Key Enabling Technologies for Increased Competitiveness of the Serbian ICT Industry

Study

Belgrade, August 2013

Published by:

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Program for Private Sector Development in Serbia ACCESS

In cooperation with

ICT Network, Nis Cluster of Advances Technologies, Vojvodina ICT Cluster and South-East Europe Information and Communication Technologies

Belgrade, August 2013

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Abbreviations and Acronyms

ACCESS	Assistance to the Competitiveness and Compatibility for the EU of Serbian SME
BMO	Business Membership Organization
BSO	Business Support Organization
CIP	Competitiveness and Innovation Framework Programme 2007-13
COST	European Cooperation in Science and Technology
CTC	Collaborative Training Centre
EC	European Commission
EEN	Enterprise Europe Network (Serbia)
EIF	European Investment Fund
EIP	Entrepreneurship and Innovation Programme
EIT	European Institute of Innovation and Technology
EU	European Union
FP7	7th EU Framework Programme for Research 2007-13
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
FIC	Foreign Investors Council
ICT	Information and Communication Technologies
ICT Net	ICT Network Cluster
ICT-PSP	ICT Policy Support Programme
IPA	Instrument for Pre-Accession Assistance
IMP	Institute Mihailo Pupin
KET	Key Enabling Technologies
KETP	Key Enabling Technologies and Processes
MoFE	Ministry of Finance and Economy
MoES	Ministry of Education and Science
NARD	National Agency for Regional Development
NiCAT	Nis Cluster of Advanced Technologies
PK	Provincial or Regional Chamber of Commerce
PKS	Serbian Chamber of Commerce
R&D	Research & Development (organization)
RDA	Regional Development Agency
RTDI	Research, Technological Development and Innovation
SaaS	Software as a Service
SEE ICT	South-East Europe Information and Communication Technologies
SIEPA	Serbia Investment and Export Promotion Agency
SME	Small and Medium-sized Enterprises
SRC	Shared Resource Centre
VOICT	Vojvodina ICT Cluster
WBC	Western Balkan Countries

Preface

In order to create an internationally competitive ICT industry, Serbia has to develop shared resource centres which can facilitate access of ICT companies to key enabling technologies and services. Further growth of the ICT industry is directly related to the capacity of business support organisations to provide to ICT companies access to key enabling technologies and processes. Business support organisations should help Serbian ICT companies to innovate through facilitating technology transfer from science and research sectors.

The most critical aspect of building the competitiveness of Serbian ICT companies and to change the business model from outsourcing to the development of own new products is to facilitate access to the latest technologies through the technology transfer mechanisms. The main focus of assistance to ICT companies should be on enhancing their internal processes from developing of new products to their commercialisation.

The experience of business support organizations all around the world shows the great benefit that shared resource centres can bring to companies in the ICT industry. For example, the government system of ICT companies support in South Korea has confirmed at which point the model of shared resources enables companies to develop world class products. The RFID technology (Radio frequency identification) and multiple types of new products developed using it, popular applications for Samsung smart phones, IT embedded systems for public transport which are exported all around the world – all of these new products have been created by Korean small and medium companies using tools, equipment and services of shared resource centres. A similar approach could be implemented in Serbia too allowing ICT companies to fully benefit from this model and create highly competitive products for the local and international markets.

The purpose of this study is to evaluate needs of Serbian ICT companies and propose solutions to facilitate the creation and commercialization of new products through shared resource facilities. The study analyze in-depth a sample of few companies from different sub-sectors of the ICT industry and makes approximation for the rest of Serbian IT sector.

It is not an extended survey based on statistical analysis of a representative sample of companies; it is rather an overview of the needs of Serbian ICT companies in terms of key enabling technologies and processes facilitating the development and commercialization of new products.

The methodology of the study is based on the analysis of findings of in-depth interviews with managers of 20 selected Serbian ICT companies, representatives of business support organizations, ministries, national agencies as well as consultations with GIZ ASSESS experts, Serbian international industry specialists and business development consultants.

In this study the term Key Enabling Technologies and Processes (KETPs) is taken in a large sense. It means not only equipment and software, but also encloses methodologies, external services, knowledge and information. The term Processes comprises procedures of new products development and organisation of internal business operations.

The critical success factor for designing of a shared resources centre is to assess needs of ICT companies and then to identify modern key enabling technologies which will allow these companies to radically enhance their new product development capacities. For this purpose, an in-depth assessment methodology through individual interviewing of companies has been prepared. Also, the input into the assessment of clusters managers, specialists of enterprise support organizations and government bodies brings another perspective of understanding of the level of companies' competitiveness in new products development. The detailed description of the methodology applied for the study is presented in the Appendix.

About the GIZ ACCESS Program

Working efficiently, effectively and in a spirit of partnership, we support people and societies in developing, transition and industrialised countries in shaping their own futures and improving living conditions. This is what the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) is all about.

Established on 1 January 2011, it brings together under one roof the long-standing expertise of the Deutscher Entwicklungsdienst (DED) gGmbH (German Development Service), the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH (German Technical Cooperation) and Inwent – Capacity Building International, Germany. As a federally owned enterprise, we support the German Government in achieving its objectives in the field of international cooperation for sustainable development. For further information on GIZ please visit www.giz.de.

ACCESS is a Program implemented by GIZ on behalf of the German Ministry for Economic Cooperation and Development (BMZ). It aims to promote the Serbian economic development and to facilitate the future membership of Serbia in the European Union (EU) by supporting the implementation of the Serbian "National Strategy for Development of Small and Medium Sized Enterprises and Entrepreneurship" as well as the "National Strategy for EU Accession".

ACCESS assists Serbian intermediaries in their support to SMEs in selected sectors to make better use of their production, employment and growth potentials and to explore new markets in South-eastern Europe as well as in the EU. The overall objective of the project is the improvement of the competitiveness of small and medium-sized enterprises and start-up companies in selected sectors and regions. Methodologically, the project is based on integrated support measures applied at several levels (companies, institutions, government, municipalities, and regions).

The ACCESS project works with a diversified implementation structure. Consequently, the elements of the projects are (i) support to local and regional economies, (ii) support to industries, including associations and clusters, and (iii) creation of a climate favourable to business and investment. The support components include advising government and institutions, companies and groups of companies, as well as training of local labour through both international and national experts, and providing local subsidies for seminars, trainings and promotional activities. For further information on GIZ/ACCESS please contact tobias.stolz@giz.de.

1. New Products Development and Services in Serbian ICT Industry

In 2011, there were around 1,700 Serbian IT companies with revenues higher than 1 million RSD. They employ in total more than 14,000 full time employees. The Serbian IT industry is concentrated in three cities - Belgrade, Novi Sad and Nis and more than half of all companies are concentrated in Belgrade.

The estimated market value of the Serbian IT sector in 2012 is 410 Million Euro. The biggest segment of IT sector, PC hardware, has declined in 2011. The application software segment had the growth rate between 5 to 10%. IT services segment had modest growth based on the expansion of the domestic user base and services related to the application software. Serbian IT market in 2011 was comprised of hardware for 61,6%, IT services for 25,7% and software for 12,6% (Matijevic and Solaja 2013).

Over the past few years, the development of IT services has increased mainly due to mobile internet technologies and applications, outsourcing and data management. The outsourced software engineering, offshore systems design and integration continues to grow. Due to reduction of profit margins in the outsourced software development and the increasing competition, there is a significant trend among Serbian outsourcing companies to try and make their own products that have high added value and export potential on foreign markets (SIEPA February 2012).

The export of IT services and software grow each year. Export of IT services and software reached $ 200 million in 2011. Serbia exported software for EUR 70 million in 2010. In 2011, the export of computers, electronic and optical products was EUR 143.2 million with increase by 2.3% from the previous year (Statistical Office of the Republic of Serbia).

About 460 ICT companies totalling more than 5.300 employees were engaged in 2011 in export activities. (Source: Chamber of Commerce and Industry of Serbia).

Export of Serbian companies is mainly consists of outsourced software development, testing of software, designing websites and providing solutions in embedded industry. The main markets for outsourced industry are Germany, USA, Great Britain and Netherlands (SIEPA February 2012).

The Serbian ICT industry is mainly comprised of the telecommunication and IT sectors. The IT hardware, software and IT services are tree main sub-sectors in the IT sector. The study analyzes the

needs of IT sector based on in-depth assessment of a sample of 20 companies from all three main sub-sectors.

Due to the small size of the sample of the analyzed companies and for the purpose of more precise analysis of their needs, the study does not employ the standard NACE sectors classification[1]. The preliminary evaluation of the potential of the Serbian IT sector has identified six smaller sub sectors with higher potential to grow then the average sector level. These sub-sectors have also showed the higher potential for export development. These sub-sectors are:

- Web design and web applications development
- Stand alone and client-server (except Web) software development
- Embedded software development
- Electronics / automation products
- Mobile & wireless applications development
- Telecommunication networks

The basis for the selection of these sub-sectors has served the results of the European ICT market evaluation, the IT industry opportunities (Matijevic and Solaja 2013), the results of the surveys and studies provided by SIEPA (SIEPA 2012), (SIEPA 2013) and the reports prepared in the framework of the EU ICIP project (EU Improved SME Competitiveness and Innovation Project 2010-2012).

1.1. Development Technologies and Processes

New product development technologies used by Serbian ICT companies vary depending on the sub-sectors and particular specialization of each company. Companies in the same sub-sector usually apply same or similar new products development technologies. Size of companies defines if they use same technologies and tools during different stages of product development. Small companies have tendency to use same tools for product conception, design engineering, prototype development and product development. This is specifically confirmed for software development companies.

Access to specialized software used for new products development is not considered by the interviewed companies as a major obstacle to their competitiveness. Most of them use Open Source or entry level professional software at reasonable cost. Several companies use non-licensed software. In some cases of recently graduated students, companies employing them are able to benefit from group licenses received by students from universities' laboratories.

[1] OECD ICT sectors classification, 2007

The study issued by SIEPA summarises the ICT-related services and main capabilities of Serbian IT companies (SIEPA, February 2012).

Software and Systems Development

Serbian ICT companies have acquired word-class expertise in the main modern programming languages and frameworks used for development of software and information systems. The companies are skilled to use different database management software available on the market and are capable of developing customized systems of any complexity. Telecommunications, banking and process manufacturing sectors were the top purchasers of software products, together comprising nearly 53% of the market share. According to estimations, the government, finance and telecommunications sectors will remain the most important source of demand for software applications on the Serbian market in the medium term (SIEPA February 2012).

Smart Hotel Control by EuroICC

The smart hotel management system provides functionalities such as access control, power saving, staff monitoring and effective processing of different alarms. This innovative system is composed of network equipment, access control terminals and different sensors. Mobile phone application enables hotel's guests to access room controls through their phones. By scanning the unique QR code for their rooms, guests access the controls for lighting, air-condition and signalling. They are also notified of flood, unauthorised penetration into their room, maid presence or calls made to their rooms.

This solution brings high level of comfort for guests enabling them easily communicate with hotel staff and to create a room environment according to their own needs.

Companies which are active in software development for Linux platform uses JBoss application server to des11ign their products. These are, in particular, companies from web design and web applications as well as standalone and client-server software and mobile and wireless applications development.

Few companies develop IT systems using Oracle software for relational databases management, application servers and Oracle SOA (service oriented architecture) lines of products. As licensees for Oracle products are expensive, this development is conducted in general by companies who are official Oracle partners for training and/or technical services. There are about 30 Serbian Oracle partner companies.

Several software development frameworks are used by ICT companies. The most popular are Hibernate library, Spring application framework, Eclipse software development environment. For relational databases development, the commonly used development frameworks are JDeveloper, DB Modeler and Visual Studio.

A large variety of programming languages and technologies is used by companies for new software and IT systems development. For standalone applications, commonly used technologies are C, C++, Python. For development of web applications and client-server systems, companies use PHP, .Net, HTML5, JavaScript, Ajax, XML, Java Enterprise Edition and Ruby.

Serbian companies develop software and applications for all major operating systems such as Windows, Linux, iOS and Android. Few companies develop mobile applications for Symbian and Blackberry.

Several companies use different Customer Relationship Management software. Among them the most popular is Open Source SugarCRM.

In terms of software for management the process of IT systems development, several companies prefer ActiveCollab (Serbian SaaS product from Novi Sad), others have selected RedMind or custom developed software.

In several cases, foreign clients provide licensees of software development frameworks to Serbian companies.

Still few software development small and medium companies use automated testing procedures in order to assure good quality of their software products. Among companies using the automated testing, the most popular software is Sonar.

Hardware and Embedded Systems

Most of companies in the electronics & automation product development sub-sector generally purchase used equipment. It is easy today to procure second hand machines for electronic components assembling. This model has the advantage of quick return on investment and the lower maintenance cost.

The equipment used by Serbian companies has, in average, the same level of productivity as the equipment used by their competitors. Higher level of automation and manufacturing is less important than the quality and innovativeness of products. As most of Serbian companies produce customized products in small series, several companies are limited by the amount of requested investments, required for purchasing of the automated equipment. This is particularly concerns selective soldering machines, printed circuit boards and moulding equipment.

