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INFORMATION TECHNOLOGY AS A DETERMINANT OF SMES COLLABORATION AND INNOVATIVENESS

Abstract: *Studies of small and medium-sized enterprise (SMEs) development around the world show that the most significant factor for increasing their numbers and improving business success is the free enterprise, as exogenous, and innovation as an endogenous variable. At the same time, the dominant view in economic theory is that innovation is a key generator of changes for which the SMEs can be considered as a kind of metaphors for a successful business over the last twenty years in a number of economies. Arguing that cooperation between SMEs is increasingly common generic strategy of their development, the paper first explains the importance of collaboration to increase innovation and competitiveness, and then provides possible models using information technology such as Workflow Management Systems (WfMS), Service Oriented Architecture (SOA) and Service-Oriented Cloud Computing Architecture (SOCCA) to support the collaboration of these business entities. Solutions provided are aimed at improving the innovativeness of SMEs and fully follow the requirements of the so-called fifth-generation innovation process whose key attributes are integration and flexibility.*

Keywords: *small and medium enterprises, information technology, WfMS, SOA, SOCCA*

1. Introduction

Small and medium enterprises are not recent economical phenomenon. However, their expansion is particularly evident at the end of the seventies of the twentieth century. Statistics confirms the overwhelming presence of SMEs in both developed economies and transition economies. To illustrate, from the approximately 20 million enterprises in the EU, 99% are SMEs .SME sector has a majority share in most indicators of the private sector in countries in transition. This illustrates the fact that the development of both economically advanced countries and transition economies over the past twenty years is based on a major participation of SMEs and their ability to recognize and seize opportunities in the market and effectively meet the needs of consumers. Thanks to these characteristics, the role of SMEs exhibit a kind of glue that connects the entire structure of the economy whose composition consists of companies of different sizes (Pokrajac, 2004).

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SMEs are often more effective than large companies, and they are able to apply new technology and introduce new products to the market in a very short period of time. Smaller businesses need much shorter time period from their inventions to mass commercialization, compared to large companies, which is understandable when you consider that they are for the most part focused on one market segment.

Development of SMEs around the world during the seventies of the 20th century is linked to the resurgence of market forms of organization. The direct link between the development of SMEs and free competition is reflected in the fact that they need smaller amount of capital, that they have a heterogeneous structure, a flexible combination of factors etc. Fink and Kraus (2009) indicate that the one of the biggest advantages of SMEs is that they quickly and easily make decisions, no matter how much risk they carry with them. This form of business entities can easily respond to all requests from more refined buyers in the market, and they, despite not being able to win a large market, have the dominance of many market niches almost guaranteed.

The basic assumption, which is often the starting point in analyzing the role of SMEs in economic development, is that, in a time of great technological paradigm shift, they have a natural advantage over large, hierarchical firms. Due to the extreme flexibility, small businesses would have to be faster in operation and taking the potential benefits of the new paradigmatic framework.

Traditionally, SMEs are faced with the challenges of the market primarily due to the existence of limited resources along with little help from the state. This scenario becomes even more onerous in uncertain economic periods such as the current economic crisis, due to the limited access of SMEs to capital markets, and the sources of their external financing much more limited compared to large companies. Despite these obstacles, Potočan and Mulej (Potocan and Mulej, 2009) emphasize that the globalization of markets and increased international competitiveness of SMEs require continuous increase in innovation and flexibility. Globalization is becoming a main factor affecting the incomes and living conditions of people.

Starting from a number of theoretical and empirical research that confirms that SMEs are important control lever in the strategies of economic progress in highly developed, and so far the largest number of developing countries, the objectives of this paper are: a) showing the importance of innovation for growth and development of SMEs, b) stressing the importance of the model of open innovation and collaboration in the growth strategies and development of SMEs c) an explanation of the role of specific models of the application of modern information technology as technical foundations for collaborating SMEs. In accordance with the case studies and defined goals, the hypothesis is: a successful collaboration of SMEs with the support of information technology results in enhancement of their innovation.

The authors of the study did not find the research that are, in a holistic way, treating three dimensions emphasized in the functioning of SMEs (innovation, collaboration as a factor of growth and competitiveness, and specific model of IT that enable the successful collaboration). Therefore the this paper makes an attempt to identify the key aspects of reference partial studies of the mentioned business and technological aspects of the SMEs and incorporate them as much as possible into a consistent whole which also confirms the hypothesis defined. In this sense, using a method of analysis, we give critical overview of the relevant partial researches of innovation, collaboration and applying information technology in SMEs, while the synthesis is done to connect them and sublimate attitudes on the importance of collaboration supported by modern information technologies in the process of

promoting innovation and competitiveness of SMEs. This is the advance of this paper.

