

ICT IN DEVELOPING COUNTRIES: CONDITION AND IMPROVEMENT BY QMS - SERBIAN CASE STUDY

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Abstract. *This paper evaluates the level of Information and Communication Technology (ICT) in the Serbian metal processing sector. This research uses data from the entire metal processing sector in Serbia (Sample: 20 large companies, 27 medium companies, and 247 small companies, overall with 33,057 workers). Data from the Serbian metal processing sector were compared to the relevant data from EU. In this paper, we present problems and steps for improvement of ICT in the Serbian metal processing industry. We will also present development of quality infrastructure necessary for support and improvement of Serbian ICT industry and improvement of ITC sectors in Serbian metal processing industry.*

Keywords. *ICT in Serbia, metal processing industry, QMS.*

1. INTRODUCTION

The effect of Information and Communication Technology on companies and successful businesses has been marked as very important by many different studies in the past. Companies in underdeveloped countries cannot isolate themselves from changes occurring due to development of ICT in developed countries. Serbia is an underdeveloped country but, nevertheless, it has experienced many unique problems during the past decade. The first problem has been the economic transition very much alike to the processes that successfully finished in most countries of Eastern Europe. But, unlike these countries, Serbian economy and manufacturing experienced economic blockade imposed by the United Nation during the 90's that devastated the Serbian economy. During the last few years, Serbia has changed its economic model and started to improve its ICT sector. One of the major tasks has been an evaluation of the ICT level in different sectors. The first attempts were made by the Serbian ICT Society, in November 2003 [2]. This research mainly analyzes conditions of the ICT sector as a base for ICT development in the Serbian industry. Since many studies show positive and significant impacts from ICT investments at the country level, the Serbian government, in 2001, listed ICT development as the national priority in the long-term plan of development of the Serbian Economy. Successful experiences of less developed countries that invested in their ICT industry, such as India (InformationWeek, June 2004) and Costa-Rica, are a great example. One priority is defined

as development of ICT in different industry branches. The first step is evaluation of current condition of the ICT sector, second step definition of existing problems, and third step is a list of actions for ICT improvement.

This paper evaluates the level of ICT in the Serbian metal processing industry and gives a list of problems and a list of possible actions that could improve this industry. In this paper, we will present current level of the Serbian ICT industry, global parameters of ICT in Serbia, information systems in Serbian metal processing industry, some economic indicators. Then, we define existing problems and suggest actions necessary for improvement of IT in the Serbian industry. One approach to improvement of Serbian ITC industry is adopting a general framework policy for the integration of the acquires in the field of standards and technical regulations. Developing an updated national Quality Plan for the ICT and other industries. This paper will also present development and implementation of QMS in Serbian ICT sector.

2. SERBIAN ICT INDUSTRY

The leading factor in reengineering and improvement of information systems in the Serbian industry is its domestic ICT sector.

Serbian information and communications industry consists of:

- Over 1000 companies – predominantly small and medium privately-held companies,
- Strong information departments in large business entities with dominant development orientation,
- Universities and institutes with dominant focus on education in the field of ICT and implementation and development of ICT.

ICT industry's share in the gross domestic product of Serbia is 0.55%, and its share of employment is 0.49%.

Advantages of the Serbian ICT industry are:

- Quality of human resources,
- Competitively low costs.

Business analysis of the ICT industry is presented in Tables 2.1-2.5

Tables 2.1 number of companies in computer and related activities and number of companies in production of computing machines as well as import and export figures. It is obvious that Serbia has much larger import than export. Table 2.2 presents structure of companies in ICT sector by number of workers. Generally most of the companies have less than 5 workers and only 6 more than 100 workers (it is clear that Serbian companies do not have human resources for managing of large scale projects). Tables 2.3 and 2.4 give detailed information about increase of import in period of 2000 and 2003. Table 2.5 present ICT macro indicators and sheer of ICT in national economy.

