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An approach to knowledge management in construction service – oriented architecture

Dr. Alexander Gromoff*, alexander.gromoff@me.com, Nikolay Kazantsev, nkazantsev@hse.ru, Julia Bilinkis (Stavenko), jstavenko@hse.ru

National Research University Higher School of Economics, 101000, ul. Myasnitskaya, 20, Moscow, Russian Federation

Abstract

Modern business driving requires agility in the reflecting changes of *Service-oriented Enterprise Architecture* (SoEA). For this purpose *Subject-oriented Business Process Management* (S-BPM) was used for facilitation of structured communication between process participants, process experts and resulted generation of collaborative business process. During such generation all necessary requirements for supporting resources (such as information, know-how, intellectual and professional skills, inputs and outputs, quality and operational risk limitations, moderation, control and monitoring) are taken into consideration using the operational knowledge of experts and project participants that act inside the predefined business area. The work results in updating the business model selecting business services from the virtual SOA torrent (that catches rated cloud services on the internet) and represents the basis for quickly adjustable "real-time" service-oriented enterprise architectures.

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* Corresponding author. *E-mail address:* alexander.gromoff@gmail.com

1. Motivation, methodology and research questions

Participating in numerous consulting/educational projects authors faced real problems of large-scale companies, among which is *proceeding with ad-hoc process changes.* The ad-hoc process adjustments could occur due to sudden shift in customer's order preferences or to broken schedule caused by scarcity of resources and other initially

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unexpected events, but mostly due to the reasons affected by customer. Regardless of process type the ad-hoc changes postpone an execution of customer-oriented process and thus trigger to customer dissatisfaction.

General motivation of the research was to create a model of agile architecture that could adopt, verify and implement ad-hoc changes in business processes. From practice we understood that ad-hoc process adjustment is only successful when provide by the true professional, gained through the years of experience. At the same time we aimed to keep the enterprise architecture consistent with the external and internal challenges using the advanced SoEA approach. In addition, our motivation was in attempt to connect the scholarly-theoretical view on business architecture with practical, which includes the peculiarities of BPM-systems application in real business scenarios.

During research we tried to answer next questions:

- *Which BPM concept could be applied in situation of rapidly changing conditions for business process?*
- *How to support collective decision process and knowledge extraction in time consuming conditions?*
- *How the model of flexible SoEA can be look like?*

Research proceeds as follows:

1) Brief literature review into a theory of Enterprise Engineering and process management problems;
2) Then *subject – oriented specifics* in business process management is described and a model of process adjustment via expert's knowledge generation is presented;
3) Finally the model of real-time SoEA (real-time business architecture) capable for business process agility is discussed.

2. Literature review

Service-oriented Enterprise Architecture (SoEA) is a relatively recent trend of Enterprise Engineering that is defined by set of various services aligned with business goals that use services as structuring and governing paradigm. In terms of information support, SoEA integrates Service-oriented Architecture pattern using cloud-computing resources[1]. In frames of SoEA business process can be developed dynamically using business services, which are available in a repository for a given business domain. However often a business process repository is built with a collection of industry '*best in breed*' practices that impose a strictly predefined process execution procedures, reference models, project references and models for packaged applications (such as SAP), which is the good foundation for a quick and effective business process modeling from scratch[2]. In this case described and logically proven agility of business processes[3] is impossible for implementation mainly due to the lack of sufficient flexibility in actual business processes designed top-down and its rigid and redundant organizational structures[2]. Furthermore attempts to integrate processes with cloud-based services often leads to extremely expensive solutions overloaded with unnecessary components and links between unexecuted functions.

In traditional Workflow Management Systems business process model modification is a time consuming and complex process itself[4] and such systems are not suitable for rapidly evolving processes. Overcoming business process rigidness requires huge efforts from company's business/information experts due to customer's requests, with result consolidation and approval from the superiors, whilst the process participants and other practical experts are urged to wait and only to follow the directed "top-down" business process logic.