It particularly can be used as a guide, perhaps a pathfinder, who takes SMSs on a transformational journey—from an incoherent and complex business world to a more rationally organized and useful state with revenue-generating platforms and an efficient operational regime. Also, for meny SMSs this paper can act as a strategic foundation for business enablement.

2. Innovativeness in companies and the economy

It is known that attitude presented by Porter (Porter *et al.*, 2000) that achieving the level of competitive advantage in the global economy requires high innovation firms, regardless of their size. Productivity growth in enterprises, including SMEs, means improving their competitiveness per se, and it is predominantly determined by innovation, says Narayanan (Narayanan, 2001).

In its product orientation, SMEs may have their own differentiated programs targeted to a specific market, but also to participate in the production programs of large companies as subcontractors. On the market there are so-called "gaps" or "niche", which are not adequately covered by the production of large enterprise applications in any industry. These areas of manufacturing and service industries are the most suitable for small businesses. Production on demand, or services on demand, is the area where the flexibility of small enterprises is particularly prominent. These "market gaps" are often not determined by territorial boundaries, although they exist in almost every regional or national market.

The survival of SMEs and increasing their numbers is the result of a number of different factors. Economic theory suggests that small companies are suitable for the industries where there is: a split or adaptive equipment, because of the geographical dispersion of the market raw materials or finished products and the high cost of transportation economy of manufacture is not possible, i.e. economies of scale, where goods are produced by the individual requirements, or customers are looking for different varieties or highly differentiated products, where working methods are often changed due to technical reasons, or where there is frequently changing demand (fashion items) or the total sales subject to wide fluctuations and the potential market is small.

In a time of paradigm shift, when the optimal industrial structure is made up of companies of various sizes, where there is relatively small number of large companies that have the potential for expensive, risky, continuous and systematic R&D, SMEs play a significant role in the diffusion of new technologies within the system that is determined by a new technology platform (Glazyev, 2009). At the level of the economy as a whole, Link and Siegel (2003) find that the economic benefits of technological progress and employment growth have been made primarily due to the growth in innovation. Out of all innovative enterprises, SMEs have an important and different role in overcoming the manifested economic imbalances. This explains why, in the priorities of economic policy, governments of some countries give more importance especially to SMEs and therefore give active policy support in different ways to their improvement of innovation.

Due to the conditions in which they operate, lack of an enabling environment that would favor their expansion on the basis of innovative development, many SMEs have not realized the importance of improving the competitiveness of key technological innovations, or are unable to realize their innovative potential. Also, due to the high risk of the high investment in innovation, in the sense that the success or failure of the inventive process can directly determine their survival and development, innovative efforts of SMEs require significant support.

This creates an environment that supports the growth and development of SMEs on the basis of innovation, which provides conditions for a sustainable increase of their competitiveness in both domestic and international markets.

Empirical data confirms the uneven distribution of innovation within SMEs, among a small number of highly innovative SMEs with high growth potential, and a large number of SMEs, which do not have considerable innovative potential and ambition. Therefore, in the policy of encouraging innovation, it is necessary to make a clear distinction between the two SMEs and their different ways and aspirations for innovation.

There are various ways in which SMEs are implementing innovations. As possible options for external sources of knowledge Trott (2005) states: association with external partners (alliance, joint venture, joint development, etc.), purchase/sale of knowledge (contract research and development activities, purchase, licensing). Models of open innovation increase the risk of SMEs much more (investing in by-products or investments in fixed assets). SMEs also take risks in finding external partners to commercialize innovations that are not used internally.

At the level of the economy as a whole, the increase in labor productivity in enterprises has resulted in accelerating the rate of economic growth and employment growth (Freeman and Soete, 1997). Recognizing the importance of innovation in the process of generating economic growth is subject of numerous research, starting from Solow and publishing the results on the factors of economic growth in the U.S. (Solow, 1956, 1957), to the present day. The greatest number of empirical research has been directed towards the conclusion that innovation is a key factor in economic growth. To the affirming attitude about innovation as the key to economic growth, a special contribution has been made by the endogenous growth theory in the late eighties and early nineties of the 20th century (Romer, 1986, 1987, 1990). Endogenous growth explanations emphasize the existence of correlation between innovation and the quality of certain macroeconomic performance. Also, it associated incentive for innovation with the existence of appropriate institutional arrangements in each national economy, as innovators are not able to realize the benefits of their results in an unfavorable institutional environment

Discussions about innovation as a factor of growth and development of companies and countries become important during previous years, which coincide with the ongoing economic crisis. So, for example, by analyzing the position of the United States, Porter and Rivkin (2012) argue that the growth of innovation and creation of new competitive advantages on that basis is the only sure way for this world leading economy out of the recession.