Table 2.1. Structure of ICT – December 31, 2003. [2]

	Total number of companies	Total number of active companies	Number of employed workers	Import I-XII 2003. \$	Export I-XII 2003 \$
Computer and related activities (nace:110072)	988	510	2883	7,459,911	1,269,185
Production of computing machines (nace:041230020)	470	369	2526	118,549,344	4,949,688
TOTAL	1458	879	5409		

Table 2.2. Structure of employees [2]

	Total number of employed	No. of workers <5	No. of workers 5-10	No. of workers 10-20	No. of workers 20-50	No. of workers 50-100	No. of workers >100
Computer and related activities (nace:110072)	2883	376	78	28	23	1	4
Production of computing machines (nace:041230020)	2526	228	83	38	13	5	2
TOTAL	5409	604	161	66	36	6	6

Many analyses show that the Serbian ICT industry has better results than other industrial branches. But there are number of problems in the Serbian ICT sector. The Serbian ICT sector mostly consists of small and medium size companies. These companies are mostly oriented toward smaller projects, or they attach their business activities to larger business partners from abroad (Europe, USA). Many highly qualified experts in the filed of information technology have left their companies and university centers and moved to the Western Europe and USA. That migration of highly qualified experts started in the first part of the 90's and culminated in 1999. Unfortunately, Serbian economy is suffering as this migration is still happening. Some analysis show a lack of experts, in Serbia whom are needed for information system development implementation, and reengineering.

Table 2.3. ICT - trends 2001 - 2002 [2]

	Computer and related activities (nace:110072)				Production of computing machines (nace:041230020)			
	No. of companies	No. Of employees	Import \$	Export \$	No. of companies	No. Of employees	Import \$	Export \$
2001	268	1512	1,840,310	388,817	508	4417	38,754,354	5,983,050
2002	330	2031	3,772,229	586,166	287	1895	65,594,601	4,118,170
2003	510	2883	7,459,911	1,269,185	369	2526	118,549,344	4,949,688

Table 2.4. Import/export [2]

	Computer Equipment (car.tar. 8471)		TOTAL	SERBIA
	Import	Export	Import	Export
2000	50.451.821	2,805,921	3,356,294,222	1,561,366,100
2001	74.798.055	426,003	4,307,417,184	1,725,204,322
2002	135,785,186	2,920,715	5,637,968,429	2,080,709,855

Table.2.5. ICT- macro indicators [2]

	Total income (millions \$)	Share in gross domestic product	Total number of employees	% of total number of employees in Serbia
Information technologies	\$54	0.55%	15,000	0.98%
Telecommunication industry	\$40	0.41%	3,900	0.29%
Telecommunication traffic	\$306	3%	13,500	0.9%

There some other parameter characteristic of the Serbian ICT companies:

- Different levels of production capacities,
- Young inexperienced development teams,
- There are enough resources only for few platforms (Microsoft) because Serbian ICT companies are mostly small firms. This fact dictates that those companies should have very narrow specialization, or that they have to cooperate among themselves.
- Telecommunication infrastructure is not very well developed
- Perspectives:
- Increasing export of software and services.
- Development of infrastructure for modern economy.

3. GENERAL PARAMETERS OF ICT IN SERBIA

It is very important that ICT become basic infrastructure for many companies in Serbia and Montenegro. In companies where ICT supports business processes, design, and decision support, we notice increase of productivity and other positive economic indicators. General estimations are: [3]:

- 1.350.000 computer users and more than 600.000 computers
 - 400.000 business computers
 - 200.000 home computers
- 500.000 Internet users:
 - 5.000 web sites
 - 200 web stores

Table 3.1. Minimal possible sale of Internet services (in US\$)

market	Sales in 2002.		Sales in 2005.	
	Millions of US\$	%	Millions of US\$	%
Serbian	8.0	66.7	25.0	75.8
Other republics of Former SFRJ (Slovenia, Croatia, Bosnia and Herzegovina, Macedonia)	1.0	8.3	2.0	6.1
Other Eastern European countries	3.0	25.0	6.0	18.1
TOTAL	12.0	100.0	33.0	100.0

Serbia has a population of 10,655,774 people, where 67.7 computers come on each 1,000 individuals and where 50 Internet connections come on each 1,000 individuals. Different research projects have [1] come to the same conclusion that the Internet service market of will be in expansion for a long time in Serbia and Southeastern Europe. Possibilities for sale of Internet services for the Serbian ICT industry is presented in table 3.1.