Eurogam 8 Mini by EUROgenyx

The device allows performing of monitoring and control of remote devices via SMS messages. Special care in the design and development made the device very robust and stable in operation, so no matter where user installs the device, the only need to work with it is sending text messages. Eurogam 8 Mini is a universal module for remote monitoring and control via GSM network.

Companies making their own design of boxes, packaging and containers for electronic equipment uses different types of industrial design software such as Rhinoceros (most affordable), Solid Works, ProEngineer. As licensees for this type of software are quite expensive for individual use, the majority of companies use entry-level software. Most advanced medium-sized companies also use Rhinoceros 3D, PTC Creo and Siemens PLM Software NX.

For modelling of physical processes, electrical signals processing simulation and mathematical modelling of algorithms several companies use MathLab and Wolfram Mathematica software packages.

For idea generation and conceptual design some companies use MindMap and Microsoft Visio software tools.

1.2. Competitiveness of New Product Development Technologies Used by Serbian Companies

In this study the concept of new products development technologies includes all the necessary apparatus which are required to create a product. It means first equipment and software, but also encloses business processes, methods, services, knowledge and information.

FinAssistant by Intens

FinAssistant is a web application for on-line evaluation of business ideas and Business Plan creation. It is intended for companies and entrepreneurs, providing them with the data they need to effectively start their businesses. FinAssistant leads users through the system of questionnaires in a step-by-step manner, requiring no previous knowledge in Business Plan

It was assessed that Serbian ICT companies do not have a significant gap in the performance of new product development technologies that they use comparing to Serbian competitors.

In general, Serbian ICT companies use similar product development tools as their competitors in Western Europe, USA or in Asia. Particularly it concerns the sub-sectors related to software development, outsourcing in web design and web application development, mobile & wireless applications development.

As an important number of Serbian ICT companies develop products or provide IT development services for their foreign clients on contractual basis, the development tools are often provided by them.

From the perspective of phases of new product development cycle, different tools are used at the stages of product conception, design, development and testing.

Software used for design and development of products exist in commercial versions as well as Open Source software. Most of interviewed companies have started with these tools moving progressively to commercial ones. So, the competitiveness of new products development technologies used by Serbian companies used during these phases is not really influenced by the quality of development tools.

The situation is a bit different for tools used during the phases of prototyping and testing.

More sophisticated, and by consequence more expensive software development tools, allow better automation of some tasks and assure better quality of final products. The disadvantage of Serbian ICT companies in accessing to

ConnectEVE by MikroElektronika

MikroElektronika is the first manufacturer in the world to release two boards for cutting-edge Embedded Video Engine graphics controller. ConnectEVE brings fast and visually stunning user interfaces to customers' devices. It is a state-of-the-art graphics controller integrates display, audio and touch onto a low cost, easy-to-use, single-chip solution.

development tools is more evident for the tasks such as new products prototyping and automated software testing. Most of companies execute these labour intensive tasks employing qualified developers. However, automation of these task using modern sophisticated software tools would allow significant increase in the competitiveness.

Serbian ICT companies have only a small disadvantage in terms of equipment used for new products development. The main equipment is personal computer which is available and accessible. However, development and testing of software products for larger scale IT systems and mobile applications require assess to expensive server equipment and software, cloud infrastructure and mobile communication devises for mobile applications. From this perspective, the competitiveness of development tools of Serbian ICT companies are disadvantaged by limited access to this infrastructure.

The biggest gap in the competitiveness of new product development technologies between Serbian ICT companies and their competitors is in processes, methods, outsourced services and different knowledge.

The competitiveness of new product development technologies in 3 sub-sectors and the perspectives in near future are different. IT hardware and IT services are on the growing trend when the software sub-sector is losing the competitiveness of the products development tools. On the following figure the arrows indicate the increase or decrease of this competitiveness:

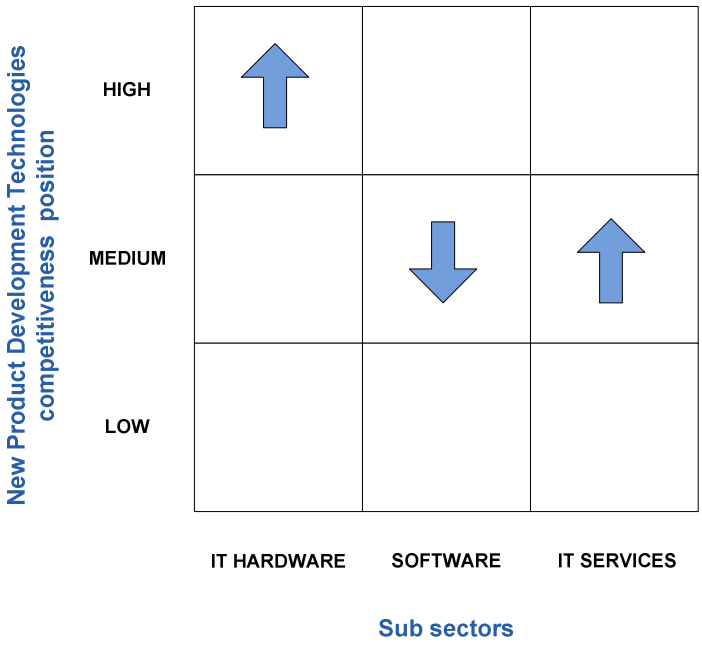

Figure 1-Competitiveness of technologies by sub-sector

The IT hardware sub-sector has the strongest competitive position due to the high level of specialisation and accumulated skills in this sector. Serbian hardware companies seize product development technologies allowing them development of word-class IT hardware equipment and components.

Meters regulators of CO2 (carbon dioxide) by EUROgenyx

The meter and regulator of carbon dioxide is based on the "Non-dispersive infrared" sensor that enables the latest generation of highly accurate and precise measurements, as opposed to the "thermal" which is commonly used in other devices. It is based on the spectrometry of air sampled (mixture of gases) which is exposed to infra-red radiation.

The device is used for air quality control in the interiors, ventilation systems and air control, alarm sensors in smart homes, systems for fire room, automatic opening of window in smart homes, agro industry, comfort and ventilation systems.

The software sub-sector is in less advantageous position because the companies mainly develop products within sub-contractual business model using existing development technologies also available to their competitors. These companies are limited to the access to innovative technologies as they do not really design their own new products. To stay competitive in new products development, the innovation in new tools, methodologies and approaches has to be applied. The sub-contractual business model does not provide the opportunity to develop innovativeness.

The competitiveness of new product development technologies in the IT services sub-sector has increased due to skills and experience gained by Serbian companies during last years.

More important difference is in the new products development processes used by companies. In this area, Serbian ICT companies lack the knowledge and experience in implementation of procedures allowing the development of new products faster and better than competitors.

This is particularly visible in the processes such as the interaction of the marketing with the research and development functions. Another weak aspect is management of processes related to introduction of technology innovations into the new products development.

In this regard, the initiative of the Serbian government to support the transfer of innovation through introduction of the tax credit for investments in research and development will have a positive effect (The Government of the Republic of Serbia 2013).Benefits of adopting the new technologies

In order to accelerate the growth of the ICT industry in Serbian, companies need to introduce several technological developments in their new product development activities. The main benefit of adopting the new technologies and processes will be the access to high margin new potential markets where there are less competition due to higher requirements in terms of skills and expertise.

Several emerging markets present huge opportunities for companies capable of providing innovative solutions, products and services. Instead of targeting the traditional markets of IT outsourced development, contractual manufacturing and offshore web design, Serbian ICT companies need to progressively acquire key enabling technologies and implement the enabling processes which will allow them development and commercialization their own new products. The important emerging markets suitable to the competencies of Serbian ICT companies are:

- Cloud computing
- Software as a Service
- Smart houses, Smart Grid Management, Smart cities
- Serbian and European e-Government programs
- Software and apps for mobile devices
- Computerization and automation related to Serbian EU pre-accession

In the traditional industries of Serbian ICT companies, adoption of key enabling technologies and processes will be specifically beneficial for gaining on new market shares in the following areas:

- Value chain creation for products and services with EU and world companies
- Export of IT services to the EU countries
- Large German market for industrial electronics outsourcing

The following chapter describes in details the needs of Serbian ICT companies in key enabling technologies and processes.

2. Needs of Companies in Enabling Technologies and Processes

Serbian ICT companies are actively engaged in the design and development of their own new products or in the contracted development of products on behalf of their clients. In both cases the availability of key enabling technologies is the critical condition for the competitiveness of Serbian ICT companies. Better tools would allow the development of new products faster and with better quality which are two most critical success factors in the ICT industry.

Knowledge and application of modern business procedures optimizes and enhances companies' internal processes. This is the most important factor for improvement of personal productivity of individual employees and of companies in whole.

The following sections describe the identified needs of Serbian ICT companies in key enabling technologies and processes. The following analysis groups the recommended key enabling technologies and processes in several categories such as equipment, software, methodologies, services, information, training, quality standards and certification.

2.1. Key Enabling Technologies and Processes Required by the Majority of Companies

2.1.1. Equipment

Mobile phones and tablets for testing mobile applications on physical devices. Software emulators for testing of apps on mobile devices do not assure that apps work on all types of devices. In order to assure the quality of developed new products, it is required to test software on different physical mobile devices. Range of devices has to include, at least, mobile phones and tablets working under Android and iOS operating systems. As models of devices and versions of operating systems change rapidly, it is preferable to establish partnerships with a local telecommunication companies which can regularly provide new devices in exchange of services by ICT companies.

Electromagnetic Compatibility (EMC) laboratory and equipment. Testing is required to confirm that a particular device meets the required standards before putting it on the market. EMC aims to ensure that equipment items or systems will not interfere with or prevent each other's correct operation. Currently, an important number of Serbian companies make EMC tests in neighbourhood countries, such as Slovenia and Germany which increases the cost and the time to market of new Serbian products. This is despite the fact that there are three Conformity Assessment Bodies in

Serbia and two of them have started offering services within 2013. One of them is IPM which is supported by GIZ ACCESS program in the accreditation process. In the next phase, GIZ plans to support IMP in the process of notification. The number of requests of EMC testing by Serbian ICT companies has being grooving and there is a need to widely promote new EMC laboratories in Serbia.

Cloud-based infrastructure for software prototypes development and testing. Cloud infrastructure can be rented from commercial providers and access to it can be shared on demand basis between ICT companies. This can include infrastructure/platform as a service and software frameworks (operating system, application servers, data bases) on platforms such as Windows and Linux. Hardware and software infrastructure would allow development and testing of IT systems in different environments. The same infrastructure can host databases, application servers and other software which are expensive to purchase by individual companies.

3D printers. 3D prototyping machines are available in Serbia. However their quality is considered by companies as sufficient only for approximate prototyping. Companies interested in prototyping of new products need more precise 3D prototyping machines with more then 30-40 sm depth capacity. Possible solution could be printers with inkjet-based PolyJet and PolyJet Matrix 3D printing technologies.

Equipment for moulding in small series. Manufacturing of electronic and embedded equipment also requires production of parts in different materials. Several ICT companies manufacture electronic equipment in small series and have difficulties to subcontract manufacturing in Serbia in small quantities with usage of moulding technologies (boxes, handles, switches). Outsourced manufacturing abroad requires putting orders for important quantities of products to be able to produce at competitive cost. There is a need for local production in small quantities. The equipment requested by Serbian companies should be able to use raw materials such as composite wood, mediapan, plastics and aluminium. The degree of requested precision in prototypes development requires 3 sizes of tools for finishing with hard, abrasive and polishing paper.

2.1.2. Software

Software tools for automated testing of software and IT systems. Software testing automation tools, such as Telerik Test Studio[2], Rapise[3] or Visual Studio Test Professional[4], allow automation to

[2] http://www.telerik.com/automated-testing-tools/purchase.aspx

[3] http://www.inflectra.com/Rapise/Default.aspx#0

control the execution of tests and the comparison of actual outcomes to predicted outcomes. Test automation can automate repetitive testing as unit and GUI testing in a formalized testing process that would be difficult to perform manually. Automated software tools could be expensive to purchase by individual companies, especially licensees for teams of testers, as the testing cycles are executed periodically and companies do not need these tools on permanent basis. Use of automated testing tools would significantly shorten the new product development time and improve the quality of developed software.

Rapid software prototyping and simulation development software. These tools enable users to rapidly build lightweight, animated simulations of another computer program, without writing code. Rapid prototyping and simulation software allow both technical and non-technical users to experience, test, collaborate and validate the simulated program. Application simulation helps in drawing mock-ups or wireframes without time-consuming, high-risk code-based prototyping. This allows software developers to validate requirements and design choices early on, before development begins. In doing so, risks and costs associated with software implementations can be dramatically reduced and development time significantly shortened. Simulation software helps with fast development of several versions of new product which improve interaction with clients.

Shared subscription to Software as a Service (SaaS) applications for management of IT systems development process and IT infrastructure management. This categories of software include, for example, Nagios[5] for IT infrastructure monitoring, Jira[6] for IT systems development issues tracking and ActiveCollab[7] for project management and collaboration (Serbian product developed by A51 company from Novi Sad). The optimal way of using this software becomes Software as a Service through web browser with Internet connection.

