planning and orientation towards buyers. Also, it was determined that the size of correlations was bigger in the USA than in the north regions of Mexico, and smaller than in the central region of

Mexico. From the aspect of infrastructure level, it follows the previous attitudes, with relatively high average grades (bigger than 3.5 on the scale from 1 to 5).

The papers (Tadić *et al.*, 2014; Arsovski *et al.*, 2009; Nestić *et al.*, 2015; Arsovski *et al.*, 2012; Arsovski *et al.*, 2008; Stefanović *et al.*, 2015; Tadić *et al.*, 2015) have pointed at a wider aspect of quality, especially at the level of organization.

The relations among institutional quality, infrastructure and propensity to export have been analysed in the paper Francois and Manchin (2006). The authors used the statistical data from 104 countries and, by the application of statistical methods, particularly structural equations; they determined the model and dimensions of the correlation of factors in the model. For different infrastructures and institutions, they determined different values of factors of influence and correlations. For the needs of this monograph, it is particularly important the cognition that the high correlation with GDP/capita and the number of residents in relation to certain tested infrastructures is 1 (communication infrastructure) and 2 (partner infrastructure), institution 1 (partner institution). It means that the infrastructure based on institutions and partners significantly influences the propensity of enterprises in tested countries to export.

In the paper of a group of authors Naor *et al.* (2008), the influence of culture as the initiator of quality management and performances has been researched. In the research, three hypotheses were set regarding the influence of organization culture on: (1) practice of quality infrastructure, (2) practice of quality core and (3) production performances. Among the mentioned, the hypothesis which is of the greatest importance for this paper is H3 on the influence of practice of quality infrastructure and production performances of quality. Through the application of statistical methods (AMOS V.40), the authors came to an adequate model and determined

the dependence of quality performance on the total of 13 variables. The research results demonstrated that the practice of quality infrastructure has a significant positive effect to production performances, and that proves the hypothesis H3.

3. Integrative model of quality infrastructure and regional development

The notion of quality is related to a product, process and/or an organization, If we start from the definition of a state region being a “territorially encircled part of a state which has some characteristics which connect it to the state as a whole and some other which make it specific”, it can be seen that they include all entities (organizations, state and local administration, banks, universities, health system, school system), but also more than that, above all the relations with the environment and the relations within the region.

Because of that, it is difficult to define the quality at the level of a region. This academic assignment is significantly less important than the practical one – recognition of regions as bearers of development and initial knowledge that there is an uneven development of regions, e. g. within SCG and the EU.

The subject of this paper is to point at the significance of quality as the characteristic of regional development, at one side, and the opportunities, above all the external ones, which should be used for the improvement of quality in a region, and by means of that the improvement of the quality of life in the region and the state.

The assessment of the quality level of organizations in the region is based on the evaluation of organizations which take part in the value creation chain of the region. Pursuant to Porter’s model, there are:

- primary activities (in primary, secondary and tertiary sector)

- activities of support at the level of state, region or organizations in the field of:
 - school system,
 - health protection,
 - local infrastructure,
 - support to development, investments, finances et.
 - Professional organization in the field of quality.

Every group of organizations in the region and every organization within a group realize their activities in accordance with their own goals. The realized performances and goals point at the level of business activities and competitiveness of the organizations and region as a whole.

If it is started from Porter’s paper, four determinative competitiveness can be identified at the level of a region, related to:

- suppliers,
- buyers,
- entering barriers and
- substitutes.

If it is started from a real situation that the products realised on the territory of a region are sold in other regions, it is obvious that at the definition of regional policy of development (and quality within it), besides the suppliers (the organizations which perform primary and support activities), the buyers have to be analysed as well (within and outside the region), barriers to entering at markets and the appearance of substitutes with favourable prices and performances.

This paper does not have pretensions to include all the factors of competitiveness, and that is why I will put emphasis on suppliers, from the perspective of quality. The aspect of quality of suppliers, particularly involved in supply chains, has been analysed in the papers (Arsovski, 2015c; Kanjevac Milovanovic, 2011; Rankovic *et al.*, 2012; Arsovski *et al.*, 2016; Ranković *et al.*, 2012).

