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Đuro Kutlača [**]
Vojin Šenk [***]

Basic directions of technology development of AP Vojvodina for the computer engineering, communications and automated systems sector: from methodology to the action plan[****]

Rezime: U radu se izlažu metodologija i glavni nalazi istraživanja organizovanih za izradu (a) strategije "Osnovni pravci tehnološkog razvoja AP Vojvodine za oblast računarstva, komunikacija i automatizovanih sistema" i akcionog plana za implementaciju te strategije. Izložena metodologija je obezbedila teoretske i praktične instrumente neophodne za izradu ove razvojne strategije akcionog plana za njenu implementaciju. Imajući u vidu činjenicu da je to bilo prva, mada parcijalna, primena metode tehnološkog predviđanja u Srbiji, ostvareni rezultati obećavaju i realizaciju razvojnih ciljeva APV u oblasti informaciono-komunikacionih tehnologija, kao i potencijalno šire korišćenje metodologije tehnološkog predviđanja u APV i Srbiji u celini.

Ključne reči: Technology Foresight; ICT; Development Strategy; AP of Vojvodina

Summary: Paper describes the methodology and main outcomes of the research organized for creation of (a) strategy named as “Basic Directions of Technology Development of AP Vojvodina” and (b) action plan for implementation of this strategy, which is a constitutive part of the strategic document “Basic Directions of Technology Development of AP Vojvodina”. This methodology provides theoretical as well as empirical instruments necessary for creation of ICT development strategy and action plan for implementation of such strategy in APV. Having in mind that this was first, although partial use of technology foresight methodology in Serbia, the results achieved are promising both for the development goals of APV and for future, eventually much broader, use of technology foresight methodology in APV and in Serbia as well.

Keywords: Tehnološko predviđanje; Informaciono-komunikacione tehnologije; Strategija razvoja; AP Vojvodina

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[**] “Mihajlo Pupin” Institute, 11000 Belgrade, Volgina 15, Serbia; dkutlaca@labtel.imp.bg.ac.yu

[***] Faculty of Technical Sciences, University of Novi Sad, 21000 Novi Sad, Trg D.Obradovića 6; ram_senk@uns.ns.ac.yu

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1. INTRODUCTION

Autonomous Province of Vojvodina (APV) lies in the Pannonian plane, ideal for agricultural production. Natural resources of APV, such as oil and gas, provide higher standard of life as compared to other parts of Serbia. This attractivity enabled the number of inhabitants of the province to be disproportionably higher than necessary for using the aforementioned resources. The surplus of inhabitants is concentrated in larger cities such as Novi Sad, above all, as well as Zrenjanin, Subotica, Sombor, Kikinda, Pančevo, Vršac, Sremska Mitrovica and others. The existence of important educational institutions in these centres, and, above all, the University of Novi Sad, enables the rise of relatively skilled resources. Retention in the country and employment of these high-quality human resources is thus the priority of the development of APV. The use of the infrastructure of these cities, above all that of Novi Sad, constitutes a chance to attain these goals. In research and development (R&D) domain this infrastructure has to be significantly improved by building of innovation activity institutions such as Science and Technology (S&T) Park in Novi Sad, business incubators, innovation centers etc. The ICT sector, as a generic one, has a key role in this domain. It cannot only employ human resources educated to work in the sector, but, because of its inherent multidisciplinarity, enable the employment of specialists in all other sectors.

Information and communication technology (ICT) as sector in economy in APV is in the formidable growth phase, with great potentials for inclusion of the advantages that ICT offers to other sectors and activities. The ICT industry in APV is currently in a phase of fast growth but there are lots of potentials in other sectors which are not used that can make use of ICT advantages for their own development. The ICT industry, thus, constitutes a huge chance and possibility of AP Vojvodina to approach European integrations and standards, and for the economy in APV to realize an outbreak into the global market. ICT sector, especially software industry, has extremely spread all over the world in the last ten years, and brought many possibilities for business development and entrepreneurship. It is expected that this growth will continue, since technology and communications enable access to global market and new business opportunities to both small and big companies.

Paper describes the methodology and main outcomes of the research organized for creation of (a) strategy named as “Basic Directions of Technology Development of AP Vojvodina” [8] and (b) action plan for implementation of this strategy, which is a constitutive part of the strategic document “Basic Directions of Technology Development of AP Vojvodina” [9]. The Executive Council of AP Vojvodina has passed the draft of the strategy “Basic Directions of Technology Development of AP Vojvodina” on its 149 session held on 14 March 2007 and the final document was passed by the Assembly of AP Vojvodina on 20 March 2007.

2. METHODOLOGY

The Methodology for creation of ICT development strategy and action plan for implementation of such strategy in APV represents first steps in partial use of technology foresight methodology [4] in Serbia. Although limited by the time (only few months) and rather small financial resources, authors were determined to implement technology foresight methods and techniques as much as this was possible due to the circumstances, in order to organize work which will result with optimal solutions, acceptable for all involved stakeholders. In short, this methodology is consisted of:

- Survey of existing ICT companies in APV, including questionnaires, interviews and on-site analysis of company's performance with primary tasks to provide evidence, facts and opinions necessary for:
    - Identification of the potentials for development and application of innovations in APV and local communities;
    - SWOT analysis of the natural and human resources and research and educational institutions in the ICT sector in APV;
- Set of brainstorming sessions, devoted to analysis of present situation and generation of possible directions for future developments in ICT sector in APV;
- Use of Delphi method for evaluation and ranking of priority projects;
- Use of Delphi method for evaluation and ranking of priority programs;
- Presentation of achieved results, in order to collect responses from all interested stake-holders, as well as to promote proposed set-up of priorities (projects and programs);
- Survey of the interests of communities in all counties in APV, in order to realize the main tasks of the strategy in the ICT sector in APV in particular county;
- SWOT analysis of the current state and obstacles for realizations of the strategy for the Computer engineering, communications and automated systems sector, stratified according to counties of APV: North Bačka, North Banat, West Bačka, South Bačka, Middle Banat, Srem, South Banat; with an analysis of the possibility of including the existing regional chambers of commerce and development agencies in APV in the process of realization of this strategy;
- Synthesis of proposed activities addressed to groups of tasks which should be realized in order to fulfill the policy according to main technological sectors and counties;

- Synthesis of proposed activities addressed to key requirements of the policy: policy, legislation, market transformation, financial mechanisms and motivations, tracking and evaluation, propagation and promotion;
- Synthesis of proposed measures for realization of the strategy and action plan for implementation of the strategy in the counties of APV, including the monitoring plan;
- Estimation of investments necessary for realization of the proposed measures for realization of the strategy and action plan for implementation of the strategy in the counties of APV.

Survey of existing ICT companies in APV is based primarily on data comes from statistical research computed in the course of preparation of this document, while the secondary data comes from existing statistical reports. The sample used for the survey was provided by the Chamber of Commerce of Serbia and came from the list of registered companies in ICT area in APV in the year 2006. Checking these data, 43 active companies are identified in the field of software industry with 497 employees, 4 in the field of telecommunication with 71 employees, and 32 companies in the field of hardware industry with 517 employees, which are 79 companies with 1085 employees' total. By direct insight – visits, interviews and analysis of gathered questionnaires in these companies, a sample of 14 companies with 399 employees is treated, which is 37% of all employees in ICT industry in APV.

For this survey we developed "*A questionnaire for surveying competence, competitiveness, and cooperation and characteristic development trajectories of companies in the ICT sector in APV*", consisting of 10 segments [8]:

(1) General company data;

(2) Company profile data – for identification of competence of the company;

(3) Business and company growth data – for identification of competitiveness of the company;

(4) Strategic company partnership data – for identification of cooperativeness of the company;

(5) Company business effects data;

(6) The opinion of the accountable manager of the company about the quality of human resources in the company – current state and trends in the period 1995-2006;

(7) The plan for further development of the company in 2006-2008 (2010), in the following fields:

- Technology development,
- Home market,
- Global market,

- Development of the company human resources;

(8) What does the company expect from the state to improve business conditions;

(9) Is the company satisfied with available communication infrastructure;

(10) Data of the people who answered the questionnaire.