We observed three approaches that are aimed on increase of business processes flexibility:

1) Pesic and Van der Aalst[4] proposed a graphical language ConDec for declarative and open modeling of business processes where a balance between support and flexibility was expected to be found. Instead of rigid definition of the interactions it focuses on (minimal) set of rules, which must be satisfied in order to correctly carry out the collaboration ("what" should be reached instead "how" it should be done);
2) Several vendors proposed ERP solutions for handling customer business processes inside Supply Chain Management, e.g. Ren et al.[2] described an IBM asset named Supply Chain Process Modeler (SCPM), which aimed to provide a tailored business process modeling and simulation environment for business user, creating the global process till customer side, and to achieve a better trade-off between usability and flexibility;
3) Pegasystems proposed Dynamic Case Management instrument Pega[5] that supported adaptive automation of work in business applications to coordinate a service request in human resources-related matters, on behalf of a subject such as a customer, a citizen, or an employee.

ConDec is a strong declarative instrument for open modeling of business processes, but mostly is oriented on

highly professional BPM teams (preferably with academic background) able to understand the rules of Linear Temporal Logic. SCOM and Pega are dealing with client demand in a "passive" way, e.g. they carefully store customer data however do not engage customer in active collaboration. The weak connection towards client is one of the reasons why customer behavior in process and customer demand is hard to predict based only on historical data.

Agility in business architecture becomes a concept that incorporates the ideas of flexibility, balance, adaptability, and coordination under one umbrella[6]. There are two basic ways how to increase agility for an enterprise:

- Encapsulating the functionalities of IT resources as services. Services shrink time for implementation of any IT project, since e.g. multiple interactions with customers to 'discover' their IT environment and to identify the resources to be managed become unnecessary and IT expansion with cloud service providers becomes much faster[7]. Li et al.[8] distinguish Cloud Computing Service Vendors (CCSV), having "a series of business flow for subscribers", while an ordinary enterprise (subscriber) has its own business processes subscribed to various services.
- Or, reducing coordination costs needed for communication between process participants while enhancing services orchestration and choreography. This effort requires a number of collaboration initiatives from customer side and expert group, which provided either by technical (IT) tool or expert community (talkatively) to find a way to balance the *collaboration of business processes* from both sides as top-down directives and bottom-up reflection[9].

Since modern organization deals with frequent changes, bottom-up reflection emerges innovation process, where every member of an organization or even customer can guide innovation that can be crucial for business process optimization. Decisions are no longer exclusively made by experts but are the results of collaborative process and thus require technical support (IT) for itself optimization.

3. Practical realization of agile architecture using S-BPM approach

In order to reach research aims, we were looking for BPM instrument that could support multiuser work, customer influence on planning the process towards him and to collect fresh data in real-time for new compositional services.

Another important requirement was assigning a new role in frames of business process – "*intelligent worker"* (subject) that has creative capacity and self-reflection for handling innovations. Alternative vision (process participant as a resource necessary for the function execution due to predetermined instruction) has still the same passive role that hampers proceeding ad-hoc changes.

Among certain alternatives S-BPM methodology was selected mainly because its simplicity of notation. There are only two types of process models for "process manager" and "subject manager" and five elements for process modeling. The former one is used for describing message exchange between subjects the latter one describes the participation of a subject in a process in a form of actor states and transitions from one state to another one.

Despite of existence of organizational borders S-BPM describes processes and rearranges process models immediately, imitates execution of models in order to achieve synergy by comparing models with the colleagues using general creative potential and dynamically connect external, new intellectual resources and/or processes performed by external subjects.[10]

The created model of the innovation process in 'process manager' is presented on (Fig. 1) in S-BPM notation. The model shows that the subject "Initiator of innovation creation" (blue box 'Initiator') interacts with the group of experts using Expert Search Service (rose box 'Expert search service'). He initiates the request to build certain expert group in according with his innovation (or dreams), and then he either approves or rejects proposed group/members. Afterwards Initiator sends an innovation description to the generated community, that oversees it and resolves whether it is sustainable or not. In case of positive answer, innovation is transferred to the investment committee (rose box 'Innovation management office') for final approval.

