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ADAPT BUSINESS PROCESSES TO SERVICE ORIENTED ENVIRONMENT TO ACHIEVE BUSINESS AGILITY

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Abstract: In the modern economy, creating agile business processes is one of the conditions to obtain/ maintain competitive advantage on the market. In addition, the agility of business processes, combined with the agility of employees and that of information technology are prerequisites for achieving business agility. Using a service-oriented architecture can provide numerous benefits to the organization, enabling it to reduce complexity and increase flexibility of business processes. This paper presents an approach on adaptation to the service-oriented architecture of tools and methodologies for modeling and management of business processes. Thus, in the paper ❶ is analyzed the aligning of BPM with SOA to achieve business agility, ❷ is provided a perspective view on the management of service-oriented business processes and ❸ is presented a case study on agility of acquisition process in higher education institutions of Romania.
Key words: Service Oriented Architecture (SOA), Business Process Management (BPM), business agility, standards, process metrics, collaborative environment

Introduction

Service Oriented Architecture (SOA) has captured the attention of researchers in recent years in terms of seeking ways to increase the agility of organizations by offering flexible business processes. Service-orientation of business processes is the result of the existence of multiple organizational levels and of the increasing need for integration, complexity reduction [3] and flexibility. At the same time, BPM (Business Process Management), Case Management and other tools and solutions have been created to meet the current requirements of organizations in the collaborative process modeling. With these analytical tools, organizations can improve delivery programs and customer service and can proactively monitor service delivery, costs and results.

The use of SOA within organizations involves adapting tools and methodologies for modeling and management of business process to service-oriented architecture. Another solution may be getting some new tools for modeling service-oriented processes, but both solutions lead to additional costs for the organization. Current state of research in this area

offers a number of approaches to process modeling methodology and service-oriented development (examples: [3], [7], [22], [23], [24], [26]).

The need for further research arises from the fact that there are gaps in the integration of BPM with SOA, and that there are few studies on the assessment environments of tools and methodologies for modeling of process/cases for collaborative environments, comparative analysis of their use on different types organizations and their use in service-oriented environments. Moreover, the solutions of service-oriented business process management have to face increased complexity resulting from the intense use of knowledge in the *collaborative* context and at the same time to achieve the *agility* required by the business activity.

1. Aligning BPM with SOA to achieve business agility

Business agility can be achieved by combining agility of employees with agility of business processes and information technology within the organization [19]. Agility of organization personnel is considered the pillar of business agility, resulting in an agile management within the organization. Agility of business processes can be achieved through BPM [25], conducted by the organization's information systems (e.g. Business Process Management System - BPMS). Technological agility concerns IT (Information Technology) infrastructure and architecture of information systems and can be achieved through SOA. SOA and BPM have captured the attention of researchers concerning their use both independently and together (Table 1), facilitating a new stage of evolution of business processes.

Table 1. Possible situations about SOA and BPM utilization

SOA	BPM	Results
Yes	No	reuse and reliable services, but not further agile framework [8]
No	Yes	continuous improvement and optimize, but un-scalable and un-adaptive process [15]
Yes	Yes	services to be used as reusable components that can be orchestrated to support the needs of dynamic business processes [13], iteratively design and optimize business processes that are based on services that can be changed quickly [4], and, as result, maximize *business agility* [16]

A first step toward understanding how SOA and BPM can be combined is to identify the most important similarities and differences between them. The main similarities are [4]: encouraging, accommodating dynamic changes, observing iterative process, dealing with distributive environment, supporting loose coupling. Regarding the differences between BPM and SOA (Table 2), special importance is given to the characteristics of processes and architectures in terms of business perspective and technological perspective. At the same time, more and more studies refer to the fact that BPM tends to combine information technology and management methodologies.