3. The role of the model of open innovation and collaboration in the growth strategies and development of SMEs

The relevant economic literature discusses five generations of innovation (Rothwell, 1992). In short, the first generation of technologically pushed innovation means the period of industrial revolution. Innovations are linear process, which starts from scientific discoveries, transforming into the invention, engineering and design, which leads to the production, marketing and sale of products or processes. This model was prevalent during the fifth and sixth decade of the 20th century, and was based on the idea that new inventions are the result of scientific discoveries that are commercialized. The model ignores consumer preferences and market demands in generating innovation.

The second generation is marked by demand driven innovations. Customers and their demand determine what will be produced. It began in the late 60s of the 20th century, with the growth of production and increasing the number of competing firms. Companies have shifted focus from rapid technological advancements to improving marketing activities. The demand has become the basis for introduction of innovation, and market has become source of ideas for research and development in companies. Thus, innovations were a response to market demand.

The third generation marks the model of technologically pushed and demand driven innovation. This means that the market gives rise to the ideas that the technology accomplishes. Alternatively, research and development creates new ideas that are refined through marketing. In short, the third-generation model of innovation accounts with feedback between research results and the market.

The fourth generation of innovation emerged in the early 80-ties of the last century. The development of information technologies has made possible strategic alliances in global companies with the same goals, which was not only a characteristic of large, but also of small companies. Time became a key factor of production, because the product life was considerably reduced.

Fifth generation innovation occurred at the time characterized by greater risk and uncertainty than ever before. It is a result of globalization, increased competition, and a strong wave of technological change. In fact, it marks the upgrade of fourth-generation innovation process, and is the result of technology development, increased market demand, and the fact that since the nineties of the 20th century, the phenomenon of resource limitation has become a central factor. The result is the emphasis of the significance of system integration and networking, in order to guarantee the flexibility and speed of development. Business processes are automated through enterprise resource planning and manufacturing information systems. Various strategic business alliances are being formed as well as collaborative marketing and research initiatives, such as open initiatives. The added value of a product is found in the quality, brand and so on. As key aspects of the process, Mroczkowski (2012) states: integration, flexibility, networking, and parallel information processing.

The fifth-generation innovation process points to the unsustainability of seeing innovation as an isolated change on the component level, without considering the wider system. Without prejudice to the importance of radical innovation, the economic potential of incremental innovation is being pointed out.

From the standpoint of business SMEs, Smith (2010) considers as very significant that the model of open innovation involves risk-taking and facilitating business start of entrepreneurial ventures. Open innovation model is more dynamic and less linear in comparison to closed innovation model, as considered by Chesbrough *et al.* (2006). In this model, the innovation is based on knowledge outside of the company, which suggests that increased collaboration is a potentially important source of knowledge for the creation of new ideas and their market launch. Solid "walls" of the company will be transformed into "the semi membranes" and it will be allowed for innovation to move more easily between the environment and internal innovative carrier.

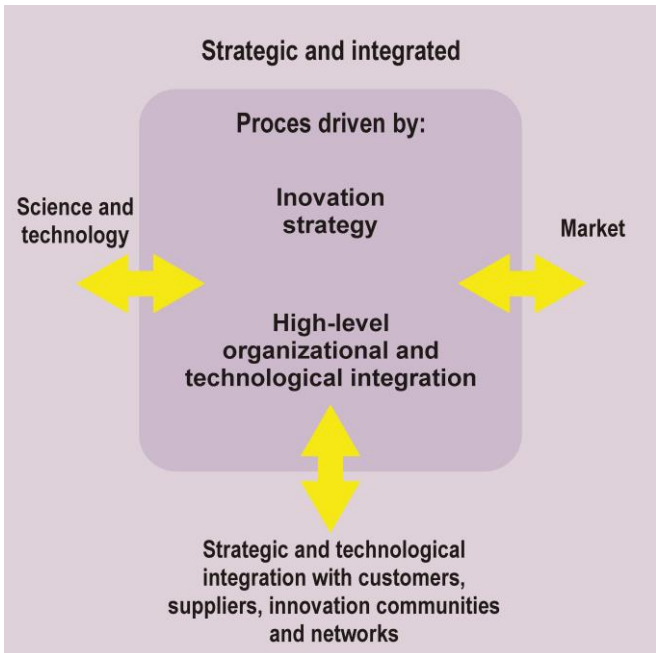

Figure 1. Model of fifth generation innovations

For SMEs it is very important to understand the importance of open innovation models. As for the external and internal influences, they largely emphasize the role of suppliers and customers in the innovation process of companies and their impact on innovation performance. Experience of companies in the region is of great importance for direct investment regime and an adequate choice of partners, to complement internal R & D activities. The main source of business strength, market competitiveness, profitability and dynamic growth, SMEs can look for, primarily, in human creativity, innovation, especially technology, and a new entrepreneurial culture, in which all human resources are seen as the most valuable "assets" of the company (Pokrajac, 2004).