The evaluation of the quality of organizations in a region can be performed

on the basis of many different approaches.

The most represented approach is the one which uses “expert” evaluations where, depending on the author, black or euphoric approaches dominate. The author is not familiar with the methodology, except the methodology for evaluation of business excellence, which has been applied in domestic organizations. The participation of these organizations is small and makes less than 1‰ (per mille) of business organizations. The evaluation results are not representative, because the organizations with a high realised level of quality apply for evaluation.

If, from the level of a state, the same approach is applied to regions, the situation is, pursuant to the author’s knowledge, even more disastrous.

There is no quality analysis, being a factor of competitiveness included, primarily, via the suppliers in Porter’s model, at the level of regions.

To realise this aspect of project successfully, a very extensive questionnaire has been made and delivered to 200 organizations, which have been selected on the basis of: side, type of activity, ownership structure, regional priorities. The collection of the survey material is in progress. The results at the end of this research will point at:

- Quality infrastructure,
- Level of quality of organizations,
- Problems in quality improvement,
- Priority fields of quality improvement,
- Resources necessary for quality improvement in the region.

The questionnaire consists of two parts:

- 1) Evaluation of needs for training and consulting services.
- 2) Needs for quality improvement.

In the first part of the survey questionnaire, the following areas have been processed:

- existing condition,
- economic environment,
- preferred way of training,

- determining of candidates for professional training,
- finances.

Having in mind that in the 21st century knowledge is becoming a priority resource, parallel with this project the other projects are applied, from the areas of:

- development of clusters,
- technological park,
- network of innovation centres, centres for transfer of technologies and centres of excellence.

All this should increase the integrative component of the region in the globalization process in which we are, whether we have wanted it or not (Ávila *et al.*, 2015; Kadlubek and Grabara, 2015; Zimon, 2015; Marco Savoia *et al.*, 2016)

In this phase of the project it is difficult to speak about the level of quality in the region, because, besides the level of quality of organizations, the level of quality of relations among them in the region and outside it has to be analysed as well. That is a special area which will be realised by means of application of the *Business Dynamics* concept and simulation techniques.

The results of the project mentioned above should also point at the entities and factors which have been hidden for us and which may have a significant role in regional policy of development and improvement of quality. There we expect, above all, the “soft factors” and the influence of alliances which have not been sufficiently investigated by now and of strategic partnership with other foreign regions and institutions.

Starting from the principles of macroeconomic policy and development, the following methods (roles) of the impact of state to quality improvement can be identified:

- 1) enactment of regulations on the functioning of economy and the control of their implementation, especially in certain branches which

- have the priority for regional development,
- 2) enactment of regulations on the functioning of public sector and the control of their implementation,
 - 3) taxation system, subventions and other conveniences and nonfinancial benefits,
 - 4) state property and management in economic activities of general importance,
 - 5) direct financinf of certain economic activities (from the budget),
 - 6) measures of current macroeconomic policy and
 - 7) care on quality infrastructure at the state level by financing and controlling of the work of institutions for standardization, metrology, technical requirements or products and evaluation of the harmonization of products.

A positive example of the role of the state is the giving of nonrefundable incentive funds for establishment of HACCP, ISO 9001 and ISO 14001 through the tender of the Ministry of Agriculture and Water-Management, at which the financial funds in the amount of 200.000.000 RSD were distributed to organizations in 2005.

There is also a positive example in the obligation of food manufacturers to have the HACCP system certified.

On the other hand, local administration may influence certain aspects of regional development. For example, the local administration in Kragujevac brought nonrefundable incentive funds for buying of greenhouses and employment of unemployed and displaced persons in agriculture, a total of 10 greenhouses.

Unfortunately, there are no state regulations and incentive measures for the implementation of:

- environmental protection management system,
- product safety pursuant to the directives of the new approach,
- accreditation of laboratories and

- system of integtated management systems *ISO 9001* and *ISO 18001*.

If it is started fom the structure and size of organizations, a European level of competitiveness in the field of quality can be reached with 10 – 15000 € of donations in small organizations (up to 50 employees), which make more than 90% of organizations. It means that, together with own investments, tax conveniences and other benefits, im next 5 years we may have the following situation (figure 4).