4. ANALYSIS OF IT IN METAL-PROCESSING INDUSTRY

There are 20 large, 26 medium size, and 247 small companies in the metal processing sector of Serbia. These companies employ 33,057 workers. These companies were included in research. The main goals of research were:

- Determination of general indicators of ICT in Serbian metal processing industry,
- Definition of level of integration and level of sophisticated solutions implementation
- Level of integration,
- Process implementation,
- Supported functions in Serbian companies,
- Security issues.

In Serbia, the majority of workers are employed by large companies. In Western Europe, majority of workers are employed by small and medium size companies. (Table 4.1)

Table 4.1. Structure of employees

Country	Number of employed persons	Total structure in %		
		1-49	50-249	250+
Serbia and Montenegro	33 057	5.4%	11.1%	83.4 %
Researches of authors 2004.				
Country	Number of employed persons	Total structure in %		
		1-49	50-249	250+
Belgium	64 921	55.9	26.3	17.8
Finland	35 578	47.1	28.1	14.8
European Union*	2 197 405	57.0	25.0	17.9
* Without Greece, Luxemburg, Netherlands and Great Britain.				
[Source: Eurostat New Cronos]				

The metal processing industry in Serbia has been compared with Finland, because both countries have similar number of workers in their respective metal processing industries, and to Belgium, because both countries have similar size populations. This comparison shows the performances of gap between Serbia and developed European countries.

Research has been performed on 280 companies which have filled requested form.

General parameters of ICT in the Serbian metal processing industry are presented in table 4.2 and 4.3.

Most of the companies use basic ICT infrastructure, but they do not have wireless or remote accesses to their networks.

Companies in this sector do not have developed solutions for Supply Chain management or Knowledge Management. Elements of Enterprise Resource Planning exist in 3 companies, and elements of the Customers Relation Management concept is implemented in 1 company (table 4.4).

Serbian companies exchange some electronic documents, but that process is not structured nor standardized, so most of these documents have "free form." Those documents do not have value in the process of system integration (table 4.5).

There is not exchange of documents using the EDI technology EDIFACT standard, or the STEP standard, or interchange of documentation in the XML format. Standardized documents as output from one company's information system could be used as input in other company's information system. E-mail messages are dominant way of exchanging messages.

Table 4.2. General indicators of ICT usage in metal processing industry in SCG comparing EU countries

		<i>Serbia</i>	<i>Germany</i>	<i>France</i>	<i>Finland</i>	<i>Greece</i>	<i>Italy</i>	<i>Luxemburg</i>	<i>Great Brittany</i>	<i>Average for EU</i>
1	Use of computers	100	99	100	96	90	100	100	94	98
2	Internet access	85	93	96	80	86	92	96	84	91
3	e-mail	63	91	90	76	84	91	96	82	89
4	WWW	63	88	84	76	64	82	94	80	84
5	Intranet	7	43	38	31	46	44	46	33	41
6	Extranet	3	13	14	19	8	6	68	4	10
7	LAN	50	68	69	51	65	51	83	59	62
8	WAN	0	23	19	27	25	9	67	13	17
9	Remote access	0	41	15	44	15	20	39	35	29
10	Wireless access	0	17	1	27	5	7	31	7	10

Table 4.3. General indicators of ICT usage in the metal processing industry in SCG by size of companies

		<i>Small companies Serbia</i>	<i>Medium size companies Serbia</i>	<i>Large companies Serbia</i>
1	Use of computers	72	100	100
2	Internet access	46	88	100
3	e-mail	41	88	100
4	WWW	39	88	100
5	Intranet	0	7	25
6	Extranet	0	3	10
7	LAN	5	50	80
8	WAN	0	0	0
9	Remote access	0	0	0
10	Wireless access	0	0	0

* values are given in %

Table 4.4. Metal processing sector: Level of integration and level of sophisticated e-business solutions

		<i>SCG</i>	<i>European average</i>
1	SCM (Supply Chain Management)	0	5
2	CRM (Customer Relation Management)	1	6
3	Knowledge Management	0	3
5	ERP (Enterprise resource Planning)	2	25

Serbian companies in the metal processing industry do not have ICT support for collaborative design e.g. collaborative engineering. Calculations and predictions, as well as planning, are not supported by information systems. Some of companies still have elements of on-line management of stocks and warehouses (table 4.6).

Serbian companies in the metal processing sector do not use Internet as e-commerce channel. They do not buy or sell products using B2B solutions (table 4.7).