Delphi method [1] was used twice:

- Based on the information acquired from a poll on the ICT industry in APV, on technological foresight performed for the needs of the EU, as well as on findings on the possibilities and the necessities for further development of CT in our region, a proposal consisting of 10 pilot R&D programs (RDP) to be realized in APV in the immediate future has been made. Pursuant to Delphi technique, significance evaluation, feasibility evaluation and ranking of these 10 RDP have been conducted, when all the engaged experts were permitted to propose an additional RDP, which they evaluated and ranked in the same way as the first 10 RDP proposed;
- Second time Delphi evaluation was used for evaluation of the significance of the proposed priority ICT fields: the engaged experts were asked to distribute the available 100% of significance into five priority fields.

During the formation of the action plan a comprehensive research has been conducted regarding the interests of communities in all counties in APV, in order to realize the main tasks of the strategy in the ICT sector in APV. Out of the total of 45 municipalities in APV, 23 were selected for this purpose. They were introduced to the strategy and asked to determine their role and interests in realizing individual tasks defined by the strategy. These municipalities were selected so as to cover all the counties in APV. An additional criterion was that an adequately educated work force was expected, which could conduct the application of ICT technologies into praxis. A corrective criterion was to include municipalities with a lower income per capita in the sample. 15 communities responded to the request. The results of this investigation are the ground of the action plan.

In the sequel, we shall present findings and results of proposed methodology and process of building strategy and action plan for realization of development goals in APV which relies on ICTs.

3. FRAMEWORK: ICT AS OPPORTUNITY FOR DEVELOPMENT

World economy includes processes that change conditions and rules in global competition, and transition towards knowledge based economy is one of its most prominent features. ICT and software industry sectors are the best representatives of a new technology revolution based on knowledge. The World

Economy Forum defines competitiveness as a blend of factors, policies and institutions determining the level of productivity in the country and thus establishing the level of development that a country can achieve in conditions where knowledge-based economy is being established and functions [10]. By the WEF methodology, developed in 2001 (authors J.Sachs and J.MacArthur), the Growth competitiveness index (GCI) is defined, encompassing three components represented by three indices [10]:

(1) A component describing quality of macroeconomical environment – represented by the Index of macroeconomical environment,

(2) A component describing the state of institutions in a country – represented by the Index of public institutions, and

(3) A component describing the importance of technology and innovations, i.e. the level of technological readiness – represented by the Index of technological readiness (or Technological index), comprising the following three indices:

- Innovativeness index,
- Technology transfer index,
- Information-communication technology index.

However, the data for Serbia and Montenegro (SMN) in the relevant (i.e. for the year 2006 relevant report means position of the country evaluated for years 2005 and 2004) WEF report (the report does not contain separate data for Serbia, and for APV or other similar regions in other states such data are not collected), are not favorable. The position of the state union has deteriorated from 2004 to 2005, measured by the *Networked Readiness Index Rating*: in 2004 it was in the 79th, and in 2005 on the 80th place (of 104 countries ranked) [11]. According to the data on the *Growth competitiveness index* of SMN, it was in 80th position (out of 117) in 2005, improving its position in comparison to 89th place in 2004. The position regarding the *Index of technological competitiveness* is somewhat better – 68th (75th place in 2004), whereas the position regarding the *Index of macroeconomical development* is quite bad – 111, which is worse than 102nd place in 2004. Regarding the third component of the aggregate *Index of state competitiveness*, the *Index of public institutions*, SMN was at the 69th place (out of 117) in 2005 (85th place in 2004) [10].

The WEF report for 2005/2006 emphasizes the importance of education and acquisition of particular skills, as well as the level of training of employees, in the new conditions of global economy and ICT development. Reduced transportation and communication costs have stimulated large multinational companies to move their production and development facilities into the parts of world where there is a favorable combination of knowledge and abilities of the employees and cost of their work, as well as political and social stability (outsourcing). Such a combination existed during the transition process in most countries of central and Eastern Europe (CEE) during the nineties, causing twice as fast economical growth as in the rest of Europe [10].

In order to better understand the influence of ICT on the development of economy and the society in general in the countries of CEE, especially in the new EU member states as well as countries candidates for EU membership, several studies of this phenomenon have been conducted in the past years, coordinated on behalf of the EU by the *Institute for Prospective Technological Studies* (IPTS) in Seville. The aim of these studies is creation of a range of national monographies on the development and establishment of information society, including analysis of positive and negative effects and influences in the countries of CEE. A synthetic report for a group of CEE countries that were analyzed points at three main challenges that will influence the development of information society in Europe in this decade [7]:

(1) A change in conditions of competition pressure – a potential of ICT for economical development;

(2) Growing divisions in the society – the influence of ICT on society groups and society segmentation, so called *digital division*;

(3) Appearance of new problems related to economical growth and demography – influence of ICT to transition and reforms in education.

Results of those studies are grouped into two main findings [7]:

(1) ICT can help countries, new EU members, to reach the level of economical development of original EU countries before its expansion (so called EU 15);

(2) There is a potential for economical growth based on ICT in sectors that do not use ICT as well.

These findings have stressed the need for more intensive use of ICT in certain branches of industry and public sector as well as creation of economical and industrial environment in which the business sector would invest more in ICT, resulting in faster economical growth and establishment of an information society in CEE countries, in line with the Lisbon strategy for increasing EU competitiveness [2].

Gloomy WEF findings related to the state of competitiveness of Serbian economy are nevertheless encouraging as regards trends. 80th place in 2005 is much better than 89th place in 2004, with even more significant improvement regarding the *Index of technological competitiveness* (68th place in 2005 compared to the 75th place in 2004). Namely, by its content, the Index of technological competitiveness describes the potential of an economy for its further development. Since ICT is one of the key factors of the *Index of technological competitiveness*, an analysis of the competitiveness of this particular sector comes as a logical subject of investigation. Table 1 shows some of the most important indicators of ICT industry development in the world and in the region.

If Romania, the country with the lowest investments in IT equipment per capita in this table, is considered a reference point for APV, it can be calculated that the minimal investment of industry and public sector in ICT is about 64 million EUR. If the entire CEE is considered a referent point instead, the minimal investment

rises to 222 million EUR. If the calculation is performed with regard to investments in Western Europe, the sum amounts to 1.47 billion EUR.

Table 1: Selection of the most important indicators of ICT development and application of ICT in economy and society (Source: [3])

Year 2002	**IT costs/GDP [%]**	**IT costs *per capita* [EUR]**	**No. of PCs per 100 HE employees**	**No. of PCs per 100 inhabitants**
Greece	1.38	169	63	10
EU	3.22	723	83	28
Western Europe	3.26	745	85	29
Japan	3.48	903	49	39
Sweden	4.88	1,216	113	54
USA	4.77	1,362	141	83
Year 2002	**IT costs in millions [EUR]**	**Participation [%]**	**IT/GDP [%]**	**IT costs *per capita* [EUR]**
Romania	719	6.2	1.5	32
Bulgaria	312	2.7	1.8	40
Poland	3,992	34.5	2.0	104
Slovakia	757	6.5	2.4	141
Hungary	1,956	16.9	3.5	193
Czech Republic	2,620	22.7	3.3	254
Slovenia	507	4.4	2.1	255
CEE total	11,555	100.0	2.3	111
Western Europe total	286,740	100.0	3.1	735

4. MAIN FINDINGS

4.1. Software Industry in APV – Survey findings

1. Analyzed companies of the ICT industry are, regarding the number of employees, in the category of micro/small and just few medium size companies. They have exceptionally good qualification structure, more than 80% of employees have a university degree, among them software developers account for more than 50%. The rise of employment is particularly encouraging. It can be observed that 2006 was the break-out one, with the number of employees more than doubled, and an intention to continue the trend in 2007 as well.
2. Most of the analyzed companies of the ICT industry are relatively young, founded after year 2000. They are mainly companies in private ownership. Figure 1 show that companies with a small number of employees have large dispersion of income per employee, because they work on a project basis,

i.e. for larger projects professionals are engaged part-time. Income per employee is virtually constant for enterprises having 60-110 employees.