The influence of quality to regional development has been shown by using the *Business Dynamics* simulation model (Figure 5), where relations R1 – R19 are identified in certain nodes as inputs or outputs.

If a region is observed as a market, in every node of this model of behaviour, from the aspect of manufacturer, the relations can be added related to:

- R1** - way of providing quality (the role of banks, loans, international projects or state administrations). This relation represents the simulative measures in the region and the level of knowledge management in the region in relation to quality initiation (initiation of projects).
- R2** - providing of missing capacities for quality improvement, such as high accuracy equipment, measurement and control equipment, eco-protection equipment etc.
- R3** - condition of capacities in terms of realization of the required quality level, and especially of process stability,
- R4** - level of using production techniques and technologies, as well of tools and methods for quality improvement,
- R5** - level of using the methods for optimal use of capacities, including the motivation measures, etc.

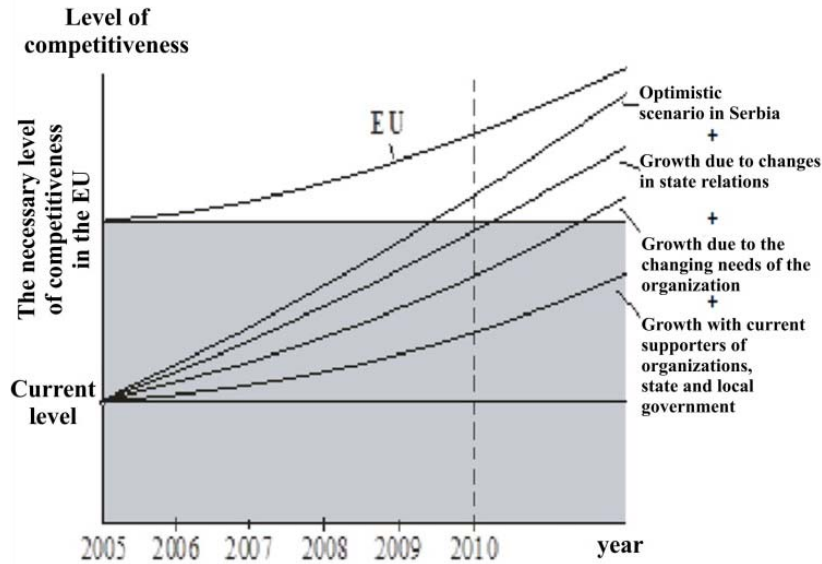


Figure 4. Scenarios of the EU competitiveness

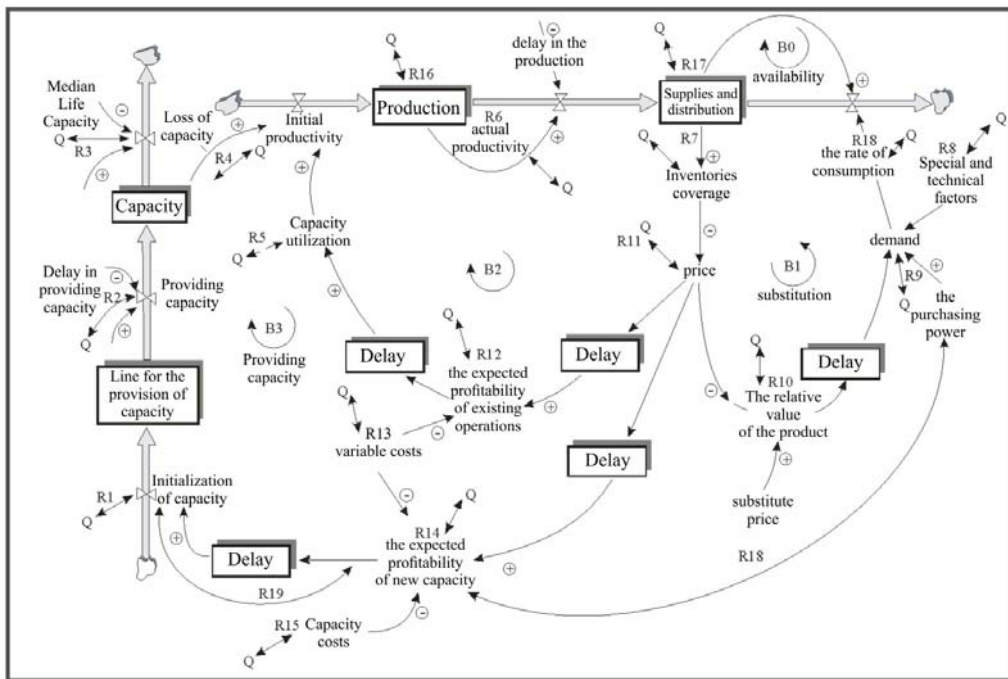


Figure 5. Dynamic model of influence of quality to regional development

Each of the relations $R1 - R19$ is connected to aspects of quality in different ways. So, for example, $R1$ is related to initiation of capacities. In the conditions of insufficient

liquidity of local economy, the main sources of initiation of capacities are knowledge, initiative and competency and competitiveness of applicants at different

funds (local, state, international) and connection with other organizations for the purpose of providing the capacities. Here we will emphasize the international funds, especially the ones directed to regional development. By using the funding from these funds (R2) and the missing knowledge, the conditions are created for the increase of productivity and, by means of that, in the perspective, for the increase of value of products, profitability of the new capacity