Oracle databases and application servers. Oracle software licensees, consulting and training can be purchased on shared basis and provided by a local provider. This will facilitate access of companies to more advanced technologies and development of value added IT systems. As Oracle development services are highly requested in Europe, this facility would facilitate export of Serbian products and services to the EU.

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[4] http://www.microsoft.com/visualstudio/en-gb/products/2010-editions/test-professional

[5] http://www.nagios.org/

[6] http://www.atlassian.com/software/jira/overview

[7] https://www.activecollab.com

Software tools for management of the SCRUM development process. Free tools do not satisfy anymore the needs of established companies which employ distributed development teams. Commercial SCRUM tools give unparalleled visibility across multiple teams, projects and agile portfolios, providing a centralized environment where all stakeholders – executives, managers, product owners, developers, and testers - can easily work together regardless of location.

2.1.3. Processes and Methodologies

Methodologies of Agile software development. After traditional waterfall type of system development methodologies, Agile becomes a necessity to answer the need of development teams to deliver products faster with more frequent interaction with customers. It emphasizes adaptive planning, evolutionary development and delivery, an iterative approach, and encourages rapid and flexible response to change. It is a conceptual framework that would help Serbian ICT companies to improve the internal development processes and the quality of their software via interactions throughout the development cycle.

Methodologies of industrial marketing for definition of prices for products and services of Serbian companies in EU countries, and particularly on the German market. Systematic application of these methodologies facilitates market analysis and segmentation, definition of appropriate distribution channels and types of appropriate promotion activities. Industrial marketing is particularly important for Serbian ICT companies in B2B sector.

Value chain organization methodologies for ICT products and services. There are several successful ICT clusters in the world and their experience has been analyzed by practitioners and researchers. This experience has been transformed into methodologies and best international practices of value chain organization. The methodologies can be made available to companies directly by training them and disseminated through cluster managers as well as through organisation of the transfer of the best practices of foreign clusters.

TRIZ methodology for resolution of engineering problems and creative thinking facilitation. Several ICT companies have intention to develop their own products but are not able to define concepts of new products. This is mainly due to their incapacity to transform potential needs of their clients into technical solutions. Systematic application of TRIZ methodology would help companies in defining concepts of new products based on analysis of clients' needs and requirements.

2.1.4. Services

2.1.4.1. Marketing and Export Development

Outsourced search of Serbian clients for ICT companies

Outsourced marketing services such as market research, competitiveness analysis, compilation of databases of potential clients, preparation of promotional materials, e-marketing, sales and promotion

Search of foreign clients through systematic marketing approach. Preparation for trade shows, identification of needs of potential clients, matchmaking and preparation of one-to-one meetings. Dissemination of information about trade shows and fairs, organization of joint participation of Serbian companies in trade shows, services to prepare design of booth and promotional materials, preparation and scheduling of individual meetings. Already operational and highly successful is the Serbian German Business Dialogue (Matijevic and Solaja 2013).

Marketing and promotion of Serbian ICT industry in Germany. Invitation and organization of visits of potential German clients to visit Serbian companies.

Identification of opportunities related to EU accession, dissemination of calls for proposals requests and opportunities descriptions, clustering of companies in order to prepare tenders.

Identification of government needs and opportunities for ICT-related tenders. Coordination of consortia of ICT companies and preparation of bids. Lobbying interests of ICT companies in order to facilitate their access to Serbian public procurement tenders.

2.1.4.2. Business Development and Restructuring

Strategy advice on the change of business models. Several companies which are used to work as contracted manufacturers or near shoring software developers want to leave the outsourcing business model. They now target to design and commercialize their own products. In most of cases this process happens with difficulties because companies have limited understanding of available market niches, narrow skills to conduct market research and are not able to formulate clear strategic objectives regarding change of business models. This demand creates a need for a service of strategy formulation of new business models from contracted manufacturing to development and commercialization of own new products.

Optimization of internal business processes and structuring of departments of companies in order to scale the business and make companies more efficient.

Advisory by specialists with foreign ICT industry experience to transfer best international practices in the industry. There are several European Senior Consultants networks that would make available retired EU specialists with significant ICT industry experience to visit Serbian companies and to provide individual advice on best international practices.

Individual coaching of business owners and senior executives facilitates their professional development and boosts growth of companies.

2.1.4.3. Financial and Legal Services

Identification of potential investors who can bring companies to the next level in their development (UK Dragon Den business concept). Several ICT companies have reached the stage in their development when the organic growth using only their own resources is slowed down. In order to gain access to new markets and clients, to acquire capacities in development of new products through partnerships with other companies – these companies would need investors who can bring capitals required for accelerated development and facilitate linkages with other businesses.

Brokerage in getting short and long term loans from public and private financial institutions. In the future, development of the national credit guarantee scheme would allow to ICT companies getting loans at lower rates facilitated by Private-Public Partnership guaranties.

Preparation of supply, service contracts and warranties for IT components, electronic equipment and software.

2.1.4.4. Clustering

Industry meetings. Assessment the needs of companies in a particular industry through organization of meetings between different industries and ICT companies. It could be organized through invitation of industrial associations and individual companies to present their challenges. ICT companies could then propose global solutions to resolve them. Also, presentations of new ICT products and technologies to industries can create opportunities for cooperation.

Value chain analysis and mapping. This service helps to identify value chain partners in Serbia for any particular company. The analysis starts with identification of market needs and leads to creation of new products concepts. A value chain is then designed bringing together companies from the same clusters and other partners outside of clusters for the phases of design engineering, prototyping, testing, product development, quality & standards conformity testing of new products. The value chain is enriched by adding partners required for commercialization of products.

2.1.4.5. Human Resources Management

Outsourced human resources management for ICT companies. This service may include collection and management profiles of candidates, screening of potential candidates according to requests of ICT companies, on-line and individual tests to pre-select potential candidates for interviews with companies.

ICT jobs board. Centralized collection and dissemination of job opportunities in the ICT sector. Management of a database of job offers, marketing services of dissemination of offers through a website and through traditional channels. Management of mailing lists and dissemination of job opportunities on social networks.

Temporary jobs agency for highly qualified ICT specialists and consultants. Important sector of economy in developed countries is temporary employment of highly qualified industry specialists. This model presents advantages of flexibility and lower costs for ICT companies which can employ required specialists on temporary basis without disadvantages of permanent employment contracts.

2.1.4.6. Software and IT Systems Tests

Management of teams of outsourced software testing specialists. There is high demand among Serbian ICT companies in services related to outsourcing of tasks related to tests of software and IT systems. Companies interested in testing of their ICT products at prototype, alpha, beta and final release stages can contract this service on temporary and on-demand basis. Limited availability of testing specialists with sectors' experience and irregularity of needs of ICT companies in these specialists create a good opportunity to provide this service on shared basis.

The service would also manage testers with knowledge of particular business functions (quality standards, finance, human resources management, customer relationship management) as well as testers with knowledge of particular industries (financial sector, insurance, automotive, retail, hotels & hospitality). It has been assessed that demand for testers with industries knowledge will be higher than for testers with knowledge of particular IT technologies. Some of ICT companies who are members of 3 clusters are interested to develop software testing service and to provide it to other companies.

2.1.4.7. Industrial Studies and Technology Intelligence

Preparation of studies about opportunities and conditions on particular markets for which ICT companies can deliver products and services. This service would also cover the assessment of competition landscape in different sub-sectors of the ICT industry on these markets.

Technology intelligence review of cutting age technologies and new trends in the ICT industry. This service would help Serbian ICT companies to be aware of the latest developments in the industry and provide guidelines about possible directions for future development of their new products.

2.1.5. Training

The assessment of the needs of Serbian ICT companies has indicated a number of areas where companies need training for their staff. Several important trainings are already provided in joint cooperation by VOICT, ICT Net and NiCAT clusters with the GIZ ACCESS support. Other areas could be covered by company-based academies like Microsoft, Cisco etc. Additionally, technical assistance projects, like OCS, often provide these trainings

Some of the indicated areas of training cover needs of a large number of companies and some are more specific to particular sub-sectors or to individual companies. This section lists the areas of common interest by the majority of companies.

2.1.5.1. Professional Employment Preparation

The majority of companies have indicated a need in additional professional training of new university graduates before they can be operational at their jobs. The requested subjects are related to modern technologies of software development, system architecture and procedures of conducting IT projects. The main subjects are:

- Programming and software development
- Use of software development tools (Eclipse, Visual Studio)
- Hardware / software interface
- IT systems architecture
- Software frameworks for web development
- Java programming
- Management of software development process
- Agile software development framework for managing software projects with SCRUM
- Preparation of functional and technical specifications
- Project management with PMBOK guide / PMI

- Quality management in software development
- Tools, processes and organization of software testing
- Automated software testing
- Industrial marketing
- Marketing, sales and promotion of technology products
- Creative thinking and problems resolution (TRIZ and other methodologies)

The scope of professional employment preparation would require between 3 to 6 months of combined in class training, practical exercises and on-the-job training directly in companies.

2.1.5.2. ICT Academy

The ICT Academy initiated by the clusters for training of employees of ICT companies has successfully implemented several training courses, mainly on SCRUM development approach. There is a need expressed by ICT companies to deeper SCRUM training by adding other topics such as:

- Agile development framework
- Advanced levels of SCRUM approach
- Quality management of the software and ICT systems development process
- Automated software testing
- Cloud computing

2.1.5.3. Marketing and Sales

All of accessed companies have expressed their need in enhancement the skills of their employees in marketing and sales. The common needs in training and capacity building are in the following areas:

- Company marketing and promotion
- Development of innovation strategy, marketing and sales plans
- Structural approach of market needs identification and analysis
- Marketing of technical products
- Sale skills at advanced level

2.1.5.4. Other Common Areas of Interest for Training

- Lean product development methodologies
- Data analysis and data mining
- Machine learning, smart devices, cognitive devices
- Use of Customer Relationship Management software tools, and especially SugarCRM

2.1.6. Quality Standards and Certification

Methodologies for preparation of quality of management systems. Only few Serbian ICT companies have been certified by ISO 9011 or ITmark[8]. Methodologies of certification for quality standards of management systems and their advantages should be explained to larger number of companies and their awareness raised. The majority of Serbian ICT companies participate in contractual development and manufacturing for foreign clients. Certification of management systems would give considerable advantage to Serbian companies and help them to secure new contracts. Management systems certification assures clients in the quality of companies' management procedures and increase probability that orders can be executed on time and with requested quality. There are several quality standards and management systems certification bodies in Serbia that are able to carry out full certification process for ISO 9001. Trainings for companies are also available.

Readiness assessment for quality management systems certification. The service of assessment the degree of readiness of individual companies for different type of certification of their management systems such as ISO 9001, CMMI, ITmark. Individual advisory service to assess the necessity and advantages for a particular company to implement certification of its management system. Preparation of individual assessment reports with recommendations. Preparation of roadmap for implementation of recommendations.

Preparation of companies for the certification of their management systems for ISO 9001, CMMI and ITmark. Several certified companies also need assistance to prepare the renewal of the initial certification of their quality management systems.

Assessment of the requirements for certification of products for CE Marking according to the EC Directives. Facilitation of CE Marking conformity assessment procedures by Serbian authorized third party notified bodies, setting up a technical file and preparation of an EC declaration of conformity.

2.1.7. Information

Requirements of foreign industrial and quality standards, particularly regarding electromagnetic compliance testing of electronic equipment, CE Marking and standards for fire resistance of electronic equipment in different countries. Reports about security regulations and standards for different types of IT systems such as fire protection in hotels, airport IT systems, industrial environments.

[8] http://it-mark.eu/

ICT industry market studies and detailed analysis of trends in ICT sub-sectors, type of products and competitiveness landscape (Gartner style).

ICT industry and technology intelligence information about what big players and leaders in the industry do. This would include digests of recent technological development in companies such as Motorola, CISCO, Google and other leaders in different ICT sub-sectors.

Industries' needs and opportunities. Analysis and reports about needs of particular markets and industries in terms of ICT enabling technologies and products for which ICT companies can provide solutions. The priority industries in Serbia would be hospitality industry, manufacturing, communications, entertainment. Similar studies could be developed for the targeted European markets.

Reports about technology trends and profiles of leading companies in mobile apps development. Analysis and best practices of implementation of mobile applications in different sectors.

E-government opportunities in Serbia. Regular information from the Serbian government about e-government, e-business, e-health and e-education governmental strategies, programs and tender opportunities.

ICT-related tender opportunities in the EU countries as well as tender opportunities of the different European Commission Directorates (DG Informatics, DG Enlargement,) and tender opportunities in developing countries (EuropeAid development and Cooperation).

Templates of contracts in English for ICT type of products and services.

European Commission's Framework Program 7 (FP7), Competitiveness and Innovation Framework Program (CIP) and new tender opportunities arising with the next seven-year EU financial framework starting in 2014 (Lazovic Mirjana, Pejovic Andrija Belgrade)

Best practice cases about commercialization of ICT products and services on the EU markets through different distribution channels. Analysis of quality standards in particular countries and key selling points to local companies. Germany is considered by most of Serbian companies as the priority export market.