3. Main activities of the analyzed companies are: (a) selling of own products/services; and (b) outsourcing. 12 products/services were identified for both activities. When the activity of a company is selling their products/services, the predominant are: Real-time system management software; Web applications; Communication software; Production management; ERP (Enterprise Resource Planning). Regarding outsourcing, the predominates are: Web applications, ERP. Note that the analyzed companies are concentrated on lesser number of products/services, when their activity is just their selling. Larger dispersion is noticed concerning outsourcing.
4. JAVA and C++ are mostly used, showing both the nature of the majority of applications developed and the kind of knowledge graduated experts need to have.
5. Year after year, revenue of these companies, on home and foreign markets, is observed to grow. Even though these companies are not particularly willing to disclose data about their business, the collected data suggest that the majority as well as the most important buyers/users of products/services of these companies are abroad. Since the average total labor cost in Romania and Bulgaria is two times lower than in Serbia, one can conclude that the main source of competitive advantage is the quality of products/services. This is confirmed by the evaluation of the sources of competitive advantage of the analyzed ICT companies: (a) Regarding the global markets, the predominant source of the competitive advantage is good quality; (b) Regarding the home market, the specialized expertise in the sector is the most important.
6. Important information for strategic positioning and development of the companies in the ICT sector is the evaluation of competitive disadvantage: (a) Regarding the global market, the most important source of competitive disadvantage is poor marketing; (b) At home, the most important sources of competitive disadvantage are poor marketing and high prices of products/services, implying that the market is still underdeveloped.
7. The most important type of relationship with foreign partners is R&D outsourcing contracts, with significant presence of license agreements. This finding should influence the institutions assigned with the task of governing the science & technology development, indicating that there exists a significant portion of the innovation system in the APV that is, at least not publicly, a part of R&D system, i.e. is not the beneficiary of regional subvention programs.
8. ICT companies in APV look for foreign partners in order to solve the problem of finding the customers, stressing the aforementioned conclusion about the poor marketing as the primary source of their competitive disadvantage.

9. The final finding indicates a large discrepancy between the development of the home and global ICT market. Global market poses more constraints, not only regarding prices and deadlines, but especially regarding quality. Home market, as stated before, is preoccupied more by the price than quality.

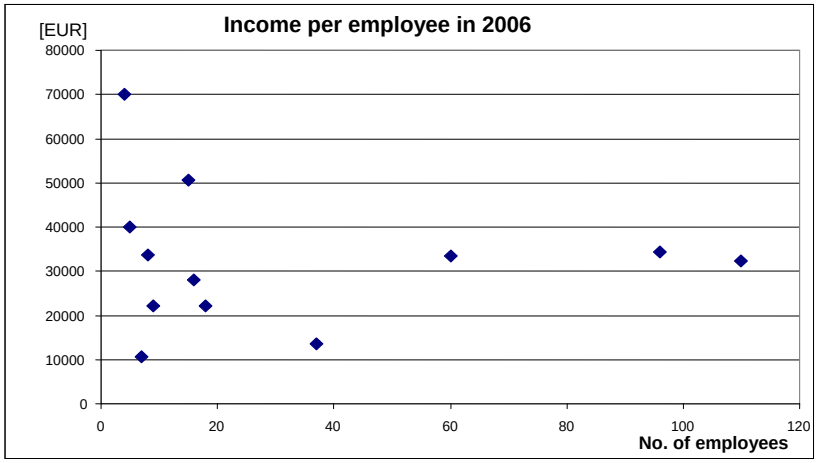

Figure 1: Income per employee in ICT sector (based on a sample of companies)

4.2. Human resources in SE

Human resource (HR) quality in SW companies in APV is evaluated through an overview of statements of analyzed companies:

- These are good programmers, dedicated to their work;
- Having in mind the exceedingly complex requirements of the software components used and realized, there is a shortage of very talented programmers, as well as experts in this complex field (digital signal processing, linguistics, math...);
- Regarding skilled managers, it is difficult to find people who are capable of acquiring this fairly complex matter;
- Quality of experts is on a very professional level, with a stress on the personal wish to improve the working environment and continuous professional improvement;
- HR of the ICT companies are their most valued assets;
- Development of human resources has been initiated from the R&D centre at the Faculty of Technical Sciences (FTS) of the University of Novi Sad (UNS);
- Regarding the beginners– junior programmer positions – the engineers coming from the FTS-UNS, are capable of a fast introduction into the work

process, with those from the Faculty of Natural Sciences and Mathematics from the same university, close second. Recent changes in curricula have enabled the students to acquire practical experience, working on the university projects, which proved to be very useful;

- The shortage of people in the sector is a consequence of huge increase in demand;
- The price of quality experts have significantly grown in the last 12 months;
- Practical cooperation between FTS-UNS, and ICT companies – strategically investment into people during their studies and focusing them on areas that will ease employment after finishing them. Thus, there is a direct correlation between the quality of studies on this faculty and the quality of human resources employed now or in the future at the companies, justifying the intense focus of the companies on the improvement of the studies on the FTS-UNS;
- Some thoughts on theme '*Which are the qualities needed for a Junior Programmer*?':
    - Intelligence (IQ) is very important; genius is not needed, but high IQ is more than useful;
    - Perseverance, will to learn new things (even an extreme IQ is useless if the person is lazy and disinterested);
    - Ethic/moral values, sincerity, openness (sounding maybe trivial, this is still of utmost importance);
    - Communication: not too many people, especially those that have recently finished their studies, are capable of actively listening, i.e. active participation in the conversation and reasoning (as opposed to just nodding without any understanding what it is about). Asking questions when something is not clear, without fear/shame that the question is stupid - usually there is a more experienced person that will give a helping hand;
    - Pragmatism: experience with beginners says that they usually try to solve the problem in highest possible generality. The other usual problem is that people are tied to a certain tool or environment, and tend to neglect any other possibility including more efficient work environments;
    - Excellent knowledge of foreign languages (primarily English);
    - Last, but not least, one should acquire the basic knowledge of project management during studies.
- Insufficient number of quality programmers for Java and .Net technologies;
- During the period 1995-2006 we observed a declining trend of available high-quality people, which can partly be attributed to increased demand;

- Specificity of the business and long-term projects implore ICT companies to 'build their own personnel', employing new human resources immediately after finishing their studies, and than gradually introducing them into their development teams;
- HR development strategy in SW companies in APV (review on individual reports of analyzed companies):
- Scholarship for the most talented students, mentoring work, number of international projects and good team organization;
- Doubling the number of HR in the next 2 years using partnership with the biggest companies in the field;
- Growing marketing team, selection end optimization of development team – the goal is to decrease expenses;
- Increasing the number, quality and competence of existing and new employees by improving cooperation with university. Foreign partners provide trainings and education, either in partner's company or in specialized houses. The company knowledge management system provides sustainability and internal education;
- Participation in conferences, postgraduate studies scholarships, mentoring programme for new graduates;
- Training in project management, quality control and managers skills and techniques, and continuous technical and professional improvements;
- Scholarship for students on last years of studying;
- Certification of leading professionals.

4.3. R&D and Educational Institutions in the ICT sector in APV

The most significant R&D and high education institutions in the ICT sector in APV are located within the University of Novi Sad: the Faculty of Technical Sciences (FTS), and the Faculty of Natural Sciences and Mathematics (FNSM). Total number of teaching staff in 2006 was 158, and number of students was close to 2000. Number of graduates is close to 300 every year.

4.4. SWOT analysis of HR in the ICT sector in APV

Following the overview of the current state in companies and research and educational institutions in the ICT sector in APV, a synthesis of the score is given in the form of SWOT tables (tables 2, 3, 4 and 5).

Table 2: SWOT analysis – Human resources in the ICT sector in AP Vojvodina

STRENGTHS – particularities of ICT	WEAKNESSES – particularities of ICT
➢ High qualification structure of employees ➢ Programmers mostly use JAVA and C++ ➢ Programmers are taught to use a very wide array of software tools ➢ Programmers are dedicated to their work ➢ Quality of human resources at a high professional level ➢ Capability of fast absorption of new knowledge, efficient use of the Internet and a logical approach to problem solving are the typical traits of young ICT experts	➢ Lack of programmers and other ICT specialists ➢ Lack of managers to run ICT business ➢ It takes 3-6 month for graduate students to be able to perform given tasks in their companies with success ➢ Some people have lost interest and motivation for work owing to the difficult situation in the country ➢ Lack of quality programmers for JAVA and .Net ➢ A decrease in the number of available quality experts and graduate ICT specialists can be seen ➢ Lack of inventiveness and innovativeness
OPPORTUNITIES – particularities of ICT	**THREATS – particularities of ICT**
➢ Increase in employment rate since 2005. ➢ FTS and FNSM are quality faculties for education of ICT specialists ➢ FTS has developed practical collaboration with ICT industry companies ➢ ICT companies organize training of their employees ➢ Programs for fast training of the people with medium education for software jobs ➢ Including people with lower education or abilities into services via ICT infrastructure ➢ Awarding scholarships to students of final years of ICT studies	➢ Cost of quality people has risen significantly since 2005. ➢ Attitude towards job and absence of professional ethics ➢ Lack of interest in studies of technical sciences ➢ Underdeveloped infrastructure for specialized training of ICT professionals ➢ Lack of specific knowledge and abilities required for ICT business: ICT project management, marketing and PR in ICT etc.