Table 2. A comparison of BPM and SOA (based on [4], [12], [14], [20])

Characteristics	BPM	SOA
Perspective	business	technology and business
Practitioner	business managers	business and system architects
Objective	optimizes business process	organizes IT infrastructure
Demand for	insight	encapsulation
Driven	directly by business goals	indirectly by business goals, translated to a need for IT agility and governance
Orientation	business planning	information technology management
Metaphor	E/R-diagram	Relational Database Management System
Strategic level	decision are taking top-down	strategy can be perform by top-down, bottom-up or meet-on-the-middle
View	process-centric	service-centric
Implementation approach	top-down	bottom-up

Organizations that combine BPM and SOA are in the best position to maximize their agility, operate efficiently and respond rapidly to changing business needs (Figure 1). Using an integrated approach allows ❶ business process semantics to be implemented into composite services and ❷ services to be recombined, re-sequenced or even substituted to lodge business semantics or process changes in the new business context.

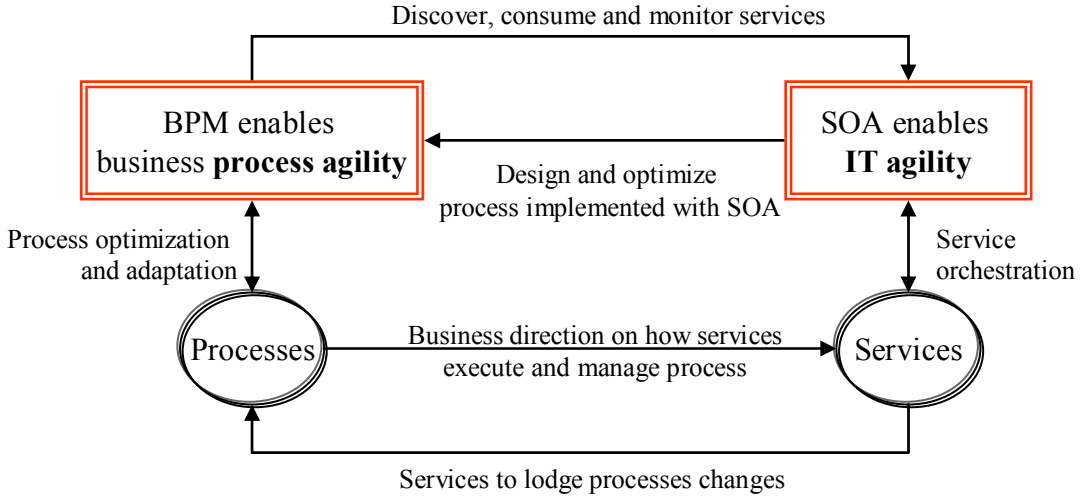

Figure 1. BPM and SOA enable business agility

Aligning BPM and SOA leads to a new stage of business processes evolution, that of service-oriented business processes. The management of these types of business processes will be done in accordance with the principles of abstraction, specialization, and separation of concerns in addition to the flexibility that service-oriented architecture

promotes. In addition, the management tools of business processes should provide collaboration capabilities (e.g. discovery, modeling, optimization of processes) and dynamic capabilities (e.g., process flows and dynamic services driven by business rules) within flexible business processes [18]. Dynamic capabilities provide agility by detecting patterns and rapidly adapting business processes to events and agents (clients, businessmen, analysts and programmers, architects and process analysts) [11].

Business process generally involves running a set of activities and using data to achieve a business objective. Control of process execution, of business data and activities is carried out by different services within the organization. They have access to business activities and data through specialized components, known as business objects (Figure 2). Service-oriented business process includes, beside the specific business process, the network services (a service that has implemented a certain business-process function and has been capsulated and published on network [27]).