2.2. Specific Key Enabling Technologies and Processes Required in Sub-Sectors

In addition of the common needs in key enabling technologies and processes independently of the sub-sector of activity, some of ICT companies have more specific needs. They depend on the new

products development technologies and procedures employed in these sub-sectors. The following sections describe the specific equipment, software, services, training and information by sub-sector of activity.

2.2.1. Web Design and Web Applications Sub-Sector

2.2.1.1. Software

The most important type of key enabling technologies for web design and web application development companies is one which helps to better organize different business processes inside of companies. The companies would gain significantly in productivity by accessing on the subscription basis to different business processes facilitation tools:

- Signavio Process Editor[9], a BPMN 2.0 standard-based process modeling tool, with cloud service monthly subscription fee (SaaS)
- Alfresco Standard or Enterprise Network[10], enterprise content platform, with professional technical support and SaaS cloud hosting
- ZK Framework[11], Java framework for enterprise web and mobile applications development, with commercial support
- Oracle suite of relational database management and application servers[12] for development of new products on the top of Oracle infrastructure
- Rational Rose UML development tools
- Fast prototyping software to design user interfaces and front ends for web applications and websites, mockups and wireframes

2.2.1.2. Services

Cloud computing capacities for 3D design

Service of patents search in EU countries and identification of opportunities among patents falling into public domain areas.

2.2.1.3. Training

[9] http://www.signavio.com/products/process-editor/process-modeling/

[10] http://www.alfresco.com/products/cloud

[11] http://www.zkoss.org/product/

[12] http://www.oracle.com/us/products/index.html

Training on big data manipulation and processing, structured and unstructured data in the cloud, analysis of clients' data. Development of skills on data collection from the cloud.

Training on ASD:Suite[13] development framework which facilitates development of products requiring hardware / software interfacing. The ASD:Suite is a unique, general purpose, software design automation platform. Incorporating fully automated mathematical verification technology, it enables software engineers to build better, more complex software while delivering a net 30%-50% improvement in productivity and a corresponding decrease in time to market.

Training on Kanban methodology for distributed team management of the software development process.

2.2.2. Embedded Software

Training in mathematical modelling, applied mathematics, signal modelling & processing.

Equipment for measurement of nano volts and nano ampere

2.2.3. Electronics and Automation Products

2.2.3.1. Equipment

Printed circuit board (PCB) machine. This machine could be shared by a number of companies in the sector. PCB machines are used for product prototyping and development of electrical circuits. Several companies in the sub-sector pay annually for PCB final products about 0,5 Million EUR. A PCB machine costs about 1 Million EUR.

Selective soldering machine[14] is coupled with printed circuit board machine and can be used on part time basis by a number of companies for manufacturing of products in small series

Packaging machine for packaging of final products (carton, plastic boxes)

2.2.3.2. Services

Legal support for preparation of contracts, warrants for electronic components and nested contracts when electronic components are provided for system integration projects

[13] http://www.verum.com/product/Verification-is-the-Difference.aspx

[14] http://en.wikipedia.org/wiki/Selective_soldering

Marketing services for the targeted promotion of the sub-sector companies on the German market for industrial electronics outsourcing services

Shared service of industrial design of containing boxes (containers for electronic components), products and packaging for the companies in this sub-sector

2.2.3.3. Information

Information and training on UL[15] (USA) certification related to safety aspects of industrial electronic components and equipment

Information about possible types of assurance of industrial electronic equipment and components delivered to clients

Information about Japanese quality standards for electronic components and equipment

Library of standards for UL, Japan standards for fire resistance of electronic equipment, CE Marking and ECM requirements in different countries

Information and education materials about best international practices in printed circuit boards assembling

2.2.3.4. Training

Shared training to prepare people without industrial experience to work on micro-controllers assembling

General technical education and professional training on hardware development, printed circuit boards assembling

2.2.4. Mobile & Wireless Applications

SAP training and certification. SAP certification allows development of products (hardware controllers) for clients which use SAP. In some cases clients allow access to their SAP systems to build applications on top of their SAP-based systems. However, this is not general practice and access to this high value IT development service requires SAP infrastructure for development and testing.

Software tools to facilitate preparation of technical documentation for software and IT systems

[15] http://www.ul.com/global/eng/pages/offerings/perspectives/newtoul/ulmarkproductcertification/

Exchange of experience with specialists who have implemented technologies such as WPF (Microsoft) and other Web 2.0 technologies

Range of iOS-based phones and tablets, Android-based phones and tablets, Nokia and BlackBerry mobile phones for tests of concepts of new products and final applications

Software emulators of mobile phones

Training in Java development for new employees from universities

2.2.5. Telecommunication Networks

Hardware and software for video streaming and media content delivery through Internet. This particularly requires servers appropriate for video content delivery. Access to broadband Internet channels.

Specialized equipment for testing of new products such as wireless system solutions, IP networking, media delivery for atmospheric testing, EMC testing

Testing range for WiFi networks and advanced laboratory free of radio frequency interference, wCDN based services.

FPGA based development kits for developing and testing new solutions, FPGA chips (wireless mesh networks).

Information and training in data mining and development of machine learning tools for patterns and triggers recognition (signal processing and communication network technologies).

2.3. Common Needs of Companies in Shared Resources

Key enabling technologies and processes with the highest impact on the companies' competitiveness are those which help strengthening the internal business processes and provide access to innovation. These enabling technologies and processes would be of most use to the highest number of Serbian ICT companies from all sub-sectors.

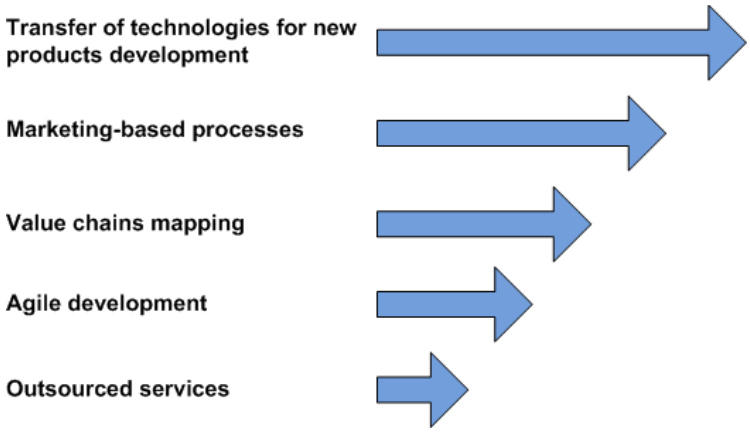

Figure 2-Key technologies & processes with the highest impact on the companies' competitiveness

The processes which enable companies to benefit from transfer of technologies for new products development would have the highest impact on the Serbian ICT companies' competitiveness.

The weakest function of most of assessed companies is marketing. For technology companies, access to outsourced marketing services which facilitates understanding of market opportunities, evaluate potential clients' needs and organise promotional activities is crucial.

Value chains mapping among Serbian companies would open wider opportunities to create competitive products and commercialise them on foreign and domestic markets.

3. Shared Resource Centre

3.1. Organization and Structure

3.1.1. Overview of Serbian Business Support Organizations

Serbia has a relatively developed system of business support organizations (BSOs). Several government organizations are presented at central and some at regional levels. The landscape of the Business Membership Organizations (BMOs) in the ICT industry is mainly composed of three SMEs clusters and few professional business associations.

The mapping of the capacities of the BSOs and the BMOs to facilitate access to key enabling technologies and processes required by Serbian ICT companies indicates that several areas are covered by existing organizations. However, the most critical areas are not currently covered by services of any business support organization.

The following table summarizes the current capabilities of BSOs and BMOs to provide key enabling technologies and processes to ICT companies:

BSO / BMO KETPs	CCIS	NARD	SIEPA	IMP	BITF	CTC	VOICT	BICNIS	ICT Net	NiCAT
Equipment										
Electromagnetic Compatibility				√						
Cloud infrastructure										
Rapid prototyping and manufacturing						√				
Software										
Automated IT testing										
Rapid software prototyping										
Shared software										
Process development										
New products development		√				√				
Marketing-based processes										
Value chain mapping					√		√		√	√
Services										
Marketing and export	√	√	√				√		√	
Business acceleration	√	√						√		

Training										
Vocational education	√	√		√		√				
ICT training				√			√		√	√
Company development	√	√			√			√		
Quality Standards										
Quality management systems	√			√						
Information										
ICT industry & technologies	√	√	√	√					√	
Markets studies	√		√		√					
EU opportunities		√	√	√		√	√	√	√	√

Table 1 - Capabilities of BSOs and BMOs to provide key enabling technologies and processes

The detailed assessment of the capacities and profiles of Business support Organizations and Business Membership Organizations are presented in the Appendix (4.1.).

The key competencies required from BSOs to host shared resources centre of key enabling technologies and processes for ICT companies are the following:

- The Serbian ICT companies are located in several regions of the country with some concentration in Belgrade and regional centres of Nis and Novi Sad. The important criteria for selection of hosting organization for a shared resource centre is the capacity to provide services to companies located in different locations. Currently, only two Serbian BSOs have this regional outreach. They are the Serbian Chamber of Commerce and Industry and the Serbian Agency for Regional Development. The three main clusters (ICT Net, NiCAT and VOICT), based on their collaboration agreement, could offer joint-services for the three main areas of company concentration - Belgrade, Nis and Novi Sad.

- Capacity to coordinate the provision of services related to KETPs by specialized partner organizations. The diverse scope of requirements by Serbian ICT companies makes it almost impossible for a single organization to prove the whole range of services. The shared resource centre is viewed more as a coordinator which redirects the requests of companies to the right service providers.

- Sufficient human resources capacities and a system of continuous education for the enhancement of skills to provide services

- Financial support, especially at the beginning of the operations of the shared resource centre. Possible financial models for the shared resource centre can be based on government subsidies, public-private financing or fully sustainable commercial model.

The needs of Serbian ICT companies are complex and diverse. None of existing BSO or BMO can cover alone the full scope of key enabling technologies and processes requested by Serbian ICT companies.

3.1.2. Business Models of Shared Resource Centre

The common concept of shared resource (SRC) facilities has always been strongly focused on provision of facilities such as laboratory and workshop spaces with equipment and additional central business support services. However, for Serbian ICT companies, particularly in the stable or growing phase of development, on-site space and facilities may be less relevant. Also, for the companies intending to operate in the international environment, physical shared resources space may be important but access to virtual services may be even more necessary in terms of providing specialist knowledge which may not be available through their local shared resource centre.

The analysis of needs of Serbian ICT companies and the landscape of business support organizations suggests four possible models for the organization of the shared resource centre. Each of them has its advantages and disadvantages. The main criteria to prefer one against another would be the degree of willingness of BSOs and BMOs to develop set of missing skills in order to provide key enabling technologies and services to ICT companies.

3.1.2.1. Centralized Model

In the traditional centralized model, the SRC is organized in one physical location. Access to key enabling technologies is provided through face-to-face interaction between managers of the centre and client companies.

The assessment of capacities of the Business Support Organizations in three regions of Serbia and their comparison with the demand of the KETPs by ICT companies suggests the following candidates for the role of the hosts of shared resource centres:

- **Belgrade** – Regional Centre for SMEE Development / National Agency for Regional development, Belgrade

  The incubator of the University of Belgrade could become the second option. With the

future development of Zvezdara technological park and relocation of the incubator to its premises, it would be possible to develop additional services in the premises of the technological park. SEE ICT with its developed IT start-up hub concept “StartIT Hub”, which integrates formats like the Start-up Academy, could provide the framework concept to be implemented at such a central suitable location.

- **Nis** – Regional Chamber of Commerce and Industry Nis

- **Novi Sad** – Regional Agency for SME Development "ALMA MONS"

  The second option is Vojvodina Provincial Chamber of Commerce and Industry

These organizations currently provide the largest set of services corresponding to the needs of the Serbian ICT companies (see the Appendix 4.1.). At the same time, they have bigger potential to develop missing skills.

This model requires that the hosts progressively develop additional skills to provide access to other key enabling technologies and processes required by Serbian ICT companies.

3.1.2.2. Networked Shared Resource Centres

For Serbia, with its ICT competencies grouped in several regions of the country and BSOs providing specialized support services, another suitable model of SRC would be the networked model. Nodes or satellites, physical premises, are linked to main SRC - a primary physical shared resource centre in one region that provides access to key enabling technologies in outreach locations.

The regional satellites are responsible for creation of partnerships with specialized BSOs in each region. The regional satellites provide access to the KETPs which are in their scope of competence. For other requests, they redirect requests of ICT companies to specialized BSOs.

In this model the satellites play important role of one-stop-shops for ICT companies. They assess the needs of each incoming company and facilitate access to the KETPs by directly providing them or by redirecting to BSOs.

The assessment of capacities of the BSOs has indicated that the Chamber of Commerce and Industries of Serbia (PKS) has developed capabilities to provide a range of key enabling technologies and services within the networked model.