Table 3: SWOT analysis – infrastructure in the area of R&D in the ICT sector in APV

STRENGTHS – particularities of ICT	WEAKNESSES – particularities of ICT
➢ Tradition of high quality education in the area of technical, mathematical and other sciences ➢ Innovative-entrepreneurial potential at the University well developed ➢ International cooperation in the area of ICT research and development well established ➢ Price of R&D resources in the ICT sector still competitive	➢ Inadequate potential of high education in the area of technical, mathematical and other sciences compared to the needs of APV ➢ Inadequate regional distribution of R&D infrastructure in the ICT sector in APV
OPPORTUNITIES – particularities of ICT	**THREATS – particularities of ICT**
➢ A high level of competence of local human resources as well as potential for cooperation with foreign and local ICT companies and R&D organizations ➢ EU programs for regional R&D cooperation in the field of ICT ➢ Potential and needs of the ICT market in APV and Serbia	➢ Political situation in the city, APV and the republic, slowing down and/or obstructing the development of the ST park at the University ➢ Cheap outsourcing – R&D projects not defined in accordance with local needs – in case international cooperation is not commercially based ➢ Unstable economical and political situation in the country ➢ Brain drain

Table 4: SWOT analysis of the ICT industry in AP Vojvodina

STRENGTHS – particularities of ICT	**WEAKNESSES – particularities of ICT**
➢ ICT companies are mostly young, founded after 2000, and mostly owned by private parties ➢ Good qualification structure, with more than 80% of employees with high education ➢ ICT companies launch their products and services mostly in the following areas: software for real-time system management, web applications, communication software, production management and enterprise resource planning ➢ ICT companies outsource mostly in the areas of web applications and enterprise resource planning ➢ ICT companies are typically concentrated on a smaller number of products/services, and their key activity is the actual sale of these products/services ➢ Income of these companies on both local and foreign markets grows each year ➢ The major buyers/users of products/services of these companies are located abroad	➢ Most companies do not have an international quality control certificate ➢ The most important cause of weak competition at markets abroad is weak marketing ➢ The most important cause of weak competition at the local market is the high price of products/ services. ➢ Local ICT companies look for foreign partners for solving the problem of finding a market, due to the lack of their own marketing potentials ➢ Local ICT market usually pays attention to the price of ICT products/services rather to their quality ➢ In case of outsourcing, a larger dispersion in engagement can be noted, i.e. acceptance of a much larger number of product/service development projects
OPPORTUNITIES – particularities of ICT	**THREATS – particularities of ICT**
➢ Gross price of work of employees in local ICT companies is about 50% compared to the competition in EU countries, leading to the conclusion that the major source of competitiveness is actually the quality of products/services offered by our companies, since the price of the same work in Romania or Bulgaria is about half the price here. ➢ As to the local market, the main source of competitive advantage is a specialized expertise in a certain area.	➢ Foreign partners demand a quality control certificate according to ISO 9001 and CMMI / level 3 or higher ➢ Access of Romania and Bulgaria to the EU, since these are countries with the same geographical position, but lower cost of work ➢ Crisis in the ICT sector in the EU (bankruptcies of certain traditional partners of our companies) ➢ Foreign ICT product/service market is more demanding regarding price, deadlines, as well as quality ➢ Appearance of some new players at the market (Belarus, Moldavia)

Table 5: SWOT analysis of the ICT sector in APV – synthetic table

STRENGTHS	**WEAKNESSES**
➢ Well developed ICT market ➢ Expert staff in ICT sector ➢ Diverse products/services ➢ An increase in the number of ICT SMEs ➢ Active innovative behavior	➢ Absence of foreign companies ➢ Lack of inflow of new programmers and designers
OPPORTUNITIES	**THREATS**
➢ Attracting new students to the ICT area ➢ Planned industrial infrastructure ➢ Repressing and/or legalization of "grey" economy ➢ Presence of large ICT companies in neighboring regions in Hungary and Romania, owing to their plans for expansion into Serbia/ Vojvodina ➢ Readiness of local government to deal with issues important for economic development, as well as consciousness of ICT development	➢ Illegal outsourcing ➢ Brain drain ➢ Political instability in the country ➢ Possible instabilities at target markets, especially in Germany ➢ Increase in the price of quality human resources ➢ Increase in the need for communication infrastructure not covered by providers of broadband communication services

4.5. Preferences for use and development of ICT in the counties of APV

Tables 6, 7 and 8 give an overview of expressed interests for realizing the strategy for the computer engineering, communications and automated systems sector according to different municipalities in counties of APV [9]. It is important to note that the interests of municipalities for realizing the strategy for the computer engineering, communications and automated systems sector. It is important to note that the interests of municipalities, given in these tables as expressed importance for development of a particular municipality are in the majority of cases also stated in the form of assigned budgetary funds for realizing:

- Preferential R&D programs in the ICT and automatization of industrial systems (AIS) sector;
- Preferential projects of pilot production or system services;
- Infrastructure for massive use and development of ICT and AIS;

in individual municipalities of APV.

Table 6: Overview of preferential R&D programs in the ICT and AIS sector, according to their importance in different municipalities of APV [9]

Municipality R&D Program	Apa-tin	Vr-šac	Bela Crkva	Bačka Topola	Ka-njiža	Ki-kinda	Novi Kneževac	Kula	Novi Sad	Pan-čevo	Sremska Mitrovica	Subo-tica	Žiti-šte	Zre-njanin	Vr-bas
I-1	A1			A2	A2		A2	A1							
I-2		A3	B2												
I-3								A2	A1	A2				A2	
I-4															
I-5															
I-6	A2	B2							A2					B2	
I-7	A3				B2	A2						A3	A3	B3	
I-8					A1			A3						A3	
I-9								B1							
I-10			B1												
I-11															
I-12															
II-1	B1		A3	A1	A3		A1		A3	A3		A2		A1	
II-2		B1				A3				A1		A1		B1	
II-3		A1	A1		B3					B1			B2		
II-4													B1		
II-5															
II-6									B3						
III-1	A2			B1			B3	B2					A1		
III-2						B1									
III-3				B2		B3	B2						A2		
IV-1															
IV-2			B3		B1										

Municipality R&D Program	Apa-tin	Vr-šac	Bela Crkva	Bačka Topola	Ka-njiža	Ki-kinda	Novi Kneževac	Kula	Novi Sad	Pan-čevo	Sremska Mitrovica	Subo-tica	Žiti-šte	Zre-njanin	Vr-bas
IV-3															
IV-4															
IV-5															
IV-6															
IV-7	B3	B3	A2	B1			B1	B3		B3					
IV-8															
IV-9															
IV-10															
V-1															
V-2									B2						
V-3													B3		
V-4	B2	A2		A3		B2			B1	B2					
V-5						A1	A3								

Legend: **The evaluation of importance** is given as follows: **The first three**, most important preferential R&D programs are denoted by: **A1** – the most important R&D program; **A2** – the second in importance R&D program; **A3** – the third in importance R&D program. **The next three**, important, but not as much as the first three, are denoted by: **B1** – the most important preferential R&D program in the second group of less important programs; **B2** – the second in importance R&D program in the second group of less important programs; **B3** – the third in importance R&D program in the second group of less important programs.
For the names of priority fields (abbreviations I to V), see table 9.
For the names of R&D programs, see table 10.