Manopichetwattana and Khan (Khan and Manopichetwattana, 1989), stated that innovative companies with fewer than 500 employees are classified into two groups. The first group consists of young innovative companies and proactive firms, research-oriented and highly prone to risk. Their focus is on product innovations, and their dominant strategy is product differentiation. The basic mechanism of action of the product innovations of company profit is reflected in their impact on revenue growth. Another group of innovative small and medium-sized enterprises accentuates the importance of innovation processes. These small innovative companies have management teams, whose key task is the improvement and development of new technological processes. Innovation processes act on profit growth by influencing the reduction of production costs.

Collaboration has positive effects on the growth of innovation and competitiveness of SMEs. In a very detailed analysis of the literature in this area, Casals (2011) gives the reasons why SMEs need to adapt to a collaborative way of doing business, as well as common problems and barriers they face in the process, as well as factors that affect the efficiency of the collaboration. Assuming that the cooperation is a strategic decision of many SMEs, Casals (2011) divided reasons

for SMEs collaboration into internal and external. External reasons are related to achieving a better position in the market, responding to external threats, internationalization and the establishment of relations with competitors, customers or suppliers while internal reasons for collaboration include elements related to the mechanisms within the company: achieving goals, acquisition of new values, providing resources, capacity, etc.

Gloor (2006), indicates that collaboration has stimulating effect on product innovation and process innovation. In the initial stages of SMEs development, collaboration seems to affect sustainable growth and competitiveness improvement primarily due to product innovations, i.e. thanks to differentiation of existing products and investing in new product development. Product innovation is market focused. Innovation processes, which are characteristic of the later stages of the life cycle of SMEs, in essence, represent improving the current and design and implementation of new processes. Innovations in processes have an internal focus. SMEs can no longer be based on the above-defined reference model of business processes, but they can be executed by ad hoc market demands.

Kanter points out that establishment of collaborative relationships that are based on open systems and sharing information is a good way to promote innovation and achieve competitive advantages of SMEs (Kanter, 1994). In the case of SMEs, that has special significance because of their need to supplement their internal resources with external sources and resolve difficulties in establishing successful business relationships.

4. Collaboration based on information technologies in function of SMEs innovativeness

In the literature, the importance of collaboration in the SMEs growth and development strategy is widely treated. A number of authors underline that the success of SMEs in a competitive battle on the global market depends on their ability to collaborate and thus improve performance and increase the productivity (Kanter, 1994). Casals divides main advantages of SMEs collaboration into internal and external (Casals, 2011). Internal reasons for SME collaboration are: learning and sharing experience, innovation, find complementarities, saving costs by sharing resources, increase sales, gain buying power, external communication, improve investments, access to big projects and funding, lobbying power, increase product quality, increase flexibility, improve competitiveness, performance, keep business autonomy. External reasons for SME collaboration are: internationalization, overcome uncertain economic periods, new businesses opportunities, reputation, and better position, risk sharing (Casals, 2011).

One of the most important aspects of SMEs collaboration is its contribution to the growth of SMEs innovations (Coombs *et al.*, 1996; Liefner *et al.*, 2006; Bullinger *et al.*, 2004). The general conclusion is that there are positive relationship between collaboration and innovation. Porter (1990) suggests that firms that collaborate with each other are more able to clearly and quickly perceive new customers' needs and preferences, and they can better realize and achieve the innovations. They can experiment with lower cost and delay commitments until they are confident of the success of a new product, process or service.

Starting from the fact that the IT solutions raise the efficiency of SMEs collaboration, authors in the remainder of this paper propose the application of various technologies in order to support this process. By analyzing the available literature, they believe that there are two technological solutions that are the best: Workflow Management Systems (WfMS) and Service Oriented Architecture (SOA), which recently

appeared in a slightly modified form, known as a Service-Oriented Cloud Computing Architecture (SOCCA)

Cardoso *et al.* (2004) explain that WfMS are oriented to manage processes rather than data, and as such can be used to integrate heterogeneous, autonomous and distributed systems in any business sector. They do not rely on predefined business process reference models, but are more suitable for ad hoc, heterogeneous processes and as such contribute to innovation processes. Information flow control and transfer to the appropriate application is done in accordance with workflow map that is defined by the business process administrator.