The PKS already provides a range of key enabling technologies and services which only in a limited way covers the needs of the Serbian ICT companies. Yet the PKS is not specialized in providing services to the ICT industries. However, it has a developed regional network of two provincial and 16 regional chambers providing professional services to companies. The PKS has potential in terms of human resources, IT infrastructure and financial capacities to develop additional skills required to host shared resources centres in Belgrade and in main Serbian regions.

Another advantage of the PKS and the Chamber system is its network of representations in several European countries.

The SRC in Belgrade and in regional capitals could coordinate the relations with partner BSOs and BMOs in their respective regions. They also redirect companies to BSOs from other regions if the companies have specific requests for KETs which could not be addressed in the region of their location.

3.1.2.3. Outreach Virtual Shared Resource Centres

This business model refers to shared resource centre (SRC) with clients who are not located in the proximity and implies that key enabling technologies and services are delivered to companies physically and virtually. It combines traditional SRC space and services with virtual way of delivering access to key enabling technologies and processes.

The SRC managers meet with clients companies face-to-face and KETs are facilitated using virtual tools. This service model is bundled offering of the networked model with virtual services. With outreach way of providing access to KETPs, there is still a strong physical element to the virtual way of delivering services.

Similar to the networked model, the regional satellites provide access to the KETPs which are in their scope of competence. For others which are outside on their scope of competencies, they redirect requests of ICT companies to specialized BSOs. In the outreach virtual model the services are provided physically and virtually.

The implementation of this model would require development of an information system and on-line applications enabling the provision of key enabling technologies and services. The critical role of the SRC host will be the management of the network of partners and enhancement of the virtual services together with partner BSOs.

The Chamber of Commerce and Industry of Serbia is considered as the best candidate to coordinate the network of outreach virtual resource centres comprised of its provincial and regional chambers.

3.1.2.4. Clusters-Based Model of Virtual Shared Resource Centre

The three Serbian ICT clusters (ICT Net, NiCAT and VOICT) would be able to play a central role as coordinators of a SRC in the clusters-based model. The current capacities of clusters to provide KETs are weak and development of their skills would request significant amount of human and financial resources. Also, the capacity building would take time. Instead of developing skills in providing KETs to companies, the clusters would be able to play the role of coordinators of a virtual network of specialized business support organizations. The main role of clusters managers would be interfacing with companies in order to translate their needs into requests to business support organizations. The access to the KETPs is delivered mainly electronically by the most competent BSO in the related area.

Services of facilitation of key enabling technologies and processes could be also provided through physical contact of BSOs if company is located in proximity.

The clusters have a strong competitive advantage to play the role of coordinators of the cluster-based shared resource centre. They are in permanent contact with ICT companies and understand well their needs and wishes in terms of growth and development.

3.1.3. Planned Activities and Inputs

The main function of the shared resource centre (SRC) would be coordination of the flow of requests for assistance from ICT companies. Depending on its business model, the SRC will directly provide some services to empower ICT companies to adopt key technologies and processes. Other requests will be redirected to relevant BSOs.

First of all, the management of the SRC has to develop capacities to understand needs of each individual company and to provide advice where the company can get the professional assistance.

Independently of the chosen business model, the key functions of the shared resource centre are:

- Diagnostic of company needs
- Company competitiveness assessment
- Value chain mapping according to requirements of individual companies
- Guidance of companies in the landscape of Serbian BSOs and BMOs
- Information about services provided by each BSO

- Management of the SRC information web portal
- Assessment of BSOs capacities to provide key enabling technologies and services to ICT companies
- Management of the directory of providers of key enabling technologies and processes
- Raising the awareness of ICT companies about benefits of technologies and processes adoption to become competitive on the European market
- Development of software applications enabling provision of virtual services

The main function of the BSOs is providing ICT companies with the access to key enabling technologies and processes.

3.2. Partner Organizations

Currently, the ensemble of Serbian Business support Organizations and Business Membership Organizations does not provide the full scope of services required by Serbian ICT companies. Even with important investment in development of these organizations, there still will be a need to involve private companies which can provide commercial high value and high quality services to Serbian ICT companies.

The optimal ecosystem of shared resource centres would be a mix of public and private organizations linked through public-private-partnership relations.

The following table provides recommendations regarding the development of missing competencies to provide key enabling technologies and processes to Serbian ICT companies. In addition to the existing competencies indicated by "√", the "+" sign indicates the skills to be developed:

BSO/BMO/SME **KETPs**	**CCIS**	**NARD**	**SIEPA**	**IMP**	**BITF**	**CTC**	**VOICT**	**BICNIS**	**ICT Net**	**NiCAT**	**STP Zvezdara**	**STP Nivi Sad**	**SEE ICT**	**Quality Nis**	**Private SMEs**
Equipment															
Electromagnetic Compatibility				√										+	
Cloud infrastructure											+	+			
Rapid prototyping and manufacturing						√					+	+			
Software															
Automated IT															+

testing															
Rapid software prototyping											+	+			
Shared software											+	+			
Process development															
New products development	+	√				√							+		
Marketing-based processes	+	+					+		+	+					+
Value chain mapping		√			√		√		√	√					
Services															
Marketing and export	√	√	√				+		√	+					+
Business acceleration	√	√	+					√							+
Training															
Vocational education	√	√		√		√					+	+			+
ICT training				√			√		√	√	+	+	+		
Company development	√	√	+		√			√	+	+					+
Quality Standards	√			√										+	+
Quality management systems		+												+	+
Information															
ICT industry & technologies	√	√	√	√					√						+
Markets studies	√		√		√										+
EU opportunities		√	√	√		√	√	√	√	√					

Table 2 - Development of capacities to provide key enabling technologies and processes

The Appendix lists the proposed partner BSOs and BMOs with description of their current competencies.

3.3. Contributions by Other Donors and Projects

Several international donor organization have been providing financial and technical support to develop Serbian private sector, to enhance the competitiveness of its companies and to increase the capacities of business support organization to provide services to companies.

Assessment of donors support activities and on-going technical assistance projects indicates possible areas of cooperation to provide Serbian ICT companies with the required key enabling technologies and processes:

Donor / Project Area of contribution	GIZ ACCESS	FP7 & CIP	EuropeAid	JICA	Serbia-Italy forum	European Software Institute	SIPP	FINNO	WEM	ICES project	EVAL-INNO	SWISContact	IISP	USAid
Equipment		√	√							√				√
Software		√	√											√
Process development	√	√	√			√	√	√		√		√		
Services	√		√	√	√				√	√	√	√		
Training	√	√	√	√				√	√	√		√	√	√
Quality Standards	√	√	√			√	√					√		
Information	√		√	√	√	√				√			√	√

Table 3 - Contribution by other donors and projects

GIZ ACCESS Program

www.giz.de.

The program `Assistance to the Competitiveness and Compatibility for the EU of Serbian SME (ACCESS)` commenced in January 2011 within the framework of bilateral development cooperation between the Government of the Republic of Serbia and the Government of the Federal Republic of Germany the German Government. The project is implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

The programme has the overall objective `to improve the conditions for an enhanced competitiveness of Serbian SMEs on regional and EU-markets`. The programme objective is foreseen to be supported through four components:

- Component 1 - Business and Investment Climate (BIC): Supporting MoFE, chambers and associations actively pursue their roles to promote SME
- Component 2 - Innovation System (IS): Improvement of the framework conditions for SME for creating new and enhanced products and services

- Component 3 - Quality Infrastructure (QI): The Serbian Quality Infrastructure is in selected sectors aligned with international best practices and offers demand-oriented services
- Component 4 - EU: Increasing the absorption capacity of relevant Serbian institutions for resources of EU-programmes

The ACCESS project works with a diversified implementation structure (including public and private institutions as well as chambers and associations). Consequently, the elements of the projects are (i) support to local and regional economies, (ii) support to industries, including associations and clusters, and (iii) creation of a climate favourable to business and investment. The support components include advising government and institutions, companies and groups of companies, as well as training of local labour through both international and national experts, and providing local subsidies for seminars, trainings and promotional activities.

Institutionalization of mentoring as a service in the system of support for small and medium enterprises and entrepreneurship (JICA, Japan)

http://www.narr.gov.rs

Strengthening bilateral cooperation between Serbia and Italy through permanent forum

http://www.forumserbia.eu/

The main objective is the creation of a Serbian portal and the implementation of a number of well defined promotional actions for Serbian companies. This informative and operational instrument regarding Serbia constitutes the unique reference point for the Italian System (institutions and enterprises) in order to collaborate, develop activities in a synergetic way and for the mutual advantage.

The spirit underlying the project consists in the idea to expose Serbian companies and institutions to the experience of the Italian system of the Chamber of Commerce in some fields that are topical for business service bodies that allows intermediary institutions to help the entrepreneurs to find business opportunities.

On the Serbian side, Serbian Chamber of Commerce (Lead partner), National Agency for Regional Development and Serbia Investment and Export Promotion Agency are involved into the project.

Currently the forum does not support Serbian ICT industry. However, the capitalization on the experience in promotion of Serbian companies from 6 industries would open an opportunity to extend the activities of the forum to Serbian ICT companies in Italy.

European Software Institute

http://www.esi.es/

The European Software Institute (ESI), created in 1993 by the European Commission is now a Division of TECNALIA, one of the leading European research institutes. Its main activity is based on helping the software industry in their objectives or producing better software of a higher quality, on time, in the best way and at a lower cost.

The ESI implements the ITMark - the first international certification specifically designed for IT SMEs.

The Serbia Investment Promotion Program (SIPP) is administered by IFC/FIAS and funded by the European Union through the European Agency for Reconstruction

www.fias.net

FINNO – Mechanism for Fostering Innovation in the South East Europe

http://www.finnoeurope.eu./

The aim of the FINNO project is to contribute to better productivity and achieve more comparable level of innovativeness between countries in South East Europe (SEE) region.

The project creates a communication platform of decision-makers supported by sustainable mechanism for fostering innovation in SEE area, the FINNO Committee, a legal body providing governance level with constant and relevant policy recommendations.

Mentors of Women Entrepreneurs in Serbia

http://narr.gov.rs/index.php/narr_en/WEM/Home

Network of mentors of women entrepreneurship (WEM) are mentors that support women entrepreneurs in early stage of doing business, with aim to increase the number of success enterprises managed by women. Network has been established in 17 countries in Europe with 170 mentors, entrepreneurs with more than five years experience.

The National Agency for Regional Development is the implementing agency for this project. The period of realization is 24 month, starting from September 1st, 2011

Improvement of the competitiveness of enterprises in Serbia through new technologies transfer and support of innovations

http://www.ctc.kg.ac.rs/

The ICES project aims to provide a collaborative environment where key enabling technologies such as CAD/CAM/CAE, rapid prototyping and tooling, virtual manufacturing are integrated and applied in rapid product development. ICT companies, especially in electronic manufacturing and embedded IT systems, can benefit from its services for development of different types of prototypes.

Fostering evaluation competencies in research, technology and innovation in the SEE region (EVAL-INNO)

www.eval-inno.eu

4. Appendix

4.1. Overview of the Capacities of Serbian BSOs/BMOs

4.1.1.1. Chamber of Commerce and Industry of Serbia (PKS)

The Chamber of Commerce system of Serbia comprises the national chamber – Chamber of Commerce and Industry of Serbia, two Provincial Chambers, Belgrade Chamber of Commerce and Industry and 16 Regional Chambers of Commerce and Industry. It has its representative offices in nine European countries. Related activities:

- Representation of its members' interests before the state bodies and institutions
- Promotion of companies in the country and abroad by organizing participation in fairs and exhibitions
- Information on current economic trends, business environment, business standards and new technologies
- Facilitation of the search of business partners abroad and connection with them
- Consulting services in legal matters, quality management systems, introduction and protection of innovations, setting up business
- Training, specialized courses, seminars aimed at continuous improvement of professional competencies and business skills

Centre for information technology and e-business (Chamber of Commerce and Industry of Serbia 2013) the Centre is responsible for:

- Keeping track of world trends in IT development and its development in Serbia
- K making suggestions for its use within the system of Serbian Chamber of Commerce, as well as Regional Chambers of Commerce
- Making reports for the needs of the Chamber
- Participating in preparing regulations on ICT Section
- Cooperation with international chambers on IT development

4.1.1.2. Association of IT Industry

Association of IT (Chamber of Commerce and Industry of Serbia)

- Software producers

- Production of computers and computer equipment
- E-trade

Association provides the following services to companies:

- Represents the interests of its members in the field of information communication technologies
- Prepares initiatives and suggestions relating to the standards and regulations in this field
- Promotes the development of new technologies in Serbia
- Creates new jobs
- Carries out the training programs for its members through the seminars, workshops, round tables
- Cooperates with other relevant associations in the region
- Connects domestic firms with potential partners abroad
- Cooperates with the related state institutions
- Organizes trade fairs both in the country and abroad
- Issues the certificate on domestic origin of goods in the public procurement procedure
- Issues the certificate on the sole bidder of domestic goods