Table 7: Proposal of preferential projects of pilot production or system services, according to the importance for individual municipalities in APV [9]

Municipality Project	Apa-tin	Vr-šac	Bela Crkva	Bačka Topola	Ka-njiža	Ki-kinda	Novi Kneževac	Kula	Novi Sad	Pan-čevo	Sremska Mitrovica	Subo-tica	Žiti-šte	Zre-njanin	Vr-bas
1		b2		a3	b1		a3	a3					a3	b1	
2		a3		b3			b3								
3	a1		b1	a2	a1	a2	a2	a2	a1					a1	
4		a2	a1	a1	a2	a1	a1	a1	a2				a1	b2	
5	a2	b1			a3				a3						
6			a3		b2										
7		a1							b2					b3	
8			a2	b1	b3		b1						a2	a2	
9		b3	b2						b3					a3	
10			b3	b2			b2		b1						

Legend: **The evaluation of importance** is given as follows: **The first three**, most important preferential projects of pilot production or system services, are denoted by: **a1** – the most important project; **a2** – the second in importance project; **a3** – the third in importance project. **The next three**, important, but not as much as the first three, programs are denoted by: **b1** – the most important preferential project in the second group of less important projects; **b2** – the second in importance in the second group of less important projects; **b3** – the third in importance in the second group of less important projects.
For the names of projects of pilot production, see table 11.

Table 8: Infrastructure for massive use and development of ICT and AIS in APV, according to the importance for individual municipalities in APV [9]

Municipality / Infrastructure	Apa-tin	Vr-šac	Bela Crkva	Bačka Topola	Ka-njiža	Ki-kinda	Novi Kneževac	Kula	Novi Sad	Pan-čevo	Sremska Mitrovica	Subo-tica	Žiti-šte	Zre-njanin	Vr-bas
1	3	3	3	1	1		1						1	1	1
2	2	2	2		2	3		1	2				3	2	2
3				3	3		3		3						
4						1		3							
5									1						
6	1	1	1	2		2	2	2					2	3	3

Legend: **The evaluation of importance** is given as follows: **Three** most important infrastructures for massive use and development of ICT and AIS in APV are denoted by: **1** – the most important infrastructure; **2** – second in importance infrastructure; **3** – third in importance infrastructure. **For the names of infrastructures, see table 12.**

One of the mentioned Delphi cycle of the use of experts opinion resulted with evaluation of importance of five priority fields (see table 9).

Table 9: Evaluation of importance of priority fields [8]

	Priority field	Importance (in %)
I	Support for health and social needs of people	24
II	E-government	17
III	Support for agriculture	20
IV	Support for innovation activities	18
V	Support for process industry and control of technological systems	21
	Total:	**100**

The main groups of tasks are given in tables 10, 11 and 12 wherein the R&D programs, projects of pilot production and infrastructure has been ranked according to interest and expressed importance of individual municipalities in different counties of APV. The expressed interest for individual tasks given by municipalities in APV has been weighted by the intention of municipalities to co-finance the realization of those tasks on their territories. Interests of different municipalities to realize individual R&D tasks in the ICT and AIS areas given in table 10 are given in figures 2, 3, 4, 5 and 6 [9]. Each program has been shown with an area in its specified color, while the area covered by the color is proportional to the number of points a municipality gave to the program (A1=10, A2=8, A3=6, B1=4, B2=2, B1=1), weighted by the degree of intended co-financing of the municipality for the program if implemented on its territory (without co-financing, the number of points is multiplied by 1, with 50% of co-financing by 1,5, and with 100% of co-financing the number of points is multiplied by 2). The use of this procedure gives an easy insight into regional groupings for individual R&D programs, as well as into the interest for realizing individual preferential areas and programs. The support for health and social

needs of people is obviously the most important area, and the realization of the strategy should begin by its implementation.

Figure 2: Interests of municipalities in APV for realization of R&D program in the priority field I – Support for health and social needs of people

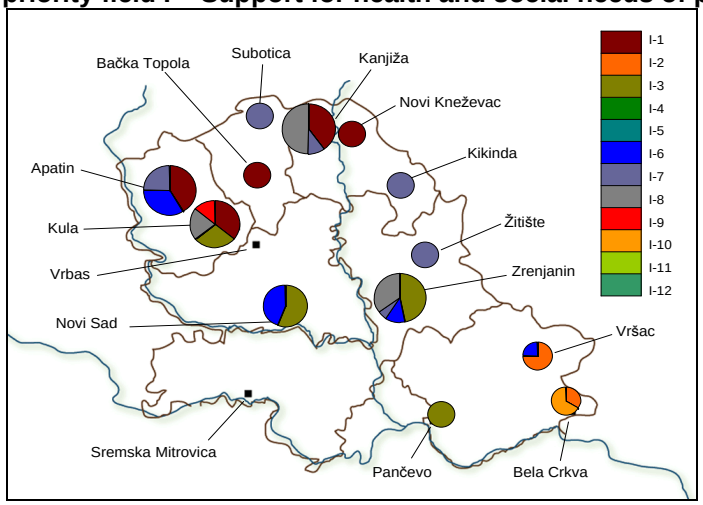

Figure 3: Interests of municipalities in APV for realization of R&D program in the priority field II – E-government

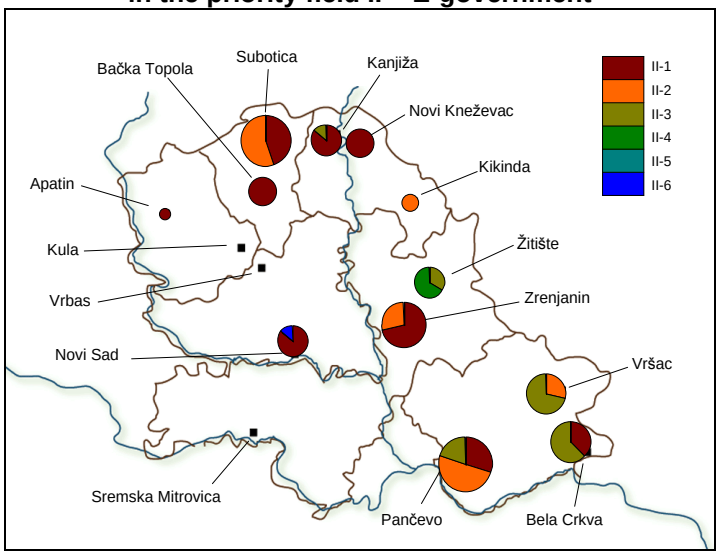

Figure 4: Interests of municipalities in APV for realization of R&D program in the priority field III – Support for agriculture

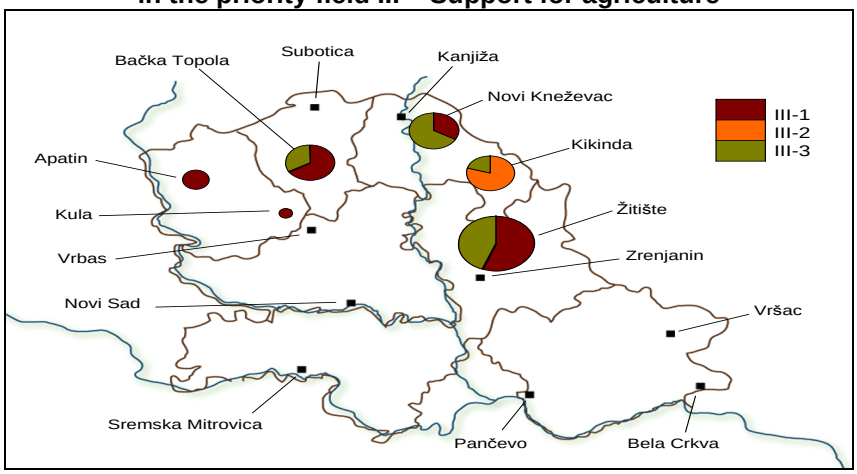

Figure 5: Interests of municipalities in APV for realization of R&D program in the priority field IV – Support for innovation activity