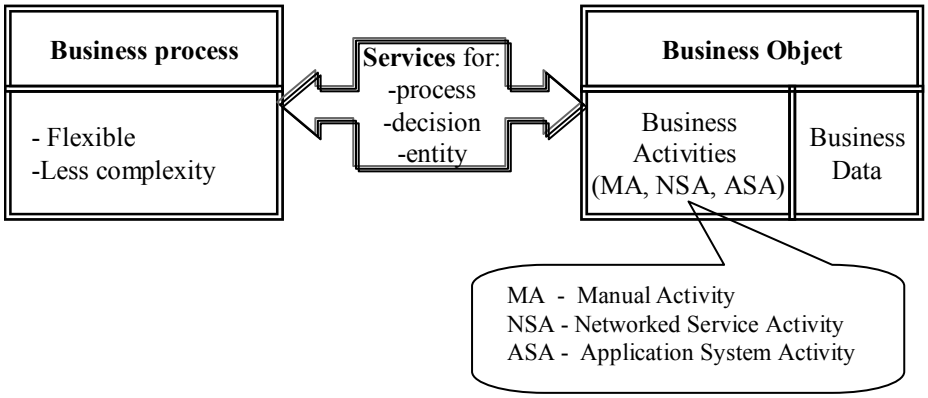

Figure 2. Service oriented business process

The existence of manual activity is due to intensively knowledge-based processes, which allows only a subset of activities within the processes to be automated (activities are implemented by an enterprise application system or a networked service). Complex interactions between participants and the need for the use of knowledge lead to a complexity of activities that many traditional modeling systems and system applications are not able to support. In addition, within a collaborative environment, solutions have to enable integration of systems, business partners and business users and to respond to external events (system events and events of transactions) and internal events (generated by internal agents and systems) that generate frequent changes in the organization. These facts lead to the need for the use network services.

Increasing use of services within a collaborative environment leads to the necessity of obtaining a high performance service oriented business process with loosely coupled services (Figure 3). To this end, organizations should identify business processes and services needed by these processes. In order to achieve success, it is necessary that service-oriented business processes, workflow and service orchestration tools fit perfectly with SOA IT [10].

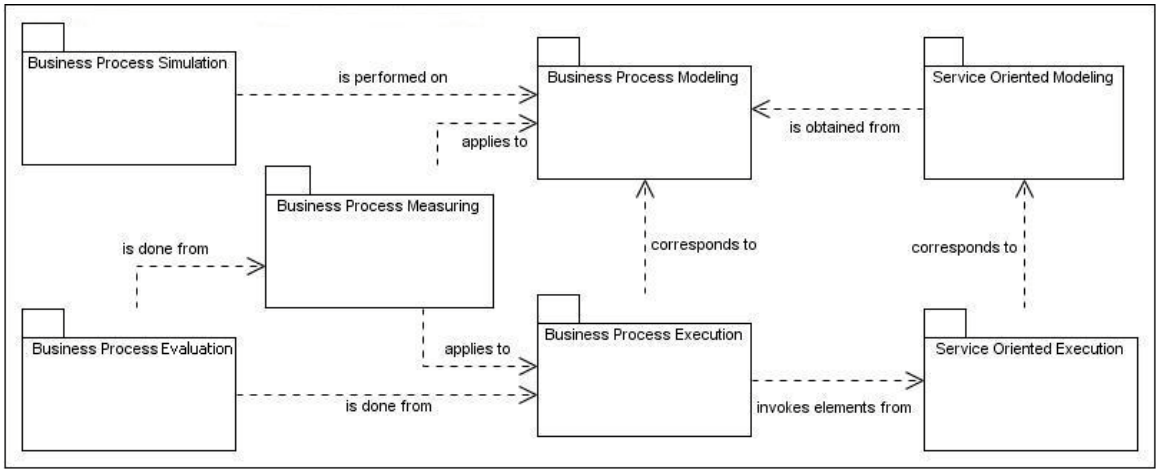

Figure 3. High level ontology for service oriented business processes [9]

2. Management of service oriented business processes

According to research in this field, business process management activities can be grouped into following categories: design, modeling, deployment, execution, monitoring, and optimization. Using a combination of BPM and SOA requires an analysis of each specific BPM activity in terms of service-orientation. Service-oriented business process management can be achieved based on several standards in the areas of modeling, implementation, execution, monitoring and optimization (Figure 4).