and the purchasing power in the region, being the significant characteristics of regional development.

Results of simulation in this article are presented some parts of simulation results based on research of Moljevic S. (2010) for quality infrastructure in Bosnia and Hercegovina.

The objectives of regional development were presented in figure 6.



Figure 6. Model of objectives of regional development

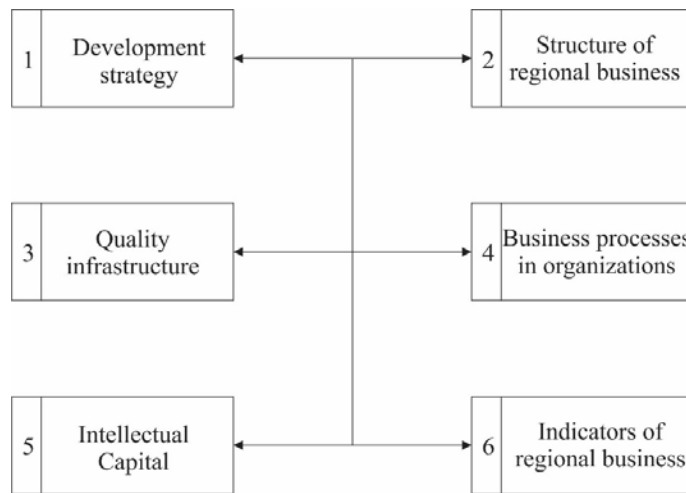


Figure 7. Relationship among sub-models in simulation model

In figure 8 there are partial results of simulation for sub-model 1, for impact of Q

on other objectives. The highest impact of quality is related to conformity assessment

labs and GDP/capita, and medium impact is related to productivity and environmental protection.

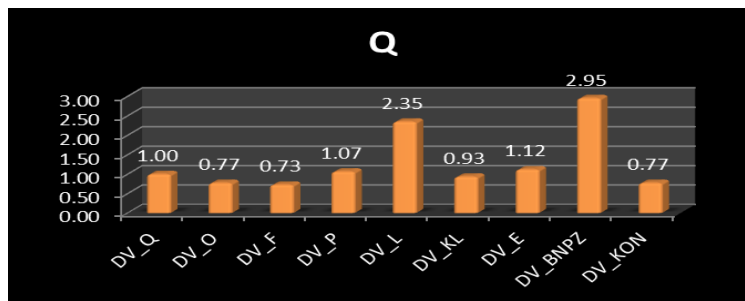


Figure 8. Indexes of intensity of mutual impact of variables for the unit Q

The lowest level of quality exists for occupational health, flexibility, quality of life, and competitiveness.

5. Conclusions

The following conclusions can be made from the previous analyses:

- 1) quality infrastructure is an unavoidable factor in the improvement of regional sustainability,
- 2) the level of quality infrastructure in countries in transition and the observed region is significantly higher than the level in the EU,
- 3) by modelling and simulation of regional sustainability in the function of quality infrastructure level, key factors of success can be determined,
- 4) in the observed region in B&H, the level of quality has been mostly influenced by the development of the network of testing laboratories and the GDP per capita, where the first is of regional character and the second is at the level of B&H as a country,
- 5) the suggested approach is still in the phase of testing, both from the aspect of the model and from the aspect of inclusion of new methods and simulation tools.