On the other hand, SOA uses open standards and technologies such as XML and Web services. According to Juric *et al.* (2006) opinions, Web services represent a high form of abstraction which is located between the business process layer, defined by Business Process Model (BPM), and application layer, which is used to automate them. The role of Web services is to deliver the appropriate application logic. In recent years, the SOA is integrated with Cloud computing and is known as a Service-Oriented Cloud Computing (SOCCA). Tsai *et al.* (2010) explain in their paper, that the role of Cloud Computing in SOCCA is to provide services through the delivery of not only the application logic, but also the hardware and software platforms. The fundamental difference between the layers of SOA in SOCCA and traditional SOA is that the SOCCA service providers do not host published services. Instead, services are published in deployable packages that can be easily replicated and redeployed on different Clouds for hosting. Service providers, on the basis of certain criteria, can decide on which Cloud they want their services performed. SOA layer in SOCCA has much more flexibility than traditional SOA because it separates the roles of service providers and cloud providers.

Collaboration, according to Camarinha-Matos and Afsarmanesh (1999) can be realized in a variety of environments which depends on several factors: the length of the necessary collaboration, network topology in which SMEs are connected, ability for one SME to be part in one or more alliances, the ways in which coordination is done in carrying out business activities and so on. Depending on these factors, the following classification is possible:

- Extended Enterprise
- Supply Chain Management
- Networked Organization, Cluster of Enterprises

Extended Enterprise is a common way of collaboration in which a company has a dominant role and its limits are being "extended" to one or more SMEs, which represent its main suppliers. These are alliances which often operate within specific industries and last very long. They have a network of fixed structures whose work is coordinated by the "dominant" company by imposing certain "rules" in the definition of standards of business process models, mechanisms for the exchange of information, access rights, etc. In this collaboration, according to Zhao and Cai (2002), senders of information pack data according to the defined common ontology and receivers decode the received packets in the local ontology.

Laudon and Traver (2004) stated that Extended Enterprise operates within "Private industrial networks" that are used to coordinate business processes, known as collaborative commerce. It not only supports supply chain management, but also the ability to work together, or collaboration on product design, predicting demands, income management, sales and marketing. The work of private networks, until recently, was based solely on the use of EDI (Electronic Data Interchange) standards, the use of which has many disadvantages.

The authors of this work consider that in such a way of SMEs association, collaboration can be realized by the

application of technological solution that is based on inter organizational integration using WfMS. As in this case, the "dominant" firm sets new standards in the definition of business process models; there is no question which business model should be selected by different participant. Bearing in mind that the "dominant" company defines mechanisms for exchanging data and ERP solutions of individual participants were mainly purchased from the same vendors, their integration in a technical sense, it is much simpler. The role of the integrator would have to be given to a business process that is at the top of the private network topology and linking and controlling the flow of information between different SMEs. Workflow map of the business process is defined by the administrator or consultant. Potential components of these systems in addition to ERP solutions can be other WfMS as well as many applications as shown in Figure 2.

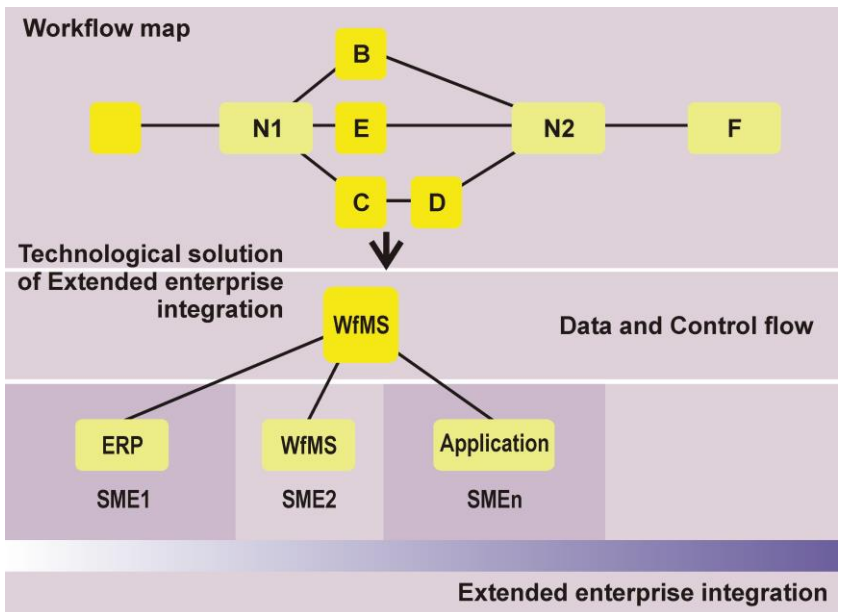

Figure 2. Technological solution of extended enterprise integration

Figure 2 shows that the workflow system that is on top of the topology of the Extended Enterprise controls the flow of information within each SME and transmits them to the appropriate operations that are performed in accordance with the workflow map. When a map is once designed, deployment of applications is done with very little programming because the system automatically generates a code for each application. However, in some cases it is necessary to manually write code for integration of WfMS with some special features such as workflow engine to connect to individual applications, the definition of recovery, determination of access rights etc.. In the literature, the types of workflow applications that provide such rich integration opportunities are known as "Enterprise Application Integration" - EAI and "Business Process Management" - BPM tools.