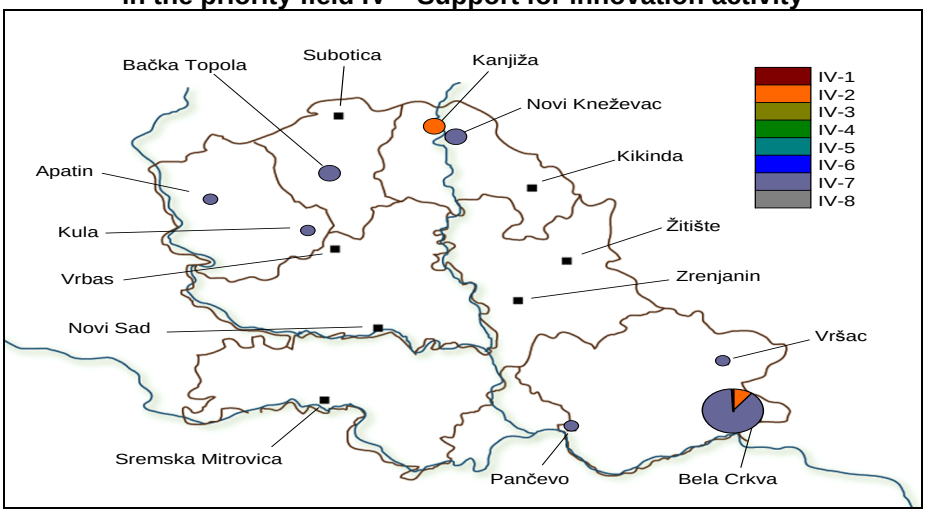

Figure 6: Interests of municipalities in APV for realization of R&D program in the priority field V – Support for process industry and control of technological systems

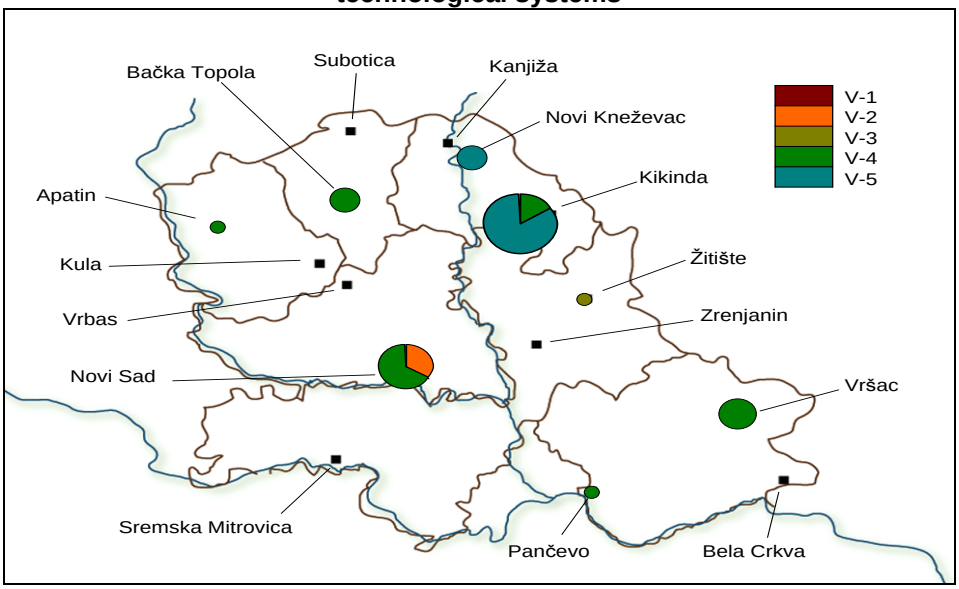

Table 10: Ranking of R&D programs in the ICT and AIS areas according to the priority for development of APV [8], [9]

Rank	Priority Field	R&D Program	Points (weighted by the level of co-financing of the municipality)
1	**II-1**	System of e-government in APV. The goal is to establish the e-government on the level of the Province oriented toward the citizen and based on cooperation of local levels of government with the provincial government. The development should be directed towards the development of ICT components and systems which provide swift, efficient and economical cooperation of local levels of government where tle local level of government provides the services for the population and/or companies on its territory. The realization of the project gives the local government electronic services suitable for communication with the provincial authorities.	**85.10**
2	**I-1**	Development of ICT tools for identifying the health risks, overview of groups with health risk and early diagnosis of disease.	**61.34**
3	**I-3**	Development of the infrastructure for the support for e-Learning: communication, hardware, software and organizational infrastructure. Communication infrastructure should provide educational institutions of all levels (elementary, secondary and university) with basic communication capacities. Computer infrastructure includes computer and specialized hardware equipment for the preparation and conducting of e-Teaching. Multilingual support is obligatory for software infrastructure. Organizational infrastructure includes organizational forms for the support for teaching subject matter development, for infrastructure maintenance and conducting e-Teaching.	**41.38**

Rank	Priority Field	R&D Program	Points (weighted by the level of co-financing of the municipality)
4	**II-2**	Integration of already built GIS infrastructure for control of natural and artificial resources of APV.	**40.10**
5	**II-3**	Integration of information infrastructure of local governments among themselves and with the information structure of provincial institutions.	**37.20**
6	**I-7**	Networking of all institutions for health care, including laboratories. The goal is to provide the communication infrastructure and organization which can provide the local institutions of health care to exchange data, samples and consulting services as well as exchange of best practice with the leading medical organizations.	**33.68**
7	**V-4**	Development of an ICT system intended to provide monitoring and control of environment.	**33.48**
8	**I-8**	Development of information infrastructure for support of pupils in elementary and high and secondary schools. The goal is to establish an electronic information system (classroom material, literature, virtual laboratories etc.) that will provide identical quality of information content and equal availability for educational institutions in all local communities in APV.	**30.16**
9	**IV-7**	Massive implementation of new generation Internet, support in a much larger number of potential users.	**29.14**
10	**III-1**	Building an integrated system for the protection of agricultural production and estates: from the protection from natural disasters to the protection from human negligence, theft, intentional destruction, and the like.	**28.06**
11	**I-6**	Development of the software infrastructure for the support of an integrated basic and specialist health care in APV oriented towards the patient. The first phase of development should concentrate on registering all subjects of health care in APV, their offer (type, conditions etc.) and to enable their offer to be available through the Internet and other delivery channels for every citizen in APV. The next phase would assume the possibility to commission services (such as checking), expert consulting, result delivery, different services for chronic patients in order to maintain their health value (e.g. for patients with diabetes).	**23.66**
12	**V-5**	Development of equipment and systems for watering the crops.	**21.10**
13	**III-3**	Production of automated machines (systems) for collecting, sorting, preparation and packing of agricultural products (notoriously fruit and vegetables).	**15.53**
14	**I-2**	The development of ICT based support for enhancing human vital capabilities, for prolonging working life and for enhancing work quality of elderly people: systems that enable elderly and disabled people to remember, see, hear, communicate, move better, and according to that to work and fit in with their social surroundings more.	**11.06**
15	**I-9**	Building an informational infrastructure for the support for educational process of remote learning for students (an increasing number of them works while going to university) as well as for the needs of permanent learning. Eventually creating a virtual university.	**6.04**
16	**III-2**	The use of ICT for increasing agricultural (crop farming and cattle breeding) yield.	**6.04**
17	**IV-2**	Building information infrastructure as support for innovative activity development in APV (improving large information flow from and to innovative system elements: innovation centres, business and technology incubators, ST parks).	**5.00**
18	**I-10**	Building an informational infrastructure supporting the development of electronic teaching and “life long learning” (technology incubators, ST parks).	**4.00**
19	**II-4**	Electronic public service for libraries (book catalogues, search	**4.00**