Each participant of the innovation process should have a certain degree of freedom in decision-making. This freedom is a kind of 'stimulus' for motivation of creativity, self-reflection and self-organization. If it is necessary to make a modification within the process, the corresponding model is modified and immediately uploaded on a server.

The updated application (a modified instant of the innovation process) could be run immediately. All instances of the innovation process, including source and modified ones, are stored as well as information environment. It is necessary to collect complete information about each process instance and to consolidate experience of enterprise's innovative activities.

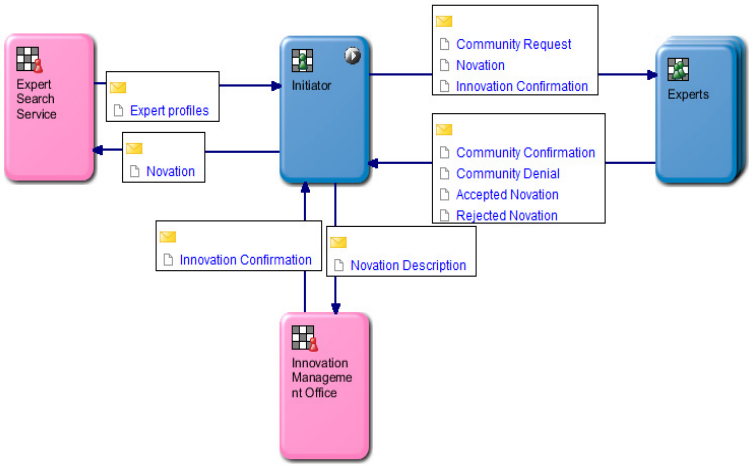

Fig.1. Example of describing collaboration between employees and customer[11]

This approach based on S-BPM platform enables to realize on-line connection both to multiple services of information access to unstructured information and to various DBMS with data access till the field level. An access to unstructured information can be realized by a single query that executes in several services simultaneously, for example Yandex, Google, Exalead, which are connected to the system at the moment. In this way the auto-generation of the system architecture for the innovation process management takes place, which can be corrected and analyzed by an expert group joined with process specialists.

This approach has advantages not only for innovation processes, but also for all processes that require flexibility, easiness and rapidity of modifications. The use of S-BPM within an innovative information system provides an enterprise with a powerful tool for independent management of business processes in real-time environment.

4. Real-time Business Architecture paradigms

Firstly the concept of Real-time business architecture (RBA) was presented as an approach for rapid modification of business requirements[9]. To avoid the hierarchical and top-down organizational structures misleads and related problems business process was presented as a puzzled picture. Each function (elementary puzzle) was described not only as a set of operations with related inputs/outputs but as well with particular knowledge belonging to the executive process expert and indeed required in the described set. Thus were assigned business activities to various knowledge domains, which were not exclusively belonging to the particular process or structure[11].

In order to implement the mentioned above paradigms the new form of business process management has to be developed, where the actors (employees, middle managers) play a decisive role reflecting in the management of innovation or transformation. Following features of enterprise play the key role:

1. Any participating employee has to describe easily Working process and its models can be rearranged immediately;
2. Synergy effect can be achieved by process consideration among coworkers versus simulation of the process model execution, which in fact is good for approving but in reality loses 'true vision';
3. Integration of innovation or transformation into working process has to be facilitated by quick acceptance

by experts and managers.

In this respect two modifications of Service-oriented Enterprise Architecture with synergy effect can be obtained:

1. Reformation of executive activities in frame of S-BPM approach, thus, transformation from rigid process structure into Subject-orientated Business Process moderation due to satisfaction of the market requirement. This transformation is organically realized in S-BPM paradigm by lowest level of process executives in ad-hoc mode, moderated by senior expert responsible for goal achievement. In this case, the real orchestration of real-time market requirements is developed.
2. Secondly, while monitoring the process of moderation, we extract repetitive or long lasting fragments of the processes and fix them in the clouds for further usage. Thereby, a set of extremely required services is obtained and immediately become valid for exploitation.

Developers of these compositional services should be provided with certain environment where the convenient mechanism of services storage and retrieval and also the mechanism of receiving money for these services will be developed and established.