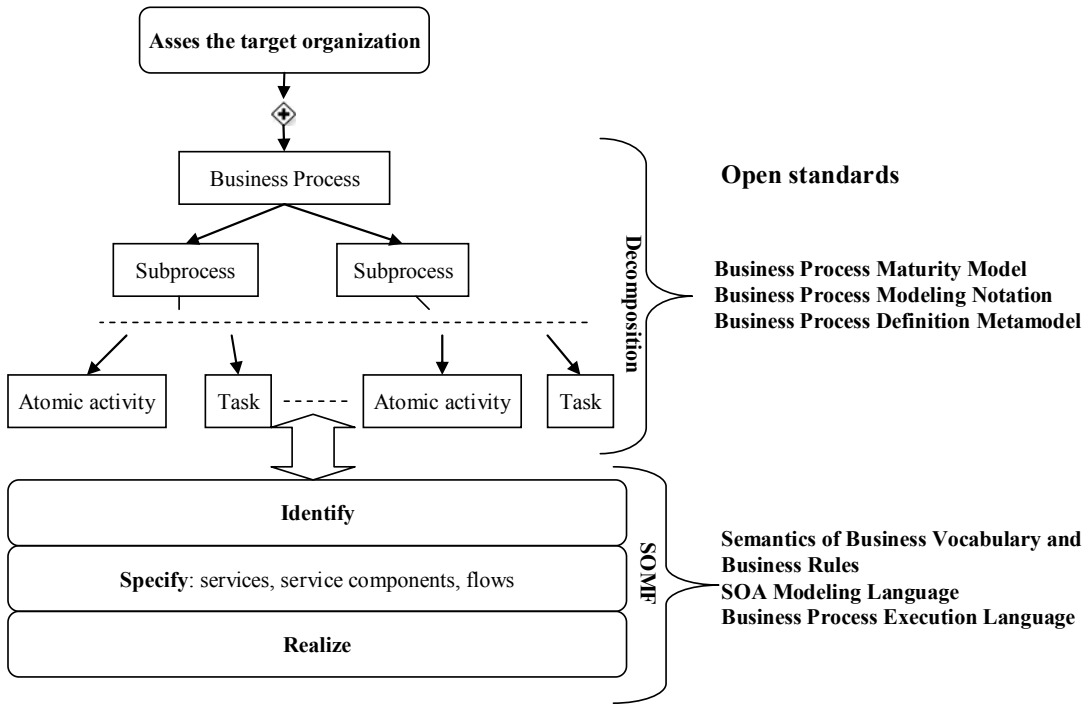

Figure 4. Management of services oriented business process

Business Process Management Initiative (BPMI) has developed three standards to facilitate BPM [21]:

- Business Process Modeling Notation (BPMN), as a standard for modeling business processes;
- Business Process Modeling Language (BPML), as a standard business execution language;
- Business Process Query Language (BPQL), as a standard management interface for the deployment and execution of e-Business processes.

BPMN can be used for modeling business processes in accordance with SOA. BPMN has service modeling capability which allows a participant to use service activities to send messages to other participants. BPMN and Unified Modeling Language (UML) have very different approaches. UML offers an object-oriented approach to the modeling of applications, while BPMN takes a process-centric approach [21].

The new breed of BPML includes the Business Process Execution Language (BPEL) for Web Services (BPEL4WS), created through effort of BEA, IBM, Microsoft, and BPMI.ORG. Making web services work is a four stage process [21]: *designing* the processes with BPMN, *verifying* them for efficiency with simulation, *making* them *available* by publishing them using a BPEL, and *orchestrating* and *coordinating* using a BPMS.

In the process implementation phase, the key technology of SOA is BPEL. This language minimizes the semantic gap between the process model and the actual execution code. BPEL enables business processes to be executed directly. Process models can manually, semi-automatically, or automatically be translated into BPEL.

Service Oriented Modeling and Architecture (SOMA) provided by Rational Software [5], as a methodology, address the gap between SOA and object orientation. It addresses how to move from business model to the models required by an SOA. SOMF (Service Oriented Modeling Framework) is a service-oriented development life cycle methodology. It offers a number of modeling practices and disciplines that contribute to a successful service-oriented life cycle management and modeling.

OMG (Object Management Group) provides SOAML (SOA Modeling Language), a standard that includes a set of extensions to UML that supports SOA modeling [2]. SoaML was adopted in 2009 [6] and provides a higher-level of abstraction, and more complete service modeling capability that BPMN could benefit from [12]. BPMN can be combined with SoaML for more comprehensive service construction and consumption modeling.

Taking into account the managerial recommendations and the practice in this field, in order to achieve success in the integration of services oriented business process, it is recommended that any organization should create a transition environment that should be based on management instruments for the existing knowledge within the organization, the elements under transition should be included into a management program, and at the organization level should be developed a policy of organization change management.

