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Towards emergence phenomenon in business process management

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A standard solution regarding business process management automation in enterprises is the use of workflow management systems working by the Rule-Based Reasoning approach. In such systems, the process model which is designed entirely before the implementation has to meet all needs deriving from business activity of the organization. In practice, it means that great limitations arise in process control abilities, especially in the dynamic business environment. Therefore, new kinds of workflow systems may help which typically work in more agile way e.g. following the Case-Based Reasoning approach. The paper shows another possible solution – the use of emergence theory which indicates among other conditions required to fulfill stimulation of the system (for example the business environment) to run grass-roots processes that lead to arising of new more sophisticated organizing forms. The paper also points the using opportunity of such techniques as the processing of complex events to fulfill key conditions pointed by the emergence theory.

Key words: business process management, adaptive case management, emergence.

1. Introduction

Standardization work in the area of business process management began in the early 90s of the last century. A key role in the initial phase of the field development played the organization called *Workflow Management Coalition* (WfMC), which defined basic terms and first rules. Initially, the issue was viewed in a relatively narrow meaning as 'task flow management' and 'document flow management'. In [8] a definition appears, which shows the then understanding of the issue: it is understood as automation of the business process as a whole or a part, in the time of which documents, information or rules are directed from one participant to another to perform an action resulting from the defined rules. In the consecutive years, the meaning of the terms was extended to encompass global perspective on business processes in an organization, seen mainly from the angle of achieved goals. Today, organizations such as *Object Management Group* or the abovementioned *WfMC* agree that the notion of business processes modelling should be analysed more broadly which is reflected by the definition included among others,

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in the [16]: business process management is a discipline that deals with the topics of modelling, automation, manufacturing, control, monitoring and optimization of the flow of business tasks in order to reinforce the fulfilment of organization goals, with participation of systems, staff, customers, and co-workers within and outside the boundaries of an organization. The new perspective except for clear orientation towards process aim considers the factors that were not present before:

- clients of organization are also active constituent of the considered system and take part in shaping the processes,
- the notion of action flow should be interpreted in a free way – the order of actions may be defined, but it can also be undefined.

Using the nomenclature applied in software engineering, management of processes in the enterprise should be 'agile' – more strongly directed to the goals of an organization and aims realized by the clients, rather than performing exactly defined procedures. Following this direction also influences the software systems designed to aid automation processes realized in a company. These systems change from the so-called workflow systems in the direction to more advanced applications, which could be called 'business objectives realization systems'. Development of such solutions is a complex task that requires knowledge and experience from different areas. The following paper shows a proposition of using the theory of self-organising (or self-growing) systems, the emergence theory, in connection with modern techniques of information management such as *Complex Event Processing* to develop a system that supports functioning of companies that realize business processes in a dynamically changing environment.

2. Workflow processes as orchestration of the use cases

One of the methods of describing a process performed in an organization is a graphical notation that is usually specially formalized and extended version of the UML activity diagram. One of them is a notation called *Business Process Model and Notation* (BPMN), which allows defining actions which occur in the business process and all possible flows between them as well as events occurring during process realization (standard published in [2]). Formally, the model developed by using BPMN is a graph, the nodes of which are actions and arcs are the flows between them.

On the other hand, one of the ways to describe the required information system functions are *use cases* (UC). A use case describes the interaction between an actor (usually a system user) and the system in the form of a scenario that consists of well-defined actions attributed to one of the sides. Realization of a properly defined use case leads to creating business value within a wider process – it contributes to meet a fragment of requirements on the way to realize a process objective. Use cases may be defined by using different abstraction levels, from the most general ones that represent a business process, to the most specific ones that represent single interaction (action) in a process. The ability to differentiate the abstraction level that is further described in [3] allows, in describing system reactions, assuming a level in which a singular use case will correspond to an action in the BPMN model. Such a model will then comprise a description of time relations between use cases. The BPMN model, apart from documentation and regulation functions relating to realized processes in a company, can also serve the function of an executable algorithm started using special software that aids workflow control. The action of defining the process model for the purpose of further automation using a control tool is called process orchestration and the person who is responsible for its realization is a 'process engineer'.