Table 4.5. Level of Integration and usage of EDI technology

Indicator	Number of companies	%
Company size:		
>250 workers	20	6.8
50-250	26	8.8
<50	247	84.4
Internet application		
Inner integration		
Not exist	264	90
Low	24	8.1
High	5	1.9
Extern integration		
Not exist	259	88.2
Low	25	8.8
High	9	3
EDI application		
YES	1	1
NO	292	99
EDI implementation		
EDI VAN	0	0
XML (Internet)	1	1
Both solutions	0	0

Serbian companies do not pay much attention to security. Generally they do not use encryption. Mostly they use anti-virus and fire wall software (95% and 43% retrospectively).

Large companies have significant resources but their ICT centers have smaller number of employees compared to companies coming from developed countries. Medium size companies sometimes do not even have ICT sectors.

Table 4.6. Metal processing sector: Process implementation

	Processes	Number of employees		
		<50	50-249	250+
1	Online collaboration (product design)	3	8	20
2	Online collaboration (prediction for needs for products)	0	0	1
3	Online management of stocks/warehouses	3	8	19
4	Electronic exchange of documentation with suppliers	6	20	54
5	Electronic documentation interchange with customers	0	50	54
6	Online negotiation	0	0	0

Table 4.7. – Supported functions in Serbian companies

	Supported functions	%
a)	Marketing web site with presentation of products and services	23.1
b)	Receiving customers invoices over Internet	7.6
c)	Payments by credit-carts over Internet	0
d)	Full service to customers over Internet	3.1
e)	Sending of orders to suppliers over Internet	13.5
f)	Payment to suppliers over Internet	5.2

Generally, all companies in the Serbian metal processing industry do not employ sophisticated IT solutions. Furthermore, their support for complex business processes is poor and their integration is very underdeveloped. A partial advantage of the industry is its young, although inexperienced workforce.

5. ECONOMIC INDICATORS

Some economic indicators can describe position of the Serbian software development industry. This industry should play important role in development of ICT solutions for the Serbian industrial sector.

One important economic parameter is GDP (Gross Domestic Product per employee per hour -Table 5.1.) It shows (as well as data in Table 5.2) that GDP in Serbia is very low compared to the ones from the EU and other countries. This is the main reason for migration of experts.

The migration of experts in the field of ICT is a huge problem for Serbia and Montenegro. Serbia and Montenegro is located in Southeastern Europe. proved their knowledge for long time. Middle age experts mostly migrated to developed countries.

Table 5.1. GDP per employee per working hour

no	Country	GDP /h (\$)	no	Country	GDP /h (\$)
1	Luxemburg	\$48.09	36	Venezuela	\$5.18
2	Norway	\$39.12	37	Czech	\$5.04
3	Belgium	\$37.77	38	Poland	\$4.94
4	France	\$36.06	39	Turkey	\$4.21
5	Switzerland	\$35.27	40	Russia	\$3.78
6	Japan	\$35.20	41	Columbia	\$2.57
7	Germany	\$35.15	42	Thailand	\$2.54
8	Denmark	\$34.66	43	Filipinas	\$1.33
9	USA	\$32.27	44	Indonesia	\$1.25
10	Austria	\$32.09	45	China	\$0.64
				Serbia and Montenegro	\$2.97

Table 5.2. Wages of employees in software development and software maintenance Plate

No	Country	Development (\$)	Maintenance (\$)
1	Switzerland	48,869	48,869
2	USA	46,550	43,495
3	Germany	42,058	34,848
4	England	38,785	38,179
5	France	36,750	41,250
6	Canada	35,156	33,846
7	Australia	34,940	30,644
8	Netherlands	33,994	47,069
9	Austria	33,000	33,000
10	Brazil	20,032	20,032
11	Italy	17,655	17,655
12	Columbia	16,000	16,000
13	Estonia	12,000	8,000
14	Mexico	10,843	13,292
15	Serbia	6,500	7,000
15	India	3,638	4,316

The European Union borders the Serbian' North. So large numbers of experts use short distance and large demand for educated ICT experts and migrate to the EU. Large number of institutes, universities, developed centers, and IT sectors have lost their development and research teams. So companies in Serbia do not have significant human resources to start with information system reengineering or development of their own solutions. Those companies do not have financial resources to buy standardized solutions. Another characteristic is that development teams are compound of young people without experience

This is the reason why number of errors in software development process, in Serbia, is relatively high. Therefore, a price of a line of code is relatively high compared to wages and other economic parameters.