References:

- Aimi, A. (2008). *Effects of Improving Infrastructure Quality on Business Costs: Evidence from Firm Level Data*, The World Bank, Policy Research Working Paper, No.4581
- Aleksić, A., Stefanović, M., Arsovski, S., & Tadić, D. (2013a). An assessment of organizational resilience potential in SMEs of the process industry, a fuzzy approach. *Journal Of Loss Prevention In The Process Industries*, 26(6), 1238-1245. <http://dx.doi.org/10.1016/j.jlp.2013.06.004>
- Aleksić, A., Stefanović, M., Tadić, D., & Arsovski, S. (2014). A fuzzy model for assessment of organization vulnerability. *Measurement*, 51, 214-223. <http://dx.doi.org/10.1016/j.measurement.2014.02.003>

- Aleksić, A., Tadić, D., Stefanović, M., Misita, M., & Arsovski, S. (2013b). A new model for organizational vulnerabilities assessment in small and medium enterprises in presence uncertainties. *Metalurgia International*, 18(1), 150-152.
- Arsovski, S., Arsovski, Z., & Mirovic, Z. (2009). The Integrating Role of Simulation in Modern Manufacturing Planning and Scheduling. *Strojniški Vestnik - Journal Of Mechanical Engineering*, 55(1), 33-44.
- Arsovski, S., Arsovski, Z., Stefanović, M., Tadić, D., & Aleksić, A. (2015a). Organisational resilience in a cloud-based enterprise in a supply chain: a challenge for innovative SMEs. *International Journal Of Computer Integrated Manufacturing*, 1-11. <http://dx.doi.org/10.1080/0951192x.2015.1066860>
- Arsovski, S., Arsovski, Z., Stefanović, M., Tadić, D., & Aleksić, A. (2015c). Organisational resilience in a cloud-based enterprise in a supply chain: a challenge for innovative SMEs. *International Journal Of Computer Integrated Manufacturing*, 1-11. <http://dx.doi.org/10.1080/0951192x.2015.1066860>
- Arsovski, S., Putnik, G., Arsovski, Z., Tadic, D., Aleksic, A., Djordjevic, A., & Moljevic, S. (2015b). Modelling and Enhancement of Organizational Resilience Potential in Process Industry SMEs. *Sustainability*, 7(12), 16483-16497. <http://dx.doi.org/10.3390/su71215828>
- Arsovski, Z., Arsovski, S., & Nikezic, S. (2012). Development of quality management in enterprises of Serbia. Article in technics technologies education management, 77(2), 944-949.
- Arsovski, Z., Arsovski, S., Aleksic, A., Stefanovic, M., & Tadic, D. (2012a). Vulnerabilities of Virtual and Networked Organizations. *International Journal Of Web Portals*, 4(3), 20-34. <http://dx.doi.org/10.4018/jwp.2012070102>
- Arsovski, Z., Arsovski, S., Aleksic, A., Stefanovic, M., & Tadić, D. (2012b). Resilience of virtual and networked organizations: An assessment. *Communications In Computer And Information Science*, 248, 155-164.
- Arsovski, Z., Pavlovic, M., & Arsovski, S. (2008). Improving the Quality of Maintenance Processes Using Information Technology. *International Journal For Quality Research*, 2(2), 101-114.
- Arsovski, Z., Rejman Petrović, D., Arsovski, S., & Pavlović, A. (2016). Information systems for supply Chain management in automotive industry. *Technics Technologies Education Management*, 7(1), 944-962.
- Ashauer, D. (1989). Public Investment and Productivity Growth in the Group of Seven, Federal Reserve Bank of Chicago, *Economic Perspectives*, 13(5), 17-25.
- Ávila, P., Mota, A., Putnik, G., Costa, L., & João, A.P. (2015). Proposal Of An Empirical Model For Suppliers Selection, *International Journal for Quality Research*, 9(1), 107-122. ISSN: 1800-6450
- Črepnalkovska, S., & Popovska, V. (2014). Education About Standardization, ----- 117-126.
- Čudanov, M., & Matić, I., & Lukić, M. (2014). Relations of Formalization and Standardization with Success of Privatization and Restructuring Process, 11th International conference "Standardisation, Prototypes and Quality: A means of Balkan countries' collaboration", Faculty of Organizational Sciences, University of Belgrade, Belgrade Serbia, 9th September.