Collaboration in the Extended Enterprise offers significant opportunities for SMEs to increase their income, necessarlly place their products, go to global markets and access technologies, competencies and brands that large enterprises have. They enter into these

alliances because of inadequate technological know-how or lack of equipment needed to respond to market demands.

The collaboration within the framework of Supply Chain Management supports mechanisms for managing the flow of materials between the participants in the value chain: consumers, producers, transporters / distributors, suppliers, etc.. SMEs often pool their knowledge and resources in these kinds of alliances in order to survive and gain competitive advantage in the global market. Partners in the supply chain are connected to the fixed network structure and remain together for a longer period of time. All network nodes co-operate on an equal basis, so they combine core competencies, without losing their autonomy. According to Lautdon and Traver (2004) systems for supply chain management also belong to the business model of "private network" which primary goal in this case is to provide chain partners to share information on the status of orders, production planning, sales, marketing promotions, etc. Through access to up-to-date, accurate, relevant information about the processes in the chain, insights into activities where there was excess inventory, increased costs, loss of profits were provided.

Systems integration within the supply chain does not represent an easy task for several reasons. The participants in the supply chain can use different models of business processes and managing them in different ways and according to Zhao and Cai (2002) those are systems with heterogeneous ontology. Great culture differences can exist between collaboration partners, which also represent an important factor of integration. In such an environment it is nearly impossible for all members of the supply chain using a unified system, purchased from the same vendor, so the technical aspects of integration is much more difficult (Laudon and Traver, 2004).

Large differences among the participants of the supply chain can be overcome by the making appropriate agreements. Koetsier *et al*. (2000) emphasize that the contract is one of the ways to briefly define the cross-organizational process integration, which includes ontology heterogeneous cross-organizational activities. In this kind of collaboration there is no possibility of sharing information, which means that there is loose interoperability between systems of individual SMEs. This, on the other, does not impose the need to chain participants for radical changes in applications and data structures, and they do not need to change their business tradition.

Since in this case there is the need for heterogeneous systems connection, for implementation of this workflow model, according to the author of this work, it is useful to apply service-oriented architecture (SOA) instead of workflow technologies. This opinion is based on the fact that SOA can improve the integration between participants in the supply chain primarily due to the use of open standards and technologies such as XML and Web services.

Juric *et al*. (2006) explain that SOA has three service layers: application layer, business layer and the layer of orchestration service and the collaboration between SMEs in the supply chain can be represented as in Figure 3.

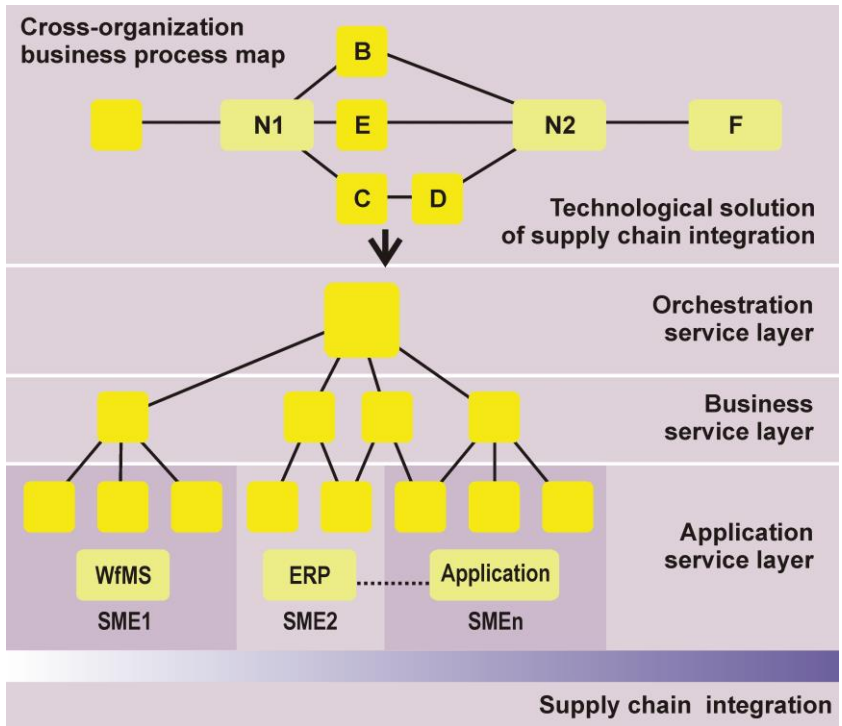

Figure 3. Technological solution of collaboration between SMEs in the supply chain

Each of the layers of services in SOA has its role. The role of application services is to present functionality in the specific context of processing at the SME level and is used to establish point-to-point integration with other application services. Figure 3 shows that application services can express the application logic that comes from ERP system, the WfMS or other types of applications.