Table 5.3. Number of errors on 1000 lines of code

no	Countries	Number. of errors	no	Countries	Number. of errors
1	USA	1.6	8	Switzerland	2.5
2	Japan	1.8	9	India	2.6
3	England	2.1	10	Greece	2.8
4	Germany	2.2	11	Norway	3.6
5	Israel	2.3	12	Ireland	3.7
6	Italy	2.5	13	Canada	3.9
7	France	2.5		Serbia	4.6

Other reason is absence of developed and implemented quality system. Even the larges companies do not have quality systems. Some of them even do not have inner procedures or conventions.

Table 5.4. Price per line of code - (LOC - Line of Code) documented and delivered

no	Country	Price of supported LOC (\$)	Price of documented and delivered LOC (\$)
1	Switzerland	1.6	27
2	Germany	1.3	22
3	Japan	1.2	21
4	Denmark	1.1	19
5	USA	1.1	18
6	France	0.8	13
7	England	0.7	11
8	Israel	0.6	11
9	Italy	0.6	10
10	Canada	0.6	10
11	Ireland	0.6	10
12	Greece	0.4	6
13	Serbia	0.4	5
14	India	0.3	5

These problems are multiplicities in the phase of software testing and documenting. It is important to mention that, generally speaking, small number of companies in the Serbian industry use standard *JUS ISO/IEC 12207* from 1997, which supports the software life cycle.

6. STRENGTHENING QUALITY MANAGEMENT, CAPABILITIES AND INFRASTRUCTURES IN SCG TO SUPPORT ICT INDUSTRY AND ICT SECTORS

Since the gap between Serbian ICT industry and ICT industry in Europe is wide, as well as gap between ICT sectors in Serbian metal processing industry and same industry in Europe, on possible approach for improvement of ICT sector was development of quality infrastructure to support ICT.

Of course many other approaches could be employed to improve ICT industry in Serbia, such as: education in order to overcome skilled manpower shortage or improvement of infrastructure. But this paper discusses an improvement by strengthening of quality management.

European Agency for Reconstruction and AFNOR started project “Strengthening Quality Management, Capabilities and Infrastructures in SCG”, project beneficiary is Union of Serbia and Montenegro (SCG). The project covered Serbia and Montenegro and Bulgaria as well. Quality policy was implemented in Serbian ICT industry, tourism in Montenegro and textile industry in Bulgaria.

Table 6.1. Strategy – goals matrix

Goals	Strategy											
	Improvement of marketing activities	Improvement of sale conditions	Continuous improvement of quality	Orientation to better post-sale activities	Management of expenses	Improvement of education processes	Purchase of modern hw/sw	Improvement of planning process	Improvement of measurement process and monitoring	Improvement of resources management	Implementation of modern methods	Improvement of conditions of work (salaries, carriers)
Increase number of customers	*	*	*	*								
Increase of sale	*	*	*	*							*	
Increase of quality	*	*	*	*	*		*	*	*	*	*	*
Increase of technological level						*	*			*	*	*
Definition of terms							*	*	*	*		
Improvement of processes			*		*		*			*	*	
Pincrease of motivation level							*					*
Increase of level of knowledge			*			*	*			*	*	*

The overall objectives of this project are as follows:

- Assisting the government in adopting a general framework policy for the integration of the acquits in the field of standards and technical regulations. Developing an updated national Quality Plan for the ICT industry (for Serbia).

- Strengthening the Federal Office for Standardization (SZS), in order to support the integration of European and International standards into national standards collection and to increase their diffusion in the industry.
- Establishing the conditions for future international recognition of tests and calibration results, as well as certificates by restructuring the National Accreditation Body (JUAT).
- Implementing a strong and recognized national metrology institute, and establishing the conditions for international recognition of the calibration and measurement certificates.
- Developing selected certification bodies with the capacity of establishing the Notified Bodies necessary for the implementation of the NA Directives. Developing selected testing and calibration laboratories to improve confidence in test reports and to ensure the traceability of measurements conducted in SCG.