4.1.1.3. National Agency for Regional Development

The National Agency for Regional Development (NARD) is the primary resource centre for information and harmonization of the institutional and entrepreneurial initiatives aimed at development of all regions in Serbia. National Agency operates through a network of 18 Regional Agencies for Economic development and Regional Centres for SMEs development. Accredited regional structures provide the following services to entrepreneurs and companies:

Non-financial support to companies

- Information on starting, growing and improving business
- Consulting in the areas of legal support, finance, innovation
- Mentoring to assist companies in overcoming unfavourable situations
- International Fair of entrepreneurship “Business base” and promotion of companies
- Training

Financial support

- Innovative clusters support program to increase productivity and competitiveness of companies and entrepreneurs by integrating them into clusters and strengthening their cooperation with scientific research organizations
- SME competitiveness support program provides grants to companies
- Business incubators support program
- Start ups support program by providing training, financial grants and mentoring
- SMEs innovation support program in cooperation with the MoFE
- Support program for fast growing SMEs – gazelles

International promotion of companies

- International business development of companies through the Enterprise Europe Network (EEN) with information on the conditions for entering the EU market, dissemination of export opportunities, new technologies, search of potential partners, EU programs facilitating technological development, organization of business meetings and companies missions
- Mentoring of female entrepreneurs through the European Network of Women Entrepreneurs Mentors (WEM)

Research and information

- Analysis of the status, needs and problems of entrepreneurs through monitoring of a panel of 3000 companies
- Research on innovation development of companies

4.1.1.4. Serbia Investment and Export Promotion Agency

One of Serbia Investment and Export Promotion Agency (SIEPA) main goals is the promotion of Serbian goods and services on foreign markets. It has two dedicated departments dealing with support to Serbian companies: the Export Promotion Department and the Marketing and Research Department. The tasks are carried out through:

Export related services

- Identification of local partners and suppliers, including meeting facilitation
- Maintaining investment and exporters databases
- Helping Serbian exporters service international markets
- Assisting in promotion of domestic products at international fairs

- Export development through the Enterprise Europe Network

Company business development services

- Sector analysis and studies
- Cost-sharing development grant program which enhances the competitiveness of Serbian companies

Foreign investment facilitation for foreign companies in Serbia

- Matchmaking with Serbian Joint Venture partners
- Linking with local suppliers
- Organizing site visits
- Facilitating contacts with national and local authorities

Serbian suppliers database with companies classification by sector of some 2300 companies with more than 300 in IT industry

- Business and ICT services
- Electrical and electronics
- Software and ICT

4.1.1.5. Institute Mihailo Pupin

Institute Mihailo Pupin (IMP) represents synthesis of scientific and expert knowledge in the broad area: electronics, automation, process control, computers, telecommunications, digital signal processing, information systems, software engineering and robotics.

The core technical service scope provided by IMP covers

- Customized IT solutions
- Hardware & software outsourcing
- Technology consulting
- Engineering
- Prototyping
- Specialized technology consulting and engineering
- Concept-refinement
- Training and Customer Support

Through the support of the European Union funded project “Building the Serbian electromagnetic compatibility quality infrastructure”, IMP will soon host a laboratory with state of the art electromagnetic compatibility equipment. The scope of EMC Lab related competencies will allow providing the following services to Serbian companies:

- EMC anechoic chamber
- EMC testing with accreditation covering 20 tests in 24 products groups
- Pre-compliance EMC tests service with the purpose to assist Serbian companies with product development and putting of their products for commercialization on foreign markets
- Memorandum of understanding with TÜV Süd which gives access to the TÜV's international network
- Provision of post graduate study course on EMC at Belgrade University of Electrical engineering

Institute Mihailo Pupin provides the following services related to EU and technological development:

- Export and technological development of Serbian companies through the European Enterprise Network
- Promotion in Serbia of EU-funded Framework Program (FP7) and the Competitiveness Innovation Program (CIP)

4.1.1.6. Business Technology Incubator of Technical Faculties of the University of Belgrade

Business Technology Incubator of Technical Faculties Belgrade (BITF) provides education to students and young people who wish to start own business, through training programs in entrepreneurship and specialized trainings, permanent consulting and mentoring program. BITF has established five clusters and business networks.

BITFe provides small hi-tech start-ups with office space, financial, legal, accounting services and permanent education, consulting and mentoring program. Services in market research and intellectual property rights are in development.

BITF regularly provides trainings in the following areas:

- Management
- Marketing
- Team work
- Business Communication and Sales

- Intellectual Property Rights
- Project management

Services to companies

- Market research
- Intellectual property rights

4.1.1.7. Collaborative Training Centre Kragujevac

http://www.ctc.kg.ac.rs/

Collaborative Training Centre Kragujevac (CTC) is a member of the network of collaborative training centres in the Western Balkans. The centre provides following services:

- CAD/CAM modeling using CATIA software tools
- Rapid prototyping using 3D printer with PolyJet technology
- Multisensor coordinate measuring machine with determination of 2D and 3D geometries
- Reverse engineering applications
- Vocational training for companies

ICT companies, especially in electronic manufacturing and embedded IT systems, can benefit from its services for development of different types of prototypes of new products.

The service of multi-sensor coordinates measuring in 2 and 3D geometries would facilitate access of ICT companies to the reverse engineering applications for their new products development.

Through the network of partner Collaborative Training Centres in the Western Balkans countries, Serbian companies can also benefit from services of 3D CAD & CAM modeling using SolidWorks, ProEngineer and Mastercam software tools.

4.1.1.8. Vojvodina ICT Cluster

The cluster (VOICT) serves as a platform for cooperation and provides a portfolio of services to its members:

- Building capacities and competitiveness of its members through training and education at the Cluster Academy
- Building links with the education system
- Creation of new business opportunities

- Facilitation the access to new markets through organization of visits to foreign countries and trade fairs
- Lobbying activities
- Matching R&D initiatives with the real world needs of SMEs in Serbia
- Transfer of ICT technical and technological achievements to businesses by developing a two-way communication channel between R&D institutions and potential users
- Enable knowledge sharing among cluster members

4.1.1.9. ICT Network Cluster

ICT Network Cluster (ICT Net) is an association of companies, individuals, academic and research institutions devoted to the development of ICT sector in Serbia. The services provided to its members:

- Dissemination of relevant and up-to-date information from ICT industry
- Value chain mapping through encourage its members to suggest their own initiatives or projects which can be realized either through Cluster's extensive network of strategic partnerships or in cooperation with other member companies
- Facilitation access to public and EU funds for its members, giving them possibility of internationalization of their business operations

4.1.1.10. Nis Cluster of Advanced Technologies

Cluster of Advanced Technologies (NiCAT) brings together 25 local companies doing business in electrical, electro-mechanical and ICT industry, Faculty of Electronic Engineering and Faculty of Mechanical engineering, Regional Development Agency ORA JUG, Regional Chamber of Commerce, Business Incubator Nis. The cluster provides to its member companies the following services:

- Facilitation of training in the subjects related to enhancement of companies' competences, standardization and certification
- Assessment of companies-potential for EU projects
- Information and training on EU-funded project opportunities
- Training on preparation of project proposals, consortia building
- Facilitation of internationalization and marketing
- Value chains development among cluster members

4.1.1.11. Science and Technology Park Zvezdara

The Science and Technology Park Zvezdara is located at northeast of Belgrade and aims to promote the growth of technology-related companies. With the start of operations planned later in 2013, the park will feature a number of shared services, including office / workshop spaces, meeting rooms, financial and legal services.

Zvezdara Science and Technology Park would be an important opportunity to develop a shared resource centre for ICT companies with provision of services related to several key enabling technologies and services. Potentially, this shared resource centre would be an ideal location to provide access the following shared services:

Equipment

- Mobile phones and tablets
- Cloud-based infrastructure for software prototypes development and testing
- Equipment for molding in small series
- 3D printers for rapid prototyping

Management of shared software services

- Rapid software prototyping and simulation development software
- Software tools for automated testing of software and IT systems
- Oracle databases and application servers
- Software tools for management of the SCRUM development process
- Shared subscription to Software as a Service (SaaS) applications

The park location would be suitable to host a computer class for organization of different types of training and education

- Professional and vocational ICT education
- ICT Academy

4.1.1.12. Science and Technology Park Novi Sad

Science and Technology Park Novi Sad will provide a number of shared services for small incubator companies involved in electronics, ICT, research and development.

Like Zvezdara, Science and Technology Park Novi Sad would be an ideal location in this part of the country to develop shared services for existing ICT companies related to

- Provision access to shared equipment

- Management of shared software services
- Hosting a computer class for organization of different types of training and education

4.1.1.13. Business Incubator Centre Nis

Business Incubator Centre Nis (BICNIS) provides services to people who wish to start own business, through training programs in entrepreneurship and specialized education and consulting program.

4.1.1.14. Regional Centre for Development of Small and Medium-Sized Enterprises and Entrepreneurship "Belgrade"

The Republic Agency for the Development Small and Medium-Sized Enterprises and Entrepreneurship (RASME). RASME has predominantly been active in providing legal and financial consulting, as well as training in co-operation with the National Employment Service. The Agency helps SMEs in adapting new technologies in the form of advisory support to their innovative activity.

4.1.1.15. South-East Europe Information and Communication Technologies

SEEICT is a young organization established in Belgrade with the aim of contributing to the development of information society in Serbia, believing that new technologies can improve all aspects of social life – the economy, education, culture and health.

With its new StartIT Hub concept, SEE ICT targets to create a carefully organized platform that consists of:

- Rich start-up education and networking program
- Various IT, digital culture and information society events delivered by relevant community organizations,
- Co-working space
- Meeting and networking space
- SEE ICT Startup Academy
- SEE ICT TechMeetups
- Modern, creative space for conferences and events

StartIT Hub is a partly commercial – partly non-profit endeavour that aims to be self-sustainable through a mixture of paid and free services, for various target groups – start-ups, entrepreneurs, tech companies, corporations and selected companies in need of creative spaces for events and work.

4.2. Methodology of the Study

The methodology of the study is based on in-depth interviews and the analysis of the outputs in order to draft the study. The analysis has been provided based on interviews of representatives of relevant Serbian business innovation support organizations, ministries, selected chambers of commerce, relevant business membership organizations in the sector and a sample of 20 representative ICT SMEs.

A description of the NPD technologies presently being used by Serbian SMEs operating in the ICT sector has been prepared with the analysis of the strengths and weaknesses of the technologies and methodologies being used.

Based on the technology audit, the definition of key enabling technologies appropriate for the Serbian ICT SMEs in order to make them more competitive on the international market has been conducted. The technological expertise of Serbian BISOs which already have access to international markets as well as the expertise of German and international experts working in the ICT sector have been utilized.

The final stage is drafting of recommendations as regards which BISOs are best placed to assist Serbian ICT SMEs introduced the KETPs and to manage a self-sustaining centrally managed, shared resource centre.