- De Vries, H., Trietsch, J., & Wiegmann, P. (2014). *Towards a Community of Standardization Professionals*, 11th Int. Conference Standardization, Prototypes and Quality: A Means of Balkan Countries Collaboration, FON, Belgrade, Serbia, 13-20.
- Deichmann, U., Fay, M., Kaoo, J., & Lall, S. (2004). Economic structure, productivity, and infrastructure quality in Southern Mexico, *The Annals of Regional Science*, 38, 361-385.
- Dickenson, R.P., Regerson, J.H., Azarov, & V.N. (2000). Building on infrastructure for quality management in Russia, *Quality Assurance in Education*, 8(2), 70-75.
- Escribano, A., Guasch, L., & Pena, J. (2006). *Assessing the Impact of Infrastructure Quality on Firm Productivity in Africa*, AICD study.
- Flynn, B. (1994). The Relationship between Quality Management Practices, Infrastructure and Fast Product Innovation, *Benchmarking for Quality Management & Technology*, 1(1), 48-64.
- Fransois, J., & Manchin, M. (2006). *Institutional Quality, Infrastructure, and the Propensity to Export*, DFID/OECD
- Harmes Liedtke U. (2010). *The Relevance of Quality Infrastructure to Promote Innovation Systems in Developing Countries*, Physikalisch – Technische Bundesanstalt, Braunschweig, Discussion Paper 3.
- Hillner, U. (2004). *Strategy paper on quality infrastructure*, Bonn, Federal Ministry for Economic and Development Cooperation
- Humphrey, J. (2005). *Shaping the Value Chain for Development: Global Value Chains in Agrobusiness*, Eshborn, GTC
- Kadlubek, M., & Grabara, J. (2015). Customers' expectations and experiences within chosen aspects of logistic customer service quality, *International Journal for Quality Research*, 9(2), 265-278. ISSN: 1800-6450
- Kalinić, Z., Arsovski, S., Arsovski, Z., & Ranković, V. (2014). The Effectiveness and Students' Perception of an Adaptive Mobile Learning System based on Personalized Content and Mobile Web. *The New Educational Review*, 37(3), 43-53.
- Kalinić, Z., Arsovski, S., Stefaniović, M., Arsovski, Z., & Ranković, V. (2011). The Development of a Mobile Learning Application as Support for a Blended eLearning Environment. *Technics Technologies Education Management*, 6(4), 1353-1364.
- Kanjevac Milovanovic, K., Arsovski, S., Kokić Arsić, A., Pavlović, A., & Ćurčić, S. (2011). The impact of CE marking on the competitiveness of enterprises. *Strojarstvo*, 53(6), 445-453.
- Le Prevost, J., & Mazur, G. (2005). Quality infrastructure improvement: using QFD to manage project priorities and project management resources, *International Journal of Quality & Reliability Management*, 22(1), 10-16.
- Nanoka, I., & Reinmolder, P. (1998). The „Art“ of Knowledge: Systems to Capitalize on Market Knowledge, *European Management Journal*, 16, 673-684.
- Naor, M., Goldstein, S., Linderman, K., & Schroeder, R. (2008). The Role of Culture as Driver of Quality Management and Performance: Infrastructure Versus Core Quality Practices*. *Decision Sciences*, 39(4), 671-702. <http://dx.doi.org/10.1111/j.1540-5915.2008.00208.x>
- Nestic, S., Stefanovic, M., Djordjevic, A., Arsovski, S., & Tadic, D. (2015). A model of the assessment and optimisation of production process quality using the fuzzy sets and genetic algorithm approach. *European Journal of Industrial Engineering*, 9(1), 77. <http://dx.doi.org/10.1504/ejie.2015.067453>