6.1 CASE STUDY: DEVELOPMENT AND IMPLEMENTATION OF QMS

One of the most important element of mentioned project, is definition and implementation of politics and action plan of quality in companies that represent different branches (ICT n Serbia, tourism in Montenegro and textile industry in Bulgaria.

The main goal of these plans are:

- Useful results for companies, which will improve quality of products, processes and services.
- Development of Quality Policy for ICT sector.
- Contribution to improvement extern and inner characteristics of all interest parties (ICT sectors in metal processing industry).

The strategy – goals matrix for implementation of QMS in ICT company is presented on table 6.1.

The ultimate, indirect beneficiaries of the project will be the industry and consumers of the Union of Serbia and Montenegro, who will benefit from modernized quality infrastructures able to support the competitiveness of the industry and to ensure compliance of products with essential requirements. Improvement of quality and implementation of quality management systems in ICT industry and ICT sectors in other industries should improve condition of IT in Serbian companies. This project is still in the progress in the phase of Development of Quality Policy for ICT sector.

The selected company from ICT sector from Serbia and Montenegro was Digit – Belgrade. DIGIT company from Belgrade is recognizable on SCG service market of IT (Information Technology) by usage of modern technology (brand name) and build in this technology in integrated products (ERP solutions, networks, services and training). Company is working as stock company of 14 years and now it is in mature phase.

Domestic market has following characteristics: ino - competition with higher quality of products and services; increase sale of product substitutes from Far East; changing in demands and habits of customers; leading experts are leaving domestic companies.

Those are the reasons why we need system approach to develop effective and efficiency development policy in order to achieve our strategic goals and become leader in our filed.

1. Project phases

No	Name	time (month)												Responsible
		1	2	3	4	5	6	7	8	9	10	11	12	
1.	Analysis of present condition													KONS.
2.	Training for QMS													KONS.
3.	Development of QMS documentation													PRK
4.	Implementation of QMS documentation													PRK
5.	Inner audit													KONS.
6.	Certification													KONS.
7.	Maintenance and improvement of QMS													PRK

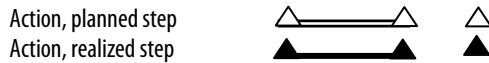
Legend: PRK – Manager responsible for quality, KONS. – Consultants

2. Selected methods :

- Monitoring of current stage
- Development of QMS documentation
- Implementation of QMS documentation
- Inner audits
- Certification
- Maintaining and improvement of QMS

3. Action plan

ACTIONS AND STEPS	2005												2006	
	apr.	maj	jun	jul.	avg.	sept.	okt.	nov.	dec.	1T	2T			
Monitoring of current stage														
Development of QMS documentation														
Implementation of QMS documentation														
Inner audits														
Certification														
Maintaining and improvement of QMS														



4. Results and evaluation approach:

Project results:

1. improvement of process quality – 5%/year.,
2. improvement of quality of service – 5%/ year.,
3. certification for having better starting position in public tenders and marketing promotion.

Number of errors per SLOC is decreased for 27%.

Evaluation approaches:

- method of expert evaluation,
- compare planned/ realized

7. OTHER PROBLEMS AND FURTHER DEVELOPMENT

According to the analysis comparing information systems and their application, Serbia is way behind developed countries of the European Union. Serbia is even behind neighboring countries.

Low level of investment, low number of employees in domestic ICT sector, weakness of ICT sector are characteristics of the Serbian ICT industry.

According to the analysis following problems appear:

a) Economic and legal issues:

- Unfair competition of foreign companies,
- Unfair competition in public purchases (and absence of mechanisms for confirmation of tenders),
- Owner transformations in the industry,
- Software legalizations,
- Absence of a law for electronic signatures, and other regulations and accompanied papers,
- Lack of financial resources,
- Necessary support of the government in development of:
 - ♦ ICT, special software industry; this industry is export oriented and should be declared as one of the priorities of the political economy;
 - ♦ Develop and implement concept of scientific - technical parks (good examples are India, Ireland, Israel)

b) Problems in ICT sector:

- Absence of stimulation in fiscal politics for intensive development of ICT,
- Inappropriate loan politics of banks for ICT projects,
- Absence of necessary support
- for Serbian ICT industry in promotion on the foreign market,

c) Human resources:

- Migration of educated experts, caused by the current economics (table 2.4.1)
- Inadequate age structure of employees caused by migration of young experts,
- Absence of qualified teachers in the education process; inappropriate curriculums and un-harmonization of curriculums with the Bologna declaration
- Inappropriate stimulation in politics of employment of young experts,
- Small number of experts employed in IT centers in different companies (in Serbian companies IT sectors have 2-3 times smaller number of employees, compared to the similar industries and companies in the European Union)

d) Problems attached to infrastructure:

Inadequate telecommunication infrastructure (Serbia has high-cost and low quality telecommunication services),

- Low level of quality systems (very few companies in the ICT sector have developed and implemented quality systems. Research was performed on larges Serbian ICT companies Digit, Spinnaker ComTrade, SAGA, Informatika AD...). This problem was elaborated and partially solved in project described above.
- Development of infrastructure IS have to have priority,

e) Hardware problems:

- Usage of low configuration working station,
- Usage of low configuration servers,
- Usage of low configuration network components.

f) Software problems:

- Lack of integrated software solutions (Large number of companies have “information islands” instead of integrated solutions. According to the presented results of 247 companies in the field of metal processing industry, a large number of dominantly small and medium size companies

has information support only for a few segments of their business processes. This fact leads to redundant data, etc..)

- Large number of companies have their information systems developed based on prior legacy platforms, DB solutions and development tools,
- Usage of their own solutions – usually this solutions are not quality ones,
- Lack of financial and human resources for implementation of complex, integrated IS (made by domestic or foreign companies)
- Very low percent of presence of complex solutions (ERP, SCM, CRM and EDI.). There are no companies (in the metal processing industry), regardless of their size in Serbia, which implement all of these concepts.
- Lack of developed methods, methodologies, and approaches for reengineering of information systems in the Serbian industry, respecting specific situation of the Serbian metal processing industry.

g) Problems in education of e-business:

- Lack of education of IT managers,
- Lack of expert preparation for implementation of digital signature,
- There is a low level of implementation of different standards for data exchange (XML) and standard software development tools,
- Low level of quality web hosting for e-sores and support of e-business.

List of actions:

- Implementation of politics and actions for stimulation of ICT development,
- Support for development and design of few ICT products,
- Support for domestic software development industry,
- Development of Quality Policy for ICT sector.,
- Improvement of education on all levels,
- Government should make tax stimulations for employment of young experts in the field of ICT, reduction of taxes on projects oriented on development and implementation off ICT.
- Support for development of e-business environment,
- Development of telecommunication infrastructure,
- Development of methodologies, methods, approaches and patterns for information system reengineering.

According to the analysis comparing information systems and their application, Serbia is way behind developed countries of the European Union, developed countries of Far East and USA. Serbia is even behind neighboring countries.

The main reason for this situation is specific economic situation and insufficient financial resources for ITC sector, and small and underdeveloped ITC sector. So it is clear that improvement of ITC in Serbian metal processing industry could be achieved by reengineering of information systems in companies and implementation of quality management system in ITC sector. According to the analysis following problems appear in: economic and legal issues, human resources, problems attached to infrastructure, hardware problems, software problem, and problems in education of e-business.

On the other hand we can define list of actions: implementation of politics and actions for stimulation of ICT development; Support for development and design of few ICT products, support for domestic software development industry; development of Quality Policy for ICT sector; improvement of education on all levels; government should make tax stimulations for employment of young experts in the field of ICT, reduction of taxes on projects oriented on development and implementation off ICT; support for development of e-business environment; development of telecommunication infrastructure; development of methodologies, methods, approaches and patterns for information system reengineering.

The ultimate, indirect beneficiaries of improvement and development of Quality Policy in ITC sector will be the industry and consumers of the Union of Serbia and Montenegro, who will benefit from modernized quality infrastructures able to support the competitiveness of the industry and to ensure compliance of products with essential requirements. Improvement of quality and implementation of quality management systems in ICT industry and ICT sectors in other industries should improve condition of IT in Serbian companies. Case study result in one of the largest ITC companies shown significant results improvement of process quality – 5%/ year; improvement of quality of service – 5%/ year; certification for having better starting position in public tenders and marketing promotion; number of errors per SLOC is decreased for 27%.

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