By layer of business services, balance is achieved between the business models of SMEs and specific types of applications. Analysts, architects, and other IT professionals jointly participate in the research process in which functional context is assigned to each business service that results from one or more of the existing business models of SME. Business services may be positioned so that they combine application services and then they are known as hybrid services.

Layer of orchestration services allows iterative calling of appropriate business/application services at the top of the supply chain topology, according to the cross-organizational processes defined by the contract and described by the appropriate workflow map. Orchestration introduces, in other words, parental level of abstraction that facilitates interaction that is necessary to ensure that the services are executed in a specific sequence. The language used for composition, orchestration and coordination of Web services is BPEL (Business Process Execution Language for Web Services, WS-BPEL also, BPEL4WS). It contains a rich syntax to describe the behavior of business processes (Juric *et al.*, 2006).

According to the Dietrich *et al*. (2007) for each service there must be a provider and demander. The service provider is responsible for the development and execution of service requests while demander requires specific functionality that

is not available in his system but can be integrated using the external services of other SMEs. For service to be found there must be service directories that list available services and give related services information. For this purpose we use three XML-based technologies: Web Service Description Language (WSDL), Universal Description, Discovery and Integration (UDDI), and SOAP (Booth *et al.*, 2004). Knowing the role of each of these technologies, the architecture for implementing the system for supply chain management using SOA can be represented as in Figure 4.

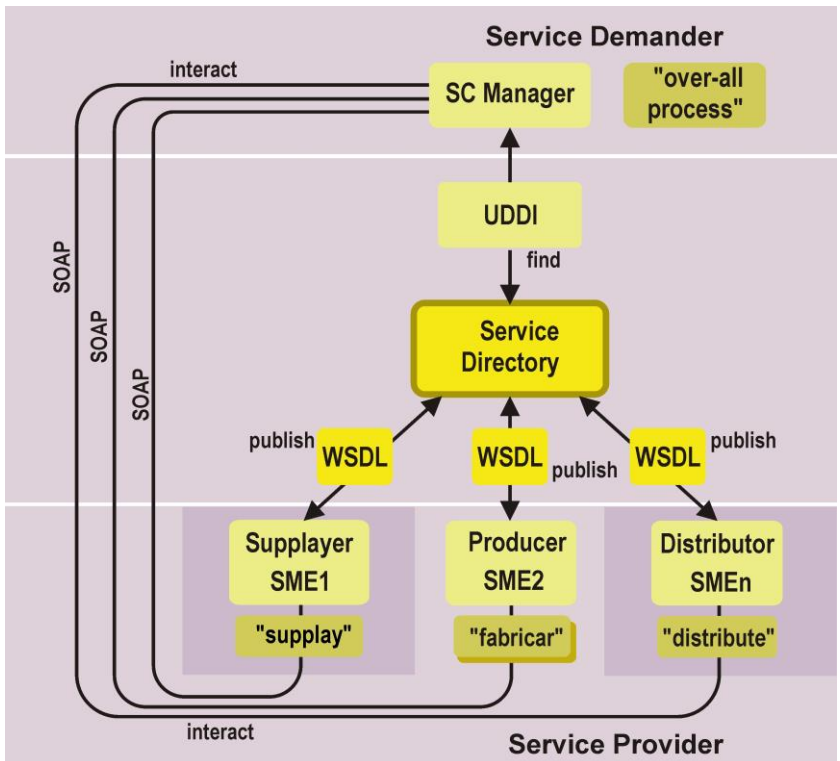

Figure 4. Architecture of supply chain management systems using SOA

In this architecture, service providers are SMEs that have different roles (suppliers, manufacturers, distributors) and offer different services. Service demander is an agent (supply chain manager) that executes business process workflow logic on top of the network topology and provides algorithms for planning, coordination and editing of Web services of individual service providers. When the appropriate service and SMEs who offers it is found, the agent makes a direct interaction with SMEs and calls the appropriate service.

The more efficient model in terms of cost and adaptability of SOA is SOCCA-Cloud model. Hosting applications on different Clouds reduces service publishing costs by savings on hardware, software platform, and work, which makes this architecture ideal for SMEs.