Among the activities that might be provided for this purpose we will mention [17]: reengineering of facilities, setting the competence base, appointing the SOA mentors, reengineering the existing standard documents, development of stuff training and reallocation programs, implementation of the quality management system, defining communication strategies, creating the excellence centers, creating the users groups, developing alliance creation strategies, etc.

The transition environment should allow, inside the analyses, the calculation of specific metrics of service oriented business process management. At the same time are important evaluating and measuring costs and benefits of integrating service oriented processes, as they having major effects on the business. Without correct evaluation of the impact of implementation, the organization may be confronted with the situation of adopting a solution that would not lead to the expected results. Next, we shall present several metrics that may be used in measuring service oriented business process performance (figure 5).

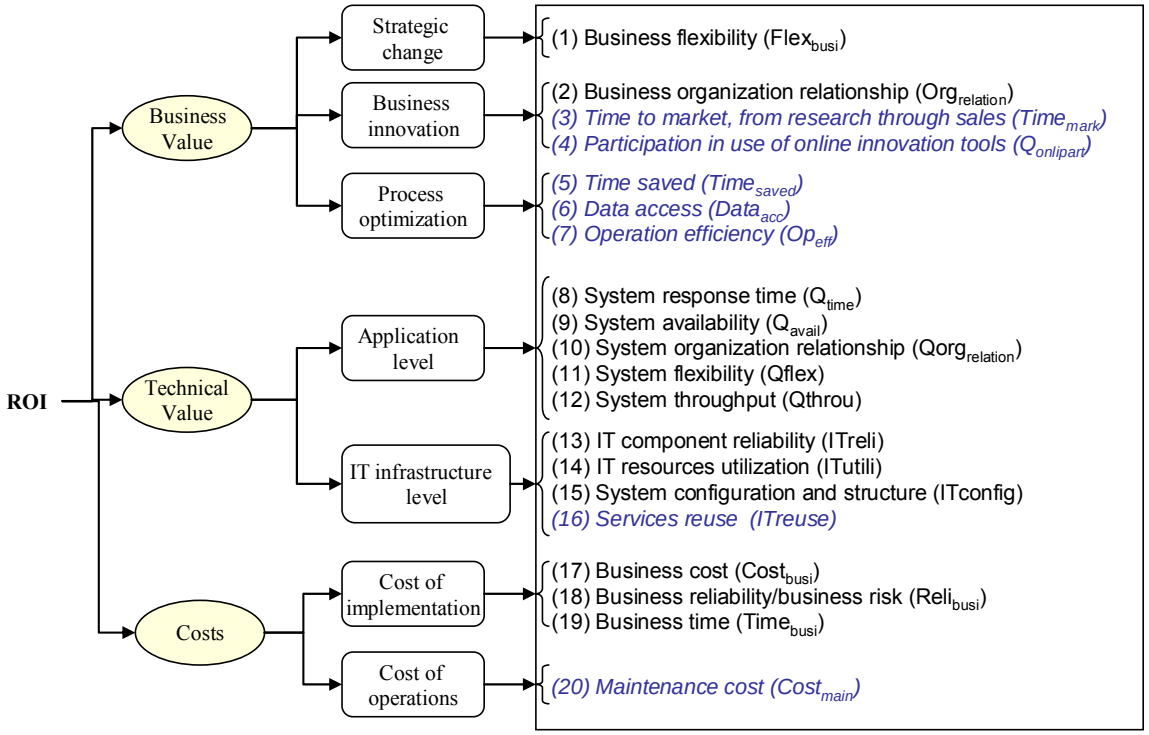

Figure 5. ROI for service oriented business process management

The following metrics, $Flex_{busi}$, $Org_{relation}$, Q_{time}, Q_{avail}, $Qorg_{relation} \in (0,1]$, *Qflex, Qthrou, ITreli, ITutili, ITconfig* $\in (0,1]$, $Cost_{busi}$, $Reli_{busi} \in (0,1]$, $Time_{busi}$, are detailed in [27]. Zeng, Huang and Fan offer analyses on the service-oriented process modeling and its performance metrics correlations among service, service oriented business process, and enterprise. They made an AHP and simulation-based performance evaluation method applicable to evaluating performance of business process in a loosely coupled environment like that of service-oriented computing. Other indicators proposed in figure 5 are presented below.