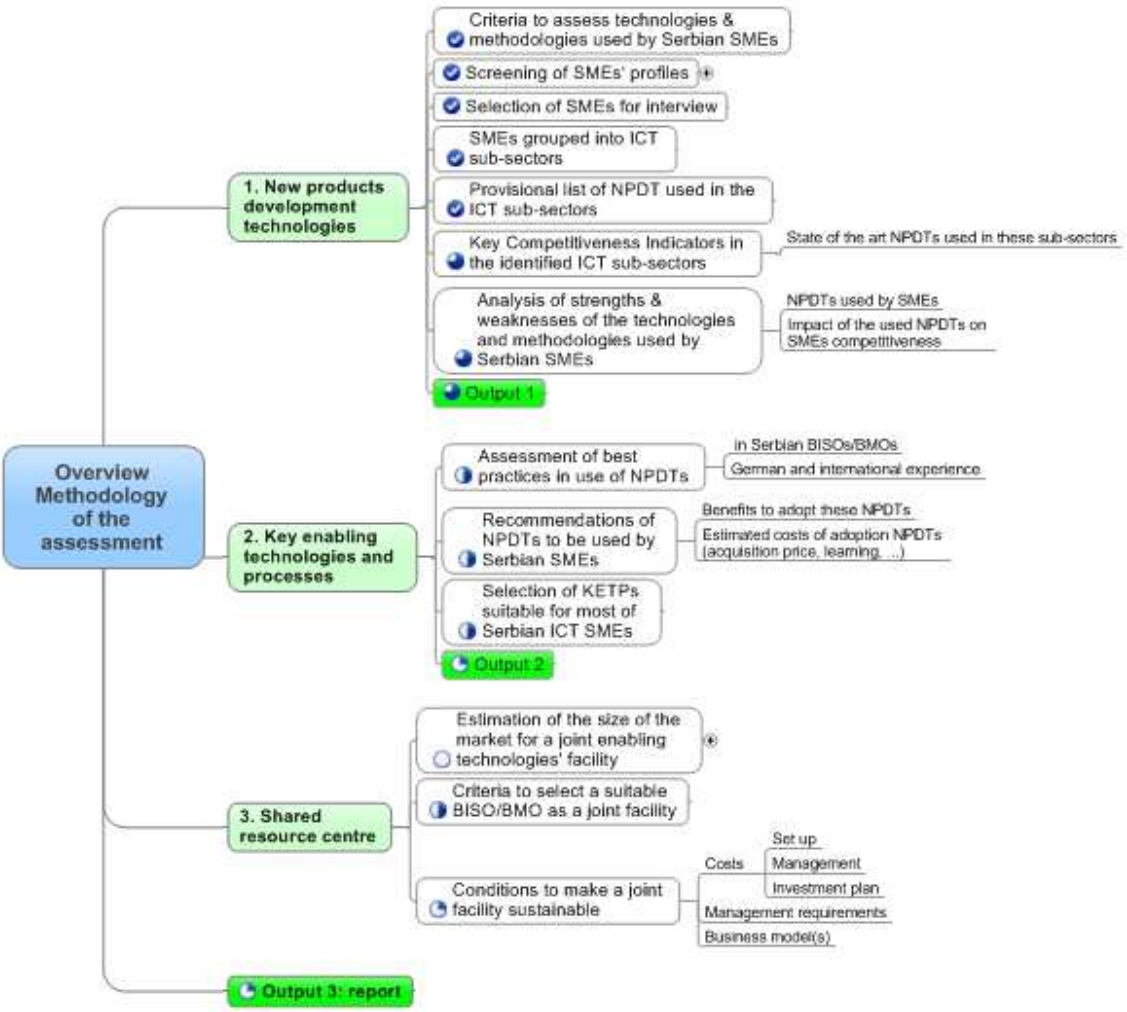

Figure 3 - Overview of the study methodology

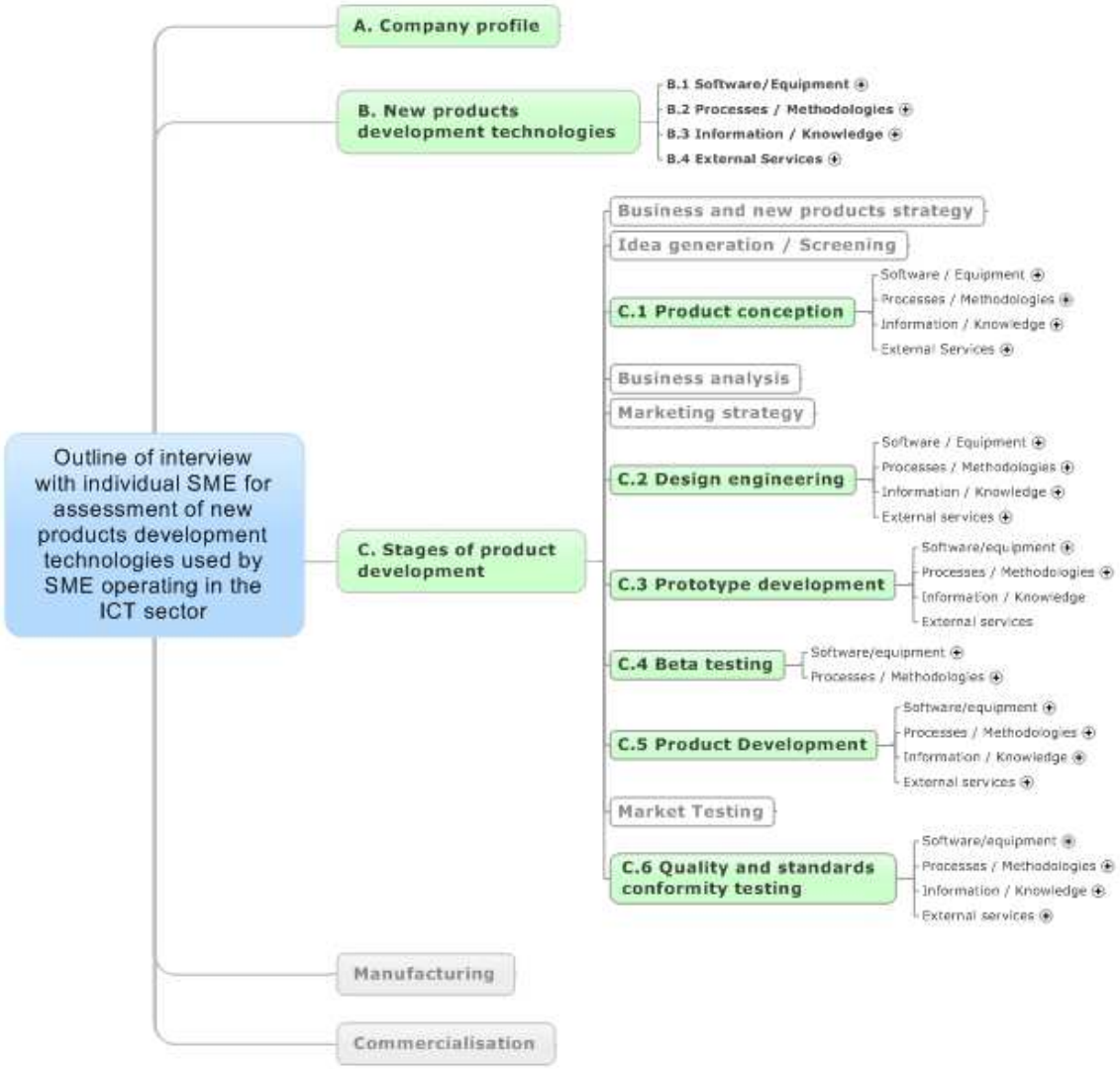

Figure 4 - Outline of interview with individual SME

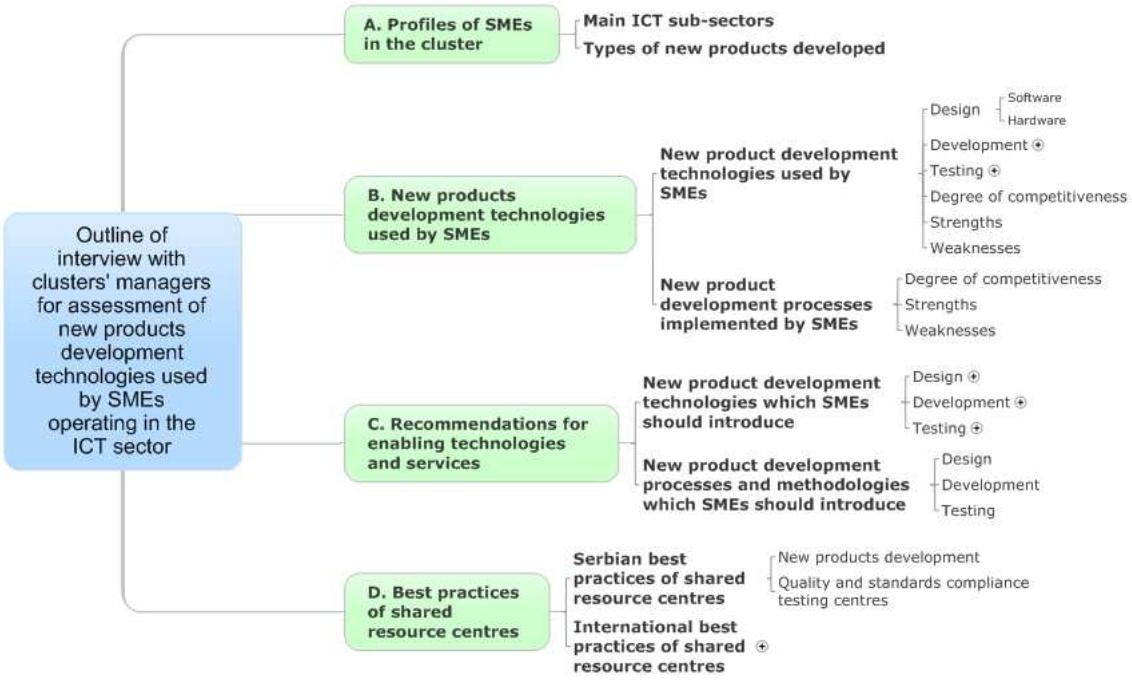

Figure 5 - Outline of interview with clusters' managers and BSOs

4.3. International Best Practices

The following examples present some international best practice cases in organisation of shared resources facilities for enterprises in ICT and other areas.

4.3.1. Korea -National Information Technology Industry Promotion Agency

www.nipa.kr

National IT Industry Promotion Agency (NIPA) was created with the purpose to reinforce the competitiveness of the national IT industry and contribute to the economic growth through the efficient support and laying the groundwork for the industrial technology promotion.

Representing 11% of the gross national product and more than 30% of exports, the telecommunications industry is leading Korea's economy. In particular, the role it plays as an essential factor in the competitiveness of other industries, including the automobile, shipbuilding, and medical sectors, is becoming critical. In the current "Smart Era" which started with smart phones and is expanding to smart TV, smart work, and the like, IT industries are laying the foundation.

The National IT Industry Promotion Agency is preparing development strategies and policies for the continuous growth of such important IT industries. As well, NIPA is fully dedicated to the creation of new future industries by laying the foundation for the growth of industries, securing the global competitiveness of Korean IT companies, and promoting collaborations between IT industries and other industries.

The main NIPA's activities comprise the following areas:

- Policy research and development support for the IT industry
- Helping to establish the foundation of the IT industry and cultivate its human resources
- Vitalizing the distribution market for the development of the IT industry and support marketing
- Assisting businesses related to the convergence and utilization of IT technology
- Supporting international exchange, cooperation, and overseas expansion of Korean IT businesses

Important part of its activities NIPA dedicates to the development of the competitiveness of Korean IT companies. NIPA operates RFID (Radio-Frequency Identification) / USN (Ubiquitous Sensor

Network) Centre and Software Engineering Centre which are fully dedicated to the assistance to businesses in application of new technologies for the development of new products. These centres operate on the model of resources facilities where interested companies can benefit for a wide range of shared equipment, technical and business advisory services, training and certification.

4.3.1.1. RFID/USN Centre

RFID (Radio-Frequency Identification) / USN (Ubiquitous Sensor Network) Centre provides comprehensive technological support for domestic and foreign RFID/USN companies. It is an institute operating the international certification system such as KOLAS, NFC Forum, EPCglobal, and so on. Furthermore, the centre makes a commitment to vitalize the domestic RFID/USN market.

The main purpose of the centre is to contribute to the activation measures of relevant industries through micro-electromechanical systems (MEMS) sensor production service and RFID/USN comprehensive technology support with the establishment of UIT (ubiquitous Information Technology) shared base facilities. The centre is located in Incheon free economic zone which is about 30 km from Seoul and employs 72 people. Its 10-year budget is about 11.6 million Euro (17.5 billion won).

The centre puts at the disposal of its clients MEMS foundry – a contract manufacturing service establishing batch/unit process in 6 fields, such as photo, etching, and bonding process. It also operates other shared equipment requested by customers through market demand surveys. The centre provides services of equipment support, prototype assembly and production, standards, test and reliability measurement, and certification.

Employees of the centre works in two teams - Technical Support Team and Test and Certification Team:

- Technical Support Team is responsible for the RFID/USN Centre's budget, planning, human resources management, contracts, and facilities management. It supports the domestic companies supplying RFID/USN in the product development, and it promotes the adoption of RFID/USN technology for the companies demanding the technology.
- Test and Certification Team offers RFID/USN-related testing and certification services including the industrial standards, performance, reliability test, etc. to both domestic and foreign companies. In addition, the Test and Certification Team pledges its support in stable technological diffusion and product improvement through developing test specifications for

various industry applications and technology such as automobiles, home appliances, clothing, food, parcel services, cosmetics, and beyond.

Following trends and new areas in IT development, the RFID/USN Centre plans its future extension in the directions such as development of the full-scale production system of MEMS fabrication, enhancement RFID/USN testing and certification system.

Also, the centre understands importance of its role to secure and promote USN applied field technologies, such as enhancing service quality, u-City and Smart Grid to strengthen its competitiveness in testing and certification services.

In near future, the RFID/USN Centre envisions to expand the international testing and certification system and jump up to become a global RFID/ USN testing and certification authority.

4.3.1.2. Software Engineering Centre

The Software Engineering Centre is the central hub connecting universities and professional research institutes in software engineering technology research based on the industrial demand. It provides small and medium-sized enterprises with the onsite application and the professional consulting on software engineering technologies to enhance software productivity as well as the overall technological data on the applicability of software engineering technology. Moreover, its team would endeavour to establish the foothold in maintaining high status as a specialized agency through reinforcing the competitiveness in software quality.

The Centre secures the overall quality of software and enhances productivity through applying software engineering technology to the industry and raising their recognition. It is located in Sangam area of Seoul. Its 10-year budget is about 5.6 million Euros (8.5 billion won) and the Centre has 34 employees.