Other forms of associations in which there are no strong enough relations between SMEs, it was in the case described as a Extended enterprise, are Networked Organization and Cluster of Enterprise. The Networked Organization establishes a very

loose way of collaboration between companies that may not have a common goal and share knowledge and resources. Cluster of Enterprises is a group of companies that only have the potential to collaborate with each other and, as such, are registered in the common registry where they declared their core competencies. These cases require a network infrastructure that allows the dynamic association into a consortiums or getting out of them. The topology of the network is to enable casual interactions between SMEs who can play the role of occasional suppliers or spontaneous clients in various aspects of electronic commerce, also known as NET markets or hubs (Kenneth and Traver, 2004).

As in the case of the supply chain management systems, in this form of collaboration there is a possibility to use SOA or SOCCA. However, the authors find that in this form of association there is no need for the creation of an appropriate agreements and cross-organizational process that iteratively include appropriate business application. For service to be found, there must be service directories that list available services and give related services information. The fundamental difference of the SOA layer of SOCCA from traditional SOA is that the service providers no longer host the published services anymore. Seth *et al.* (2012) explain that application services can be the property of individual SMEs, but also they can be hosted on a different cloud.

Porter (1998) believes that collaboration in the supply chain management systems, Networked Organization and Cluster of Enterprise allows establishment of important relations, complementarities and spillovers of technological knowledge, information, marketing, and customer needs. These relations are very important for the competitiveness, productivity and particularly for the direction and speed that creates new businesses and innovations. Collaboration in this case allows for areas of common interest to be coordinated and improved, without reducing rivalry that exists between SMEs.

5. Impact of Information Technologies in function of SME's innovativeness

For the evaluation of ICT's impact on innovations management process, SAW method (Simple Additive Weighting) of multi-criteria analysis was applied. The results of the method are defined by adding weight values for each chosen criterion. The method itself consists of three steps: a) rating normalization with an aim to obtain mutual comparability; b) application of weight values of criteria on normalized ratings; and c) addition of alternatives' indexes value

$$R = \begin{array}{c} \\ w \\ A_1 \\ A_2 \\ \vdots \\ A_n \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_m \end{array} \\ \begin{array}{cccc} w_1 & w_2 & \cdots & w_m \end{array} \\ \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \end{array}$$

Figure 5. Model's general form in matrix display

Where:
A_n- are alternatives, that is, observed aspects
C_m- are factors, indexes of certain aspects' dimension values
w_m- are weight coefficients for each chosen criterion
x_{ij}-are values of suitable criterion for each observed aspect

Based on explication of ICT's influence on innovation so far, the authors have extracted six starting criteria, based on the experience in software support development for innovation business processes, SME primarily. There is a short description of each criterion and roughly defined weight ponder for innovation management process, as a key business process of SME in the future.

Table 1. Factors included in the analysis

Factors which describe innovation process	Factor description	Factor's ponder
C1 - Autonomy	Innovation process' ability to rely on the inner resources	0.25
C2 - Agility	Speed of response to external stimulation	0.15
C3 - Collaboration and integrity	Ability to generate sinergic effect of subjects in innovation process	0.15
C4 - Openness	Information flow between innovation process' internal part and the environment	0.15
C5 - Safety	Protection from unauthorized use of data	0.20
C6 - Resilience	Ability to respond fast to a problem and return to stable state	0.10

Afterwards, the analysis has been modified, because only two aspects or alternatives of innovation process management were observed: 1) the one with ICT application and 2) the one without ICT application. This is the reason why in table 2 there is only the experts' evaluation of the factor for alternative with ICT application, while the alternative without ICT application has been appointed mean value for all the factors.

Table 2. Experts' assessment of differences among chosen factors and alternatives analysis

	C1	C2	C3	C4	C5	C6	
With ICT application (from 0 to 50)	30	32.5	45	40	12.5	30	
Without ICT application (from 0 to 50)	25	25	25	25	25	25	
Difference (from -50 to 50)	5	7.5	20	15	-12.5	5	
Analysis							
First step Normalized difference (from -1 to 1)	0.10	0.15	0.40	0.30	-0.25	0.10	*Third step Overall difference*
Second step Pondered difference	0.025	0.0225	0.06	0.045	-0.05	0.01	0.1125 (11.25%)

Based on overall difference of observed alternatives, the significance of ICT application in innovation process management can be analysed.

6. Conclusions

Based on previous explanations, we consider the starting hypothesis as proved. It means that collaboration of SME's, supported by informational technologies, as the result has improvement of their innovation as final key assumptions of productivity growth and competitiveness.

Contemporary workflow technologies and service-oriented architectures have a significant role in achieving collaboration and improving innovation of SMEs and they are being applied depending on the mode of their association. So the workflow technologies can be applied for collaboration when SMEs does not join just because of supply chain management, but also for collaboration in product design, management of net profit, sales and marketing. Service oriented architecture, especially integrated with Cloud computing, on the other hand provides a more flexible way of collaboration where each of SMEs can retain their autonomy and where there are no strong enough relations between SMEs.

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