❖ Time to market, from research through sales ($Time_{mark}$)

$$Time_{mark} = Time_{saved} + Nh_r + \sum_{i=1}^{n} Nh_i \ , \ \forall h_i \neq \forall h_j \qquad (3)$$

where $Time_{mark}$ represent the saved time between research and sales, $Time_{saved}$ – time saved with service oriented process automation, Nh_r – number of hours reduced due to the reuse of services, n – number of people involved in process creation, i,j – the person involved in the process creation, Nh_i – number of hours saved by the person i, due to the use of process management tools.

❖ Participation in use of online innovation tools ($Q_{onlipart}$)

$$Q_{onlipart} = \frac{N_{onlipart}}{N_{allpart}} \times 100 \quad (4)$$

where $Q_{onlipart}$ represent percent of participation in use of online tools, $N_{onlipart}$ – number of participation in use of online tools, $N_{allpart}$ – number of participation in use of all tools.

❖ Time saved ($Time_{saved}$)

$$Time_{saved} = Time_{PA} + Time_{CA} \quad (5)$$

where $Time_{PA}$ – the saved time with process automation, $Time_{CA}$ - reducing the time that is spent on corrective action (automated corrective action) and they are calculated as:

$Time_{PA} = Time_{MP} \times I_{rtm}$, where $Time_{MP}$ – manual process cycle times, I_{rtm} - time reduction index due process automation

$Time_{CA} = Time_{MC} \times I_{rtc}$, where $Time_{MC}$ – time spent with manual correcting errors, I_{rtc} - time reduction index due corrective action automation, I_{rtm} and I_{rtc} are calculated use a process simulation to compare current process cycle times and costs to one or more alternatives.

❖ Data access ($Data_{acc}$)

$$Data_{acc} = ADC \times I_{adc} \times 12 \quad (6)$$

where *ADC* – month cost of access to data, I_{adc} – access cost reduction index.

❖ Operation efficiency (Op_{eff})

$$Op_{eff} = 12 \times \sum_{i=1}^{n} H_i \times C_i \quad (7)$$

where *n* - number of users in process creation, *C* - hour cost / employee, *H* - no. productive hours/month due to re-allocation of workforces.

❖ Services reuse (IT_{reuse})

$$ITreuse = t \times WC \quad (16)$$

where *t* represents the time saved as a result of finalization of migration by reuse of services, *WC* wage costs needed for migration. SOAs can dramatically reduce labor costs over time through component reuse.

❖ Maintenance cost ($Cost_{main}$)

$$Cost_{main} = (1 - Icr)TC + SC + HC + OMC \quad (20)$$

where *Icr* represents the cost reduction index (reutilization standard factor), *TC* represents training costs, *SC* – software costs (basic software code maintenance, software and hardware application upgrades, other), *HC* – hardware upgrade costs, *OMC* – other maintenance costs. Typically operations costs begin after the roll out of the first improvement phase and continue into the future, until the solution is changed or improved again or sunset at the end of its life cycle [27]. Business rules and business policies can improve IT and business productivity and reduce maintenance costs.

3. Case study on agility of acquisition process in higher education institutions

In the modern knowledge-based economy, universities should behave just like any business, in the prospect of becoming intelligent universities. Increasing competition between universities, financial crisis, the opportunity of distance learning, the efficient use of resources and alignment with sthe Bologna declaration directives require the use of *agile* systems in the educational environment. In addition, increased pressure in the educational environment implies the need to ensure quality and improve quality management of all university processes.

One of the support processes for achieving the basic processes in universities (teaching and research) is the public acquisitions process. Given the expense, complexity, vulnerability and importance of operations, the greater responsibility involved by public acquisitions, all public institutions have a separate department specialized in public acquisitions, with an important role within the institution.