Combining the areas of possible innovation and existing understanding of Enterprise Architecture requirements, we anticipate movement of EA to Real-time Business Architecture (RBA) that becomes more flat and market adaptive and can quicker be transformed according to business requirements. The new architecture contains on the one hand the pseudo-constant – static component provided by BPM and services corresponding to them in BSM; and on the other hand the variable component - dynamic component representing system of activity which is always in process of constant changes and improvement, described as system of business processes, projects and the objectives.

Another feature of these transformations is increased business mobility. This feature became real not only because of created and used ‘tangible’ services but also because of ‘intangible’ ones, so called ‘intellectual assets’. While solution of the known task is developed by known, fixed and established process, the new solution search of a problem or unknown task is provided by this intellectual asset constrained on a platform of search-based applications (SBA). Therefore, instant intellectual support is provided to modern business architecture “just-in-time”. It will allow expanding, and subsequently – dissolving organization borders (see Figure 2).

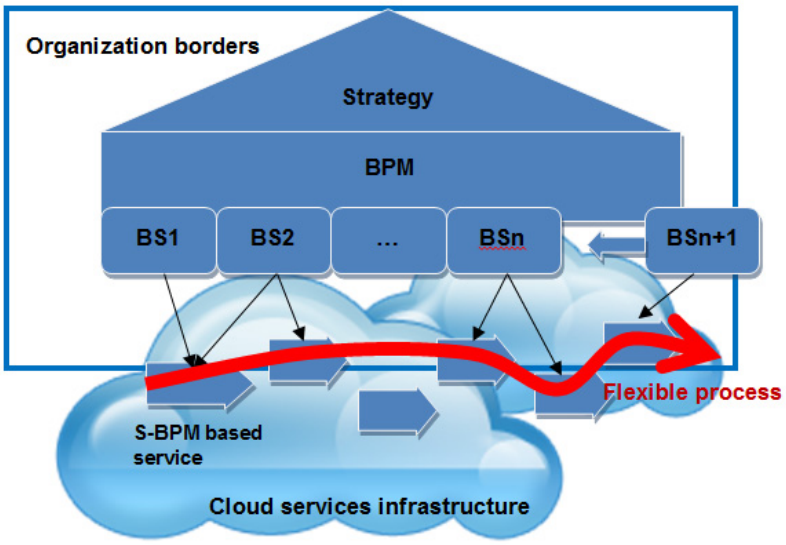

Fig.2. Real-time process handling in frame of SoEA[9]

The suggested approach to implementation of real-time architecture allows merging benefits of traditional enterprise with unlimited cloud facilities into uniform mechanism, which can provide high level of flexibility and

customizability for business. One of the key feature in modern cross cultural world of the RBA is independence from borders as cross-companies so cross-countries and over corporate communities frameworks, such, as crowd sourcing projects (instead of traditional organizations) which are gradually taking place in new knowledge economics.

5. Research limitations

Firstly, having information assets with very low actionability and validation in a cloud computing environment would undermine other business-alignment efforts, and greatly reduce the overall value of the organization's information assets.

On this way it is necessary to solve number of serious problems as technical (safety and productivity at flexible interaction of services), and organizational and administrative character (assessment of quality of competing services and qualification of related performers, ensuring risks control in self-organizing environment, ensuring quality in the subject-oriented paradigm of management).

Provided approach also reforms market from classical market-of-advertisement-use into market-of-value-use, because of business accessibility since its transparent and reflective nature representing core feature of S-BPM approach. Launching new free services market it responds to global trend of moving from static hierarchies (vertical structures) to electronic markets.

6. Conclusion

The practical worth from cloud technologies triggers a number of businesses that are examining how, when and what to migrate to the clouds and seeking best practices in running hybrid environments, which will save on IT budgets and resources. This research tried to reduce the distance and provide some hints for the answers: why, where and how to use cloud services and not to lose the coupling between business and IT functions. Authors understand that miracle dream about automatic business generation without human involvement can require a long discussion and they are ready.

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