Rank	Priority Field	R&D Program	Points (weighted by the level of co-financing of the municipality)
		tools).	
20	**V-2**	Developing ICT in the automation and control in residential-business premises (Building automation system).	**2.66**
21	**II-6**	Electronic vote in parliamentary elections. Regarding the decreasing number of voters going to the elections, provide the possibility of voting at home, all legal norms being obeyed.	**1.33**
22	**V-3**	ICT as support for managing large systems (oil, gas, traffic, electric power, waters, …)	**1.00**
23	**I-4**	Development of the means for achieving quality in educating engineer staff at polytechnics and universities in APV. Research in phase 1 would refer to the development of universal development systems for the subjects from the field of computer technique, computer communication and mechatronics.	**0.00**
24	**I-5**	Electronic learning for the talented, the disabled and the like, i.e. for small and dispersed populations, which would be much more expensive to organize student transport to one centre for.	**0.00**
25	**I-11**	Make the services of an informational society more available to larger numbers of people by liberating them from the so called PC tyranny, i.e. by simplifying man-machine interaction.	**0.00**
26	**I-12**	Networking of information and entertainment systems (TV, Internet, telephony).	**0.00**
27	**II-5**	Methodology development and defining the required informational infrastructure for monitoring the state of affairs in education, with the aim of improving classes and providing rational and purposeful spending of the resources.	**0.00**
28	**IV-1**	Filtering internet traffic is one of the applications that are very much required. Namely, a network of servers that will intercept and eliminate computer spasm, viruses, worms and Trojans should be built. This product can also be an export trump card. These servers shouldn't apply classical tools such as "Kaspersky" and the like, but should, through Internet traffic analysis, perceive the systems advertising this unwanted traffic and eliminate it at its beginning.	**0.00**
29	**IV-3**	Developing open-source solutions	**0.00**
30	**IV-4**	Developing commercial software, putting special emphasis on the agile development of complex business information systems. Both software and the aspects of software excellence represent an important export opportunity.	**0.00**
31	**IV-5**	Implementing WDM (Wave Division Multiplex) technology, based on the usage of optic sources of the newest generation, which achieves enormous permeable scale in communications (~100Gb/s). Minor investments are required. Users in Vojvodina would in that way gain world quality internet.	**0.00**
32	**IV-6**	Development and realization of informational-communicational network elements in APV: 1) Developing a nod based on VoIP technology, 2) Research on and developing sensor networks, 3) Developing cooperative networks, 4) Development in the field of radio frequency spectrum optimization.	**0.00**
33	**IV-8**	Development of a semantic web.	**0.00**
34	**IV-9**	Research into and development of complex devices based on computer structures in the field of multimedia systems (digital television, audio-video applications, algorithm realization in DSP/HW architecture, purposeful systems).	**0.00**
35	**IV-10**	Founding a center for project engineering and verification of integrated electronic circuits and systems as a basis for opening SMEs in the field of micro- and nano-electronic technologies.	**0.00**
36	**V-1**	Development of ICT support for automatization and control in process industry.	**0.00**

Table 11: Ranking of preferential pilot projects in production or system services in the ICT and AIS areas according to the priority for development of APV [8], [9]

Rank	Project	Points (weighted by the level of co-financing of the municipality)
1	Improve entrepreneurial education.	**118.22**
2	Reforming the secondary education system in to the effect of encouraging team work, creativity, active listening and reasoning in the course of conversation.	**91.54**
3	Organizing courses with foreign lecturers and exchanging experiences with colleagues from abroad. Participation in organizing thematic courses for the needs of enterprises.	**44.2**
4	Including people with lower educational profile or capabilities in providing services through ICT infrastructure, without the additional education being necessary.	**41.16**
5	Bring in insurance against employees' professional responsibility, which is a prerequisite for making some international contracts.	**28.02**
6	Simplifying customs regulations on temporary import of ICT equipment.	**18.76**
7	Starting technology foresight programs in ICT field (there is the example of Austria, which defined specific priority sectors, e.g. ferrous metallurgy, which can realize their competitiveness at most by using ICT. A similar approach to defining development priorities and the role of ICT should be adopted by APV as well).	**12.36**
8	Participation in the expenses of patent protection abroad.	**12.08**
9	Encouraging a mathematical way of thinking at the earliest age possible, by helping the activities of Archimedes and the like, by organizing competitions in mathematics at all levels regarding age, schools, local self managements, counties, APV (the goal is to include as many young people as possible, and furthermore, the competitions in logics, algorithms, and the like develop curiosity and capabilities to be significant in the later work in ICT sector).	**10.84**
10	Organizing guest engagement of professors from the universities abroad for a period from 6 months to a year, this would be financed by provincial authorities. Priority should be given to our acknowledged experts, due to the language issue.	**8**

Table 12: Ranking of infrastructure for mass use and development of ICT and AIS areas according to the priority for development of APV [8], [9]

Ranking	Infrastructure	Points (weighted by the level of co-financing of the municipality)
1	Founding training centres of secondary school pupils in the area of pneumatics, hydraulics, programmable logical controllers. The centres would serve as a place for re-educating human resources whose previous job became obsolete.	**103.42**
2	Founding training centres for secondary school pupils in the tools JAVA and C++. These centres would provide an efficient - from 6 to 12-month – training of new programmers, prepared to get involved in development projects of ICT industry in APV immediately. A similar solution was proved useful in Timisoara (Romania).	**92.88**
3	Development of communication network of high capacity for accessing and using Internet, and for data transmission and	**91.26**

	broadband communication between all possible interested users.	
4	Supporting the function of a ST park as an integrator of companies having a similar but complementary profile, so that they could apply for getting projects of a greater significance. Projects being referred to are the ones for the Serbian market and financed by EU institutions, whose terms eliminate smaller and relatively new firms from Serbia.	**32.1**
5	Organizing a business incubator in Novi Sad and in other towns in APV, in which there is interest and need for, but they still haven't been founded;	**24.16**
6	Creating a S&T park in Novi Sad;	**13.3**

Here it is important to note that the last item (S&T Park in Novi Sad) could not be ranked by no one municipality but Novi Sad, so that its priority should be considered much higher. This park also includes a business incubator.

4.6. Synthesis of proposed activities addressed to key requirements of the policy: legislation, financial and institutional mechanisms

Financial models for financing R&D realization, according to the law on scientific research activity (published on 12th December, 2005 in Official Gazette of the Republic of Serbia, no.110/05), can be:

1. Financing R&D realization on the whole;
2. Co financing R&D realization – in accordance with article 35 of the Law on Innovative activity (published on 12th December, 2005 in Official Gazette of the Republic of Serbia, number 110/05);
3. Incentive for R&D realization in accordance with the article 51 of the Law on Innovative activity;
4. Guaranties given by the provincial *Fund for the incentive of development projects* for granting credits for enterprises' development projects, on the basis of an open competition procedure for selection and approval. Enterprises can apply without any deadline, and the Fund reaches decisions on the basis of the evaluation results of every application;
5. Granting loans to pilot production or system services;
6. Investments through the National Investment Plan (NIP) and Provincial Capital Investment Fund.

The choice of an appropriate model depends on the nature of R&D programs and projects proposed for R&D realization in the open competition.

The strategy "Basic Directions of Technology Development of APV for the Computer engineering, communications and automated systems sector" is a part of the strategy "Basic Directions of Technology Development of APV". For

realizing the part of the strategy for the computer engineering, communications and automated systems sector, the following particular measures are necessary:

1. Provide financial means in the budget of APV for financing the R&D programs in the ICT and AIS areas, preferential pilot projects in production or system services in the ICT and AIS areas, and building the infrastructure for mass use and development of ICT and AIS;
2. Build instruments for issuing public calls and tenders for choosing organizations and persons who will participate in realization of R&D programs in the computer engineering, communications and automated systems sector, in preferred pilot projects in production or system services in the ICT and AIS sector, in building the infrastructure for mass use and development of ICT and AIS;
3. Establish an appropriate organizational structure for coordinated and joint work of the Secretariat for S&T Development of the Executive Council of APV with the municipalities and counties which have opted to participate in financing and realization of individual R&D programs in the ICT and AIS sector, in building the infrastructure for mass use and development of ICT and AIS;

The main measure for realization of the whole strategy of technology development of APV should be the establishment of a **Council for Technology Development of APV**. Its competences would be:

1. Monitoring the Implementation program of the Strategy of technology development of APV;
2. Analyze the results obtained and accordingly propose changes and amendments of the Strategy to the Secretariat, as well as changes in priorities;
3. Proposes programs of public interest to the Secretariat;
4. Proposes an act of selecting, evaluating and financing programs of interests to APV;
5. Proposes an act of standards for delivery of budgetary funds;
6. Performs other tasks according to defined needs and rules of conduct.

4.7. Action plan for the implementation of the Strategy

The Action plan for realization of the part of the strategy "Basic Directions of Technology Development of APV" relevant for the computer engineering, communications and automated systems sector is given in Table 13.