Activities of this department are verified and monitored by internal and external audit teams, which must assess the extent to which the department complies with the law, recommendations of authorities, acquisition risk management, internal procedures, and quality management policy within the department. Regarding quality management, the public acquisitions department should be able to prove the existence and functionality of at least the following elements:

- the extent to which the department's employees know and comply with quality standards and legal regulations on public acquisitions;
- the annual program of permanent improvement of quality management system in order to maximize stakeholders' satisfaction;
- quality policy and specific measurable quality objectives;
- systematic and regular assessment of suitability, adequacy, effectiveness and efficiency of the quality management system in relation to quality policy and quality objectives and identifying opportunities for improvement;
- procedures to ensure information flow quality within IT substantiation of documentation for granting public acquisition contracts - the fundamental element of acquisitions processes;
- the extent to which there is compliance to quality management system requirements and principles.

The quality management system of the acquisitions process must have at least the following features:

- ability to integrate with the university systems;
- ability to integrate stakeholders into the acquisition system in order to ensure quality;
- ability to simulate the acquisition process in order to improve its quality;
- ability to monitor, control and improve quality of the acquisition process in real time;
- ability to make changes in the acquisition process, with minimal effort.

Service-oriented modeling and the automation of the acquisition process (Figure 6) is due to several internal and external factors, such as: various demands, changes in preferences, the diversity of research projects and emerging needs, changing of laws, connecting with suppliers, existing problems in information flows.

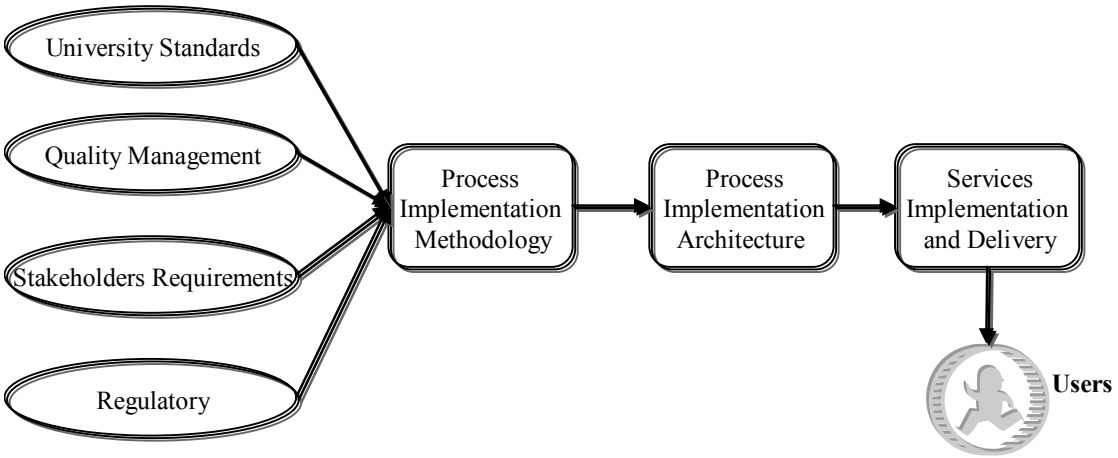

Figure 6. Automation of acquisition process

SOA exposes and shapes the existing infrastructure to provide customer-orientation [1] and process-oriented strategy. In addition, creating an infrastructure that combines the principles of SOA with BPM principles, principles of quality management and legislative principles leads to operational efficiency and ultimately to the *agility* of public acquisitions process (Figure 7).