The main roles and functions of the centre are:

- Establish and strengthen the policy base to improve software quality and productivity. Establish quantitative data management system and performance analysis, disseminate success stories, and promote the consistent policy
- Apply software engineering technology and enhance recognition for the competitiveness in software convergence. Fully diagnose the software engineering level to support selective cases and provide extensive consultation for some dozens of companies in software engineering technology application

- Implement the quality system and promote pioneering businesses for innovation of software development technique. Improve and expand software quality systems such as SP quality certification system, software business cost, and software ordering and management process to strengthen quality management system of software enterprises
- Secure effective software engineering key technologies and talented HR through academic and industrial connection. Coordinate collaborative research in software engineering and industrial domain departments

The Software Engineering Centre is composed of the following teams:

- **Software Quality Based Team**. Its tasks entail establishing and operating software bank system for the distribution of software technology and products. The team endeavours to create ecosystem for software trade and distribution where the outstanding software technology assets could widely be distributed. Such ecosystem can be established by sharing the excellent software technology assets through analyzing, processing, and building a database with the software bank as well as connecting the provider to the consumer. The team also carries out research in developing and enhancing the standard for validating the research and development of software quality.
- **Software Engineering Team** takes on duties related to consulting, development and distribution of software engineering tools for the software engineering technology area that are strictly necessary to the most software companies (requirements, analysis, design, testing, inventing, maintenance, configuration management, software engineering management, tools and techniques, software quality, and so on). This team devotes its full attention to enhance the software quality and the productivity of the small and medium-sized software enterprises.
- **Software Engineering Research Team** takes the initiative in securing the competitiveness of software industry by operating software business information repository to assess the competency level for the software development process and to estimate the objective quantitative cost for national software projects.
- **World Best Software (WBS) Team** takes on the responsibilities of supporting the independent product quality management and reinforcing of the national WBS research and development project to meet global standards and secure the competitiveness in software quality. The team pledges its help in recognizing and boosting the overall condition and value of the national software industry.

- **Management Support TF Team** takes on the jobs related to the overall management of publicizing, organizing, budgeting, as well as the human resources management for the administrative efficiencies in the Software Engineering Centre.

In the future, the centre envisions focusing on reinforcing convergence of software competitiveness and software industry development practices through connection with key industries that have large ripple effects, such as automotive, shipbuilding, healthcare, etc.

The centre plans to provide intensive support for software enterprises that have difficulties in overseas market entry due to a shortfall in software quality management ability and investment.

4.3.2. EU - ICT Lab of the European Institute of Innovation and Technology

Business Development Accelerator

http://www.eitictlabs.eu

EIT ICT Labs is one of the first Knowledge and Innovation Communities set up by the European Institute of Innovation and Technology, as an initiative of the European Union. EIT ICT Labs' mission is to drive European leadership in ICT innovation for economic growth and quality of life. Since 2010, EIT ICT Labs has consistently brought together researchers, academics and business people. By linking education, research and business, EIT ICT Labs empowers ICT top talents for the future and brings ICT innovations to life. EIT ICT Labs' partners represent global companies, leading research centres, and top ranked universities in the field of ICT.

The EIT ICT Labs builds upon Nodes in Berlin, Eindhoven, Helsinki, Paris, Stockholm and Trento, leading in ICT, and their partners representing global companies, leading research centres, and top universities. The role of the Nodes is to execute the strategy of the EIT ICT Labs, focusing on excellence in education, research, and innovation. Based on the best academic and industry researchers, already excellent regional clusters are turned into world-class innovation hotspots. Each Node has its unique profile within EIT ICT Labs but encompasses all aspects of the knowledge triangle. Activities are based on selected innovation areas, called Action Lines, each featuring a specific focus including groups and activities from several Nodes.

Each Node operates a physical Co-location Centre where most of the activities are carried out. The Nodes are organized by three to ten Core Partners together with additional Affiliate Partners.

Associated Partners outside the Node countries, have a direct mission from central EIT ICT Labs management, though they are also connected through the Nodes and, of course, expected to contribute significantly to co-location activities.

EIT ICT Labs provides several types of services to companies through its Business Development Accelerator which focuses on assistance to existing businesses at any stages of their development.

The Business Development Accelerator offers a unique Pan European ecosystem in 6 countries with an extended network of its Business Developers, access to European market through large companies and access to European wide network of investors & venture capitalists. A team of European business developers runs the Business Development Accelerator. They manage a funnel with two phases: scouting of innovative SMEs and technologies, coaching innovative SMEs to deliver European growth success stories.

The Business Development Accelerator provides the following business development services for technology-based start-ups and business growth acceleration for high-tech well-established companies:

- **Technology Scouting** at the Accelerator consists of a massive selection phase where innovative SMEs or technologies with high potential growth in Europe are screened and qualified.
- **Innovation Radar** is a strategic information hub of the EIT ICT Labs, with an expert network spread over all six nodes: Berlin, Eindhoven, Helsinki, Paris, Stockholm and Trento. The aim of the Innovation Radar is to establish a common outlook on the future of ICT. It helps to develop tools and capabilities to turn ideas into ICT-based products and services that reach the market faster and with a larger impact than today.

  The Innovation Radar:

  - ✓ Identifies trends in ICT, focusing on the innovation areas of the EIT ICT labs
  - ✓ Provides images of the future of ICT
  - ✓ Identifies innovation opportunities and potential for commercialization
  - ✓ Facilitates follow-ups on identified developments and trends
  - ✓ Creates business intelligence and strategic foresight
  - ✓ Creates cohesion within ICT Labs on the ICT developments and trends

These activities are supported by an IT platform for sharing and dynamically refining trends and innovation opportunities, and for presenting completed studies. Partners can join this platform. Access can be obtained through *https://innovation-radar.eitictlabs.eu*

Stakeholders include the strategic function of the EIT ICT Labs led by the CEO, innovation managers and strategic staff at the large partner companies, product managers at the small and medium-sized partner companies, and business and management researchers in research institutes and academia.

- **Business Modelling** supports the generation, planning, and deployment of business modelling concepts and identification and generation of commercialization opportunities of research results.
- **Strategic Coaching** is profited for qualified SMEs or technologies. It is a comprehensive program aiming at actively stimulating the development and growth of high potential innovations through intensive coaching. Strategic Coaching will help promising innovations coming from e.g. action lines, start-ups, SMEs, big companies and others to grow internationally and expand to other EIT ICT Labs nodes.

  In order to be eligible for coaching, an international ambition and a strong linkage with one or more of the action lines within EIT ICT Labs is needed. In each EIT ICT Labs node are 2 to 4 experienced business developers available who are also connected to one or more action lines and business accelerators (T-shaped professionals). The business developers are the high selective phase coordinators for the action lines, start-ups, SMEs, etc. by connecting them to all the services offered within the business development catalyst and managing them case by case.

  EIT ICT Labs offers coaching on aspects like: the strategy of the high-tech SME, professionalize the marketing of the products and services, finding the right USP's, business model testing, fine-tuning business models and pricing issues, market entry, financial planning, launching customers & deal making, CEO coaching & team development, patent advice, IP protection, writing investments plans, etc.

  EIT ICT Labs also provides access to the relevant network in the node home country and an international network through all the connected business developers of EIT ICT Labs. EIT ICT Labs can introduce the SME's into venture capitalists and organizes every year meetings where investors and high-tech SME can meet each other.

If an SME has a very promising outlook, competitive and unique technology, successful in one country and real international ambitions the EIT ICT Labs Coaching Program will push these SME's to the next level.

- **Access to Finance** supports the early stage financing possibilities for innovative start-ups and facilitates access of risk capital to the EIT ICT Labs ventures.

  EIT ICT Labs give access to the ecosystem of leading venture capitalists in Europe. It provides support for entrepreneurs to pitch their concept to venture capitalists. Through its Business developer team, EIT ICT Labs give access to several tools regarding the investment readiness, including training workshops.

  Through partnership with European Investment Fund, EIT ICT Labs aim that its coached SMEs are funded in the best conditions at the European scale. For that, EIT ICT Labs participate to several funds as partner of EIF both on PoC (Proof of Concept) level and Growth phase as well with TTFF platform (Technology Transfer Facility funds) and COIP funds (corporate Innovation Platform), which are two EIF initiatives.

- **Soft Landing** fosters SMEs and start-ups development internationally by connecting them to EIT ICT Labs' established European ICT ecosystem. Soft landing targets promising companies doing business in areas consistent with the innovation areas of the EIT ICT Labs.

  EIT ICT Labs offers to SMEs and start-ups a range of services (generally designated as soft landing services) to facilitate their immersion in the EIT ICT Labs nodes. Soft Landing is implemented across nodes through a network of partners (clusters) and contributes to potentially two of these partners' objectives such as 1) support the international development of the SMEs established in the node, and, 2) support the local investment and settlement of foreign companies in the node.

- **Technology transfer** is filling the gap between early-stage research and readiness for commercialisation. Promising technologies are identified to increase the flow of technologies from academic research organisations to the industry. Technology transfer opportunities are detected, stimulated and supported by the Business development team. The process is applied to technology in different maturation cycle in order to accelerate the technology and knowledge transfer to the market through licensing or spin-off processes.

The Business Development Accelerator supports innovative companies to scale up business up to European level and beyond. It provides end-to-end support from turning research results into

successful innovations, stimulating the birth and growth of new and young ventures, support existing SMEs for European growth, enrich large companies with new technologies and innovation coming from research or innovative SMEs.

4.3.3. Japan - SMEs Support Centres

http://www.sme.ne.jp

The Small and Medium Enterprises Agency established three types of business support system for SMEs: 1) SME and Venture Business Support Centres, 2) Prefectural SME Support Centres, and 3) Regional SME Support Centres. These centres, in collaboration with the private SME support institutions such as the Commerce and Industry Associations and the Chambers of Commerce and Industry, work as one-stop service counters which provide information concerning SME support strategies and implement support projects.

SME Support Centres are established to provide one-stop services for SMEs, which include over-the-counter consultation, dispatches of experts and incubator managers, on-site professional assistance, business feasibility assessments, information service and training programs. The centres not only provide management strategy, marketing and consulting services to SMEs and entrepreneurs, but also they provide support for specific management issues of each SME.

The SME and Venture Business Support Centres have 8 locations in the main large city level, while the Prefectural SME Support Centres have 57 locations in prefecture level and the Regional SME Support Centres have 261 locations in the local city level. The national support centres are composed of specialist groups (2009): 30 project managers, 840 specialists, which include management consultants, accountants, lawyers, patent attorneys, consulting engineers, persons experienced in corporate management, and 300 retired-but-talented peoples.

4.3.3.1. Expert dispatch program

The centres operate **expert dispatch and incubator manager dispatch programs**, through which the centres provide appropriate advices according to a level of company's development stages.

The expert dispatch program provides a long-term and continuous dispatch of experts, mainly retired specialists, in management, technology, finance, and legal affairs targeting specific and difficult management problems such as getting patents.

Expert dispatch program has the strength to provide appropriate advices in accordance with stages of company development. The expert dispatch program, which provides the long-term and continuous dispatch of experts in management, technology, finance, and legal affairs, can target specific and difficult management problems inherent in each SME. Because of this intimate long-term residency of specialists in SMEs, the management consultation services can be practical and appropriate for each SME and can easily lead to management restructuring for efficiency gains. Even in the change case of a specialists or incubator manager, the transfers of duties to a new appointee are complete and sincere in practice so that the familiarity with each SME in supports will continue without interruption.

In their turn, the project managers of the centres provide comprehensive supports that ensure consistency throughout the project, from the stage of compiling plans of operations to the stage of actual implementation.

(Source: http://www.apec-smeic.org)

4.3.3.2. Leasing equipment to SMEs

http://www.tokyo-kosha.or.jp

Tokyo Metropolitan Small and Medium Enterprise Support Centre is a public-interest corporation established by the Tokyo Metropolitan Government with the goal of contributing to the development of local economy by providing referrals for subcontractors, arranging placements, offering fostering and training services for small and medium-sized companies in order to achieve stability and development of small and medium-sized companies based in Tokyo.

In order to motivate SMEs to take the next step, to help in developing business and expand into new areas, the Equipment Leasing Section of the Business Development Support division provides a service of equipment leasing to SMEs.

The Equipment Leasing Section purchases production facilities on behalf of SMEs and lease them at a moderate rate. Security from a guarantee agency defined by the Tokyo Metropolitan Government is required. In principle, this service covers new equipment installed in offices in Tokyo.

4.3.4. United Kingdom - Manufacturing Advisory Service

www.mymas.org

MAS provide manufacturing business support for companies based in England, helping them to improve and grow. MAS is a service of the Department of the Business, Innovation and Skills of the UK government.

MAS is designed to help manufacturers streamline processes, reduce waste, become more energy efficient and generally improve and grow your business.

Regardless of the size of the business their experienced and highly skilled advisors can help businesses. They all have 'hands-on' experience of both shop floor working and management skills. They work with businesses and their workforce to ensure that business is run in the best way possible. For small or medium sized manufacturer in England, many of services are free and supplemented by appropriate grant funding.

4.3.5. United Kingdom - SEMTA

www.semta.org.uk

Semta is the Sector Skills Council for the Advanced Manufacturing and Engineering sectors. Semta address the sectors' skills needs, providing expert support to improve performance and growth, including:

- advice on qualifications
- frameworks
- strategic workforce planning
- access to funding
- identifying appropriate training to deliver return on investment
- recruitment / training of apprentices and graduates
- developing supply chain capability.

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