Table 13: Action plan for realization of the part of the strategy "Basic Directions of Technology Development of APV" relevant for the ICT and AIS sector [9]

No.	Activity	Executor of the activity	Source of funds	Deadline
1.	Start of the public call for financing R&D programs in the ICT and AIS areas	Secretariat for science and technology development of EC APV (SSTD)	Budget of APV - SSTD	September 2008
2,	Financing and realizing the R&D programs in the ICT and AIS areas	• SSTD • S&R and R&D organizations in APV	• Budget of APV – SSTD • Budgets of municipalities	January 2009 – December 2010
3.	Start of the public call for financing pilot programs in the ICT and AIS areas	SSTD	Budget of APV - SSTD	September 2008
4.	Financing and realizing the pilot programs in the ICT and AIS areas	• SSTD • R&D organizations in APV • Professional associations • Innovative individuals and entrepreneurs	• Budget of APV – SSTD • Budgets of municipalities	January 2009 – December 2010
5.	Start of the public call for financing of building the infrastructure for mass use and development of ICT and AIS areas	SSTD	Budget of APV - SSTD	September 2008
6.	Financing and realizing building the infrastructure for mass use and development of ICT and AIS areas	• SSTD • Secretariat of education • Secretariat of economy • S&R and R&D organizations in APV	• Budget of APV – SSTD • Budgets of municipalities	January 2009 – December 2010

4.8. Estimation of investments necessary for realizing the measures in counties of APV

The extent of the funds needed for each program depends on the location where it is going to be realized, and the extent to which this realization is going to be fulfilled. Local communities have expressed their interest to co-finance the major part of the programs in their realization phase. Thus, in order to estimate the necessary investments, it is necessary to take the budgets of municipalities into account as well.

Table 14 gives an overview of the Budget of APV for 2008. It is both real and necessary to provide funds for realizing the Strategy “Basic Directions of Technology Development of APV” from different positions within this budget. Thus, the estimate of the funds that could be used for realizing the part of the Strategy for the computer engineering, communications and automated systems sector amount to **144,469,630 RSD**, together with the co-financing of the local communities.

Table 14: Positions in the budget of APV that can be used to realize the part of the Strategy "Basic Directions of Technology Development of APV" referring to the ICT and AIS sector [9]

No.	Area	Budget of APV (RSD)	Funds for the ICT and AIS sector (RSD)		
			From the budget of APV (RSD)	From the budget of local communities (RSD)	Total (RSD)
1.	Employed in education and culture	5,880,000,000	0	0	0
2.	Capital investment fund of APV	4,470,000,000	49,666,667	16,555,556	66,222,222
3.	Development fund of APV	500,000,000	5,555,556	1,851,852	7,407,407
4.	Programs in the area of economy and new technologies	471,350,000	47,135,000	15,711,667	62,846,667
5.	Subsidies in agriculture and support through the agriculture development fund of APV	279,100,000	2,791,000	930,333	3,721,333
6.	Measures of demographic policy	148,400,000	0	0	0
7.	Programs in energy, urban development, SME development	138,000,000	1,380,000	460,000	1,840,000
8.	Realization of accepted programs of economy development	109,600,000	1,096,000	365,333	1,461,333
9.	Raising the quality of information of citizens, information on the languages of minorities and information for people with disabilities	72,800,000	728,000	242,667	970,667
10.	Fund for refugees, expelled and dispersed people	50,000,000	0	0	0
11.	Guarantee fund	32,500,000	0	0	0
	Total	**12,151,750,000**	**108,352,222**	**36,117,407**	**144,469,630**

Table 15 gives an estimate of the costs of realization of several preferential R&D programs. The calculation is given based on the estimated engagement of researchers and duration of realization, without costs of equipment which would eventually be needed for realizing the programs. This document will not deal with details in this calculation:

1. Realization of the actions envisaged in this strategy will be based on public calls with open participation of interested institutions and individuals. The selection procedure is based on predefined criteria and procedures, according to priorities given in Tables 10, 11 and 12. The number of projects financed depends on the total available funds, and not on the cost of individual projects, so that the number of approved projects necessarily varies. For the projects that could not be financed because they are below the cutoff line, if their evaluation is positive, a list is formed for which additional sources sponsors and donators are sought;

2. The real amounts of necessary funds will be determined according to applications of the interested candidates – institutions and individuals, during the evaluation process of the economic justification of the application.

Similarly, it is possible to estimate the costs for other programs, but the reduced space and great error margin it will be omitted.

Calculation of the costs of establishing a "Training centre of secondary school pupils in the area of pneumatics, hydraulics and programmable logical controllers" is as follows:

- The cost of one program in pneumatics: cca 540.000 RSD;
- The cost of one program in hydraulics: cca 1.170,000 RSD;
- The cost of one program in programmable logical controllers: cca 330.000 RSD;
- About 3-4 trainees can be covered by one training. The experience has shown that 4 parallel training groups is the optimum regarding quality and efficiency of the training Thus, 12-16 trainees can be covered by one training. The aforementioned cost does not include the lease of premises.
- Starting from the cost of the given training program and their number, the total cost of the training is: 4 x (540.000+1.170.000+330,000) = 8.160.000 RSD, with cca 840,000 RSD for preparation of materials, use of existing equipment and rooms. Thus, the total cost of establishing this centre is 9.000.000 RSD.
- After the conditions are satisfied, the deadline for establishing the centre can be set to two months.
- A similar calculation can be carried for the Centre for training secondary school pupils in JAVA and C++. It is of utmost importance to note that in order to establish these centres that it is not necessary to invest funds into erection of new buildings, because of existing schools, faculties, chambers of commerce etc. could be used for the purpose.
- The estimation of the price of building the part of the S&T Park of the University of Novi Sad – part at the Faculty of Technical Sciences, dedicated to ICT based companies, is as follows. A new combined building intended for education and research at the departments of electrical and computer engineering as well as hosting some 15 ICT based companies is going to be built on the place of nowadays building of TMD. The total area of the building will be some 15.500 m^2, giving the cost of some 640.000.000 RSD to be instead in the period 2009-2011. The companies in the park will be situated on cca 3500 m^2.

Table 15: An example of the calculation of the costs of several preferential R&D programs for realization of the part of the Strategy "Basic Directions of Technology Development of APV" referring to the ICT and AIS sector [9]

Program	Estimated effort (research months)	Net cost (RSD)	Total cost (RSD)	Total cost with VAT (RSD)	deadline	Notes
I-1	36	2,880.000	4,896.000	5,777.280	12 months	Pilot project for cardio-vascular diseases
I-3	48	3,840.000	6,528.000	7,703.040	18 months	Pilot project for networking 1 elementary school, 1 secondary school and one faculty
I-6 (phase I)	36	2,880.000	4,896.000	5,777.280	12 months	Pilot project for networking 1 health care center and 1 hospital
I-8	72	5,760.000	9,792.000	11,554.560	12 months	For education in higher grades of elementary school
II-1	24	1,920.000	3,264.000	3,851.520	12 months	Establishment of experimental system for exchange of electronic documents between two local communities and with a provincial authority
II-2	96	7,680.000	13.056.000	15,406.080	18 months	Establishment of experimental SDI portal
II-4	36	2,880.000	4,896.000	5,777.280	12 months	Establishment of library catalogs based on MARC21 format in master municipal libraries in APV (5 libraries)
III-2	96	7,680.000	13,056.000	15,406.080	24 months	Development of experimental web based expert system for planning the husbandry production

Legend: The following costs were the basis for this calculation: The cost of research month is 80.000 RSD net; 136.000 RSD total (without VAT). The equipment eventually needed for realizing the project has **not** been taken into account.

5. CONCLUDING REMARKS

The Methodology described in this paper provides theoretical as well as empirical instruments necessary for creation of ICT development strategy and action plan for implementation of such strategy in APV. Having in mind that this was first, although partial use of foresight methodology in Serbia, achieved results are promising both for the development goals of APV and for future, eventually much broader use of foresight methodology in APV and in Serbia as well.

Concluding remarks will be, nevertheless, addressed to a role of ICT for development of APV:

1. ICT technologies in APV, due to a lack of enough quality human resources, do not represent a significant export chance in themselves. Instead, the ICT technologies should be assumed as generic, i.e. those that enable other preferential areas of technological development a full success. Primarily, this is true for support to social and medical needs of people, agriculture, process industry and building the infrastructure for its implementation;
2. Realization in phases, re-evaluation of priorities in the process of monitoring the result of pilot projects, and linking with other sectors of technological development, together with a constant monitoring of the rate of realization of

selected projects at the Council for technological development of APV, is the fundamental method to be used;

3. Human resources are critical for the ICT sector. Thus, investment into education including lifelong education in the ICT sector is a priority that is to be persistently pursued in coordination with other secretariats, before all the Secretariat of Education of APV. The growing number of ICT based companies and the need for ICT based services, as well as arrival of foreign investors (such as the plan of Indian investors to build a Technology Park in Inđija) put the investment in development of human resources into the first line of priority. Table 12 summarizes the program which will help this intention to be realized.

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