- Palliyaguru, R., & Amaratunga, D. (2008). Manager disaster risks through quality infrastructure and vice versa, *Structural Survey*, 26(5), 426-434.
- Porta R.L., Lopez-De-Silanes, F., Shleifer, A., & Vishny, R.W. (1997). Trust in large organizations, *Interaction of Economic Institution and Theory*, 87(2), 333-338.
- Rankovic, V., Arsovski, Z., Arsovski, S., Kalinic, Z., Milanovic, I., & Rejman-Petrovic, D. (2012). Supplier Selection using NSGA-II Technique. *International Journal Of Web Portals*, 4(4), 35-47. <http://dx.doi.org/10.4018/jwp.2012100103>
- Ranković, V., Arsovski, Z., Arsovski, S., Kalinić, Z., Milanović, I., & Rejman-Petrović, D. (2012). Supplier selection using multiobjective evolutionary algorithm. *Communications In Computer And Information Science*, 248, 327-336.
- Savoia, M., Stefanovic, M., & Fragassa, C. (2015). Merging technical competences and human resources with the aim at contributing to transform the adriatic area in a stable hub for a sustainable technological development - (editorial), *International Journal for Quality Research*, 10(1), 1-16. ISSN: 1800-6450
- Schowohnke, D. (2005). *Promotion of Economic Development in Technical Cooperation: Quality Infrastructure*, Braunschweig, PTB.
- Solis, L., Raghu-Nathan, T., & Rao, S. (2000). A regional study of quality management infrastructure practices in USA and Mexico, *International Journal of Quality & Reliability Management*, 17(6), 597-614.
- Stefanovic, M., Tadic, D., Arsovski, S., Arsovski, Z., & Aleksic, A. (2010). A Fuzzy Multicriteria Method for E-learning Quality Evaluation. *International Journal Of Engineering Education*, 26(5), 1200-1209.
- Stefanović, M., Tadic, D., Arsovski, S., Pravdic, P., Abadić, N., & Stefanović, N. (2015). Determination of the effectiveness of the realization of enterprise business objectives and improvement strategies in an uncertain environment. *Expert Systems*, 32(4), 494-506. <http://dx.doi.org/10.1111/exsy.12102>
- Tadić, D., Aleksić, A., Stefanović, M., & Arsovski, S. (2014). Evaluation and Ranking of Organizational Resilience Factors by Using a Two-Step Fuzzy AHP and Fuzzy TOPSIS. *Mathematical Problems In Engineering*, 1-13. <http://dx.doi.org/10.1155/2014/418085>
- Tadić, D., Arsovski, S., Aleksić, A., Stefanović, M., & Nestić, S. (2015). *A fuzzy evaluation of projects for business processes' quality improvement*. Intelligent Systems Reference Library, Springer.
- Tadić, D., Gumus, A., Arsovski, S., Aleksić, A., & Stefanović, M. (2014). An evaluation of quality goals by using fuzzy AHP and fuzzy TOPSIS methodology. *Mathematical Problems In Engineering*, 25(3), 547-556. <http://dx.doi.org/10.1155/2014/418085>
- Verman, L.C. (1973). *Standardization – A new discipline*, Hamder, CT: The Shoe String Press/Archon Books.
- Vučinić J., & Vojtek N. (2014). *Manager Perception of the Role of Organizations for Standardization*, 19th EURAS Annual Standardisation Conference – Cooperation among standardisation organisations and the scientific and academic community – 8 – 10 September 2014 Belgrade, Serbia, pp. 31-42
- Walton, E. (2005). The Persistence of Bureaucracy: A Meta-analysis of Weber's Model of Bureaucratic Control. *Organization Studies*, 26(4), 569-600. <http://dx.doi.org/10.1177/0170840605051481>

Wipplinger, G., Phongsathoru V., & Wattanakeeree, G. (2006). Quality infrastructure – A vital aspect of business environment for enterprise development, Asia regional consultative conference, Bangkok, 1-27.

Zimon, D. (2015). Impact of the implementation of quality management system on operating cost for small and medium-sized business organizations affiliated to a purchasing group, *International Journal for Quality Research*, 9(4), 551-564. ISSN: 1800-6450

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