3. Decision based on defined rules

The theory of use cases (e.g. [3]) enumerates about ten elements that may be used to describe the use case. However, it may be assumed that the minimum set of information necessary to comprehend and implement an UC consists of the following elements:

- name of the use case – short name that describes well the aim of use case realization,
- initial conditions – system conditions required to start the UC,
- final conditions – system state after realization of the UC,
- basic scenario – a typical scenario that leads to fulfillment of the UC goal,
- alternative scenarios (extensions) – possible alternative flows of interaction that lead or lead not to the fulfillment of the UC goal.

In result of the realization of business process aims (i.e. realization of a subsequent UC that comprise the process) the system condition changes. The aim of the process realization is to lead the system to a particular, desired final state. For example, in the hereafter analyzed process of credit sale, such a state may be a signed credit agreement (a legal act) as well as the balance on the customer's account. The aim of the process engineer is to create a model that will include such range of use cases that after the realization of the last of them the process goal will be fulfilled (in other words – the final conditions of the last analyzed UC will correspond to target system conditions). A key issue that accompanies orchestration of use cases is the order of their realization. The basic limitation that affects the UC order is the necessity to guarantee fulfillment of initial conditions defined for each of them. This rule, in most cases, does not lead to one solution (unambiguous model), therefore the process engineer, while defining the process flow, has to use additional indicators and external knowledge and quite often has only intuition at his disposal. The consequence of the UC ordering is finding a proper business rule that is a function of the process state the execution of which serves as a trigger of the flow to the right direction to the next action (i.e. running of the next UC). The defined rules will be implemented in a decision node that follows directly after the realized action thanks to which it is possible to define clearly the flow of further processes. Designing the right order of UC as well as finding rules that enable automation of flows between them is a complicated task that requires extensive experience. Most often a system started and been working according to a specified model requires further observation and model correction by empirical research. The method of workflow control based on the rules mentioned above is called *Rule-Based Reasoning* (RBR).

4. Cloud of use cases

A business process of a cash credit sale will serve as an example for further discussion. Servicing of cash credit sale is characterized by relatively high requirements concerning minimization of servicing time, in comparison to the sale of other financial products (e.g. mortgages). This requirement implies the necessity to implement software that ensures a high level of automation in the process. Fig. 1 shows set of use cases that occur in the discussed process as well as a set of roles that are taken by actors involved in the process of selling credits. Relations between actors and use cases indicate potential doers of particular activities, but such a relation does not have to unambiguously indicate which of the roles are responsible for the realization of the UC: the model that was shown assumes, for example, that the credit scoring may be done both by a consultant and a credit analyst. This model also does not indicate the order of the UC tasks realization and does not even introduce assumptions to the UC set the realization of which is necessary to bring the system to the final condition.

5. Ordering

When considering a typical approach to business process modeling, it is necessary to order use cases in one coherent process spanning from the initial moment (event) to the final event. In the case of a more complex process, there usually exist many possible solutions that differ from each other regarding the order of the realized actions. If initial conditions of each use case were empty (use case may be applied in any state of the system), 17! (i.e. about $3,5 * 10^{14}$) solutions would exist in the discussed process. Even if relatively few items may be ordered in a different way, a rich set of possible solutions exists (e.g. 5040 options for seven free items). Such a set cannot be practically applied and evaluated in a real business environment. The criteria defined by using *Key Performance Indicators* (KPI) are useful while choosing a proper variant. Examples of such indicators are: total time of process realization, staff workload (total work time), number of people involved, client load (amount of information gathered, consultation time), share of positive conclusions (number of the clients acquired), share of negative decisions in the