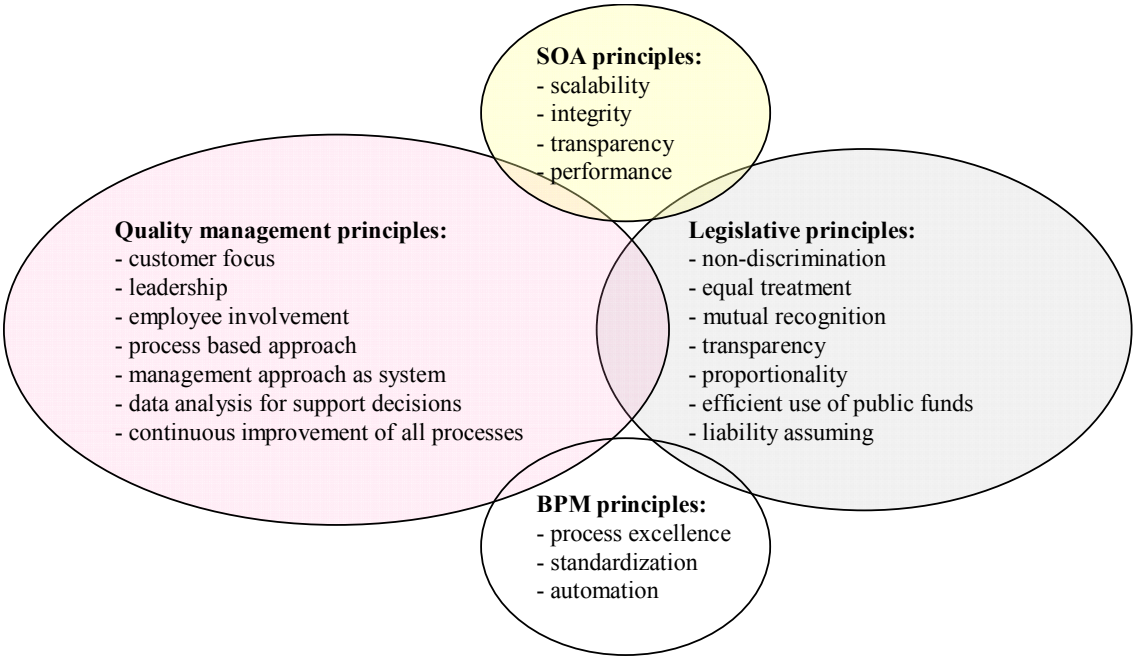

Figure 7. Principles of creating an agile architecture for acquisition process

Acquisition processes are decomposed into sub-processes and assigned to department employees according to their role. For example, the head of department creates the acquisition plan, makes the activities plan, assigns tasks, approves procedures, and participates in acquisition procedures, while the acquirers carry de acquisition procedures, take part to the evaluation, monitor contracts, etc. Services provided to the public acquisitions process are: ❶ entity services - providing access to resources, ❷ decision services - executing rules of the acquisition process to support decisions (approval, planning, risk, communication, monitoring), and ❸ process services - like planning, monitoring, management. Figure 8 presents an example of modeling of a public acquisition procedure according to quality requirements.

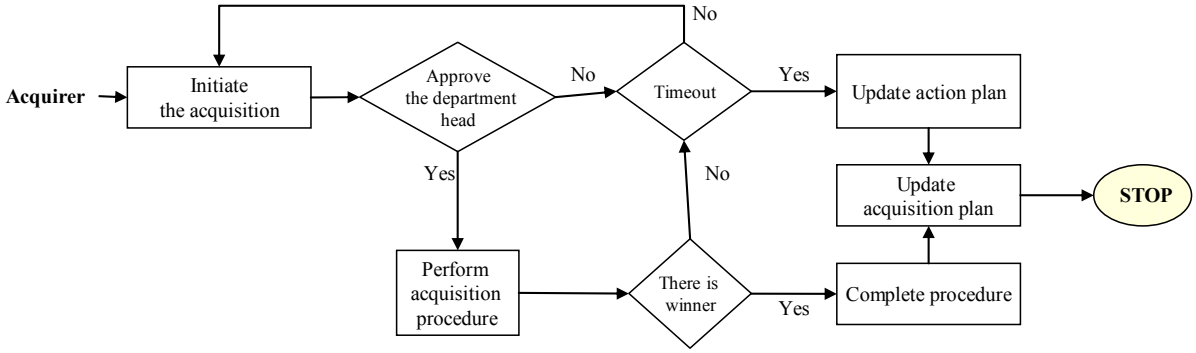

Figure 8. Example of modeling the sub-process of public acquisition procedure

Conclusions

Given the benefits of using a BPM and SOA integrated approach, organizations are encouraged to integrate these solutions and provide practical experiences that would lead to the creation of best practices in the management of service-oriented business processes. However, the decision to adapt to the service-oriented environment must take into account the type of organization, the business and IT strategy and must be accompanied by a cost-benefit analysis to determine the opportunity of this adjustment. Without correct evaluation of the impact of implementation, the organization may be confronted with the situation of adopting a solution that would not lead to the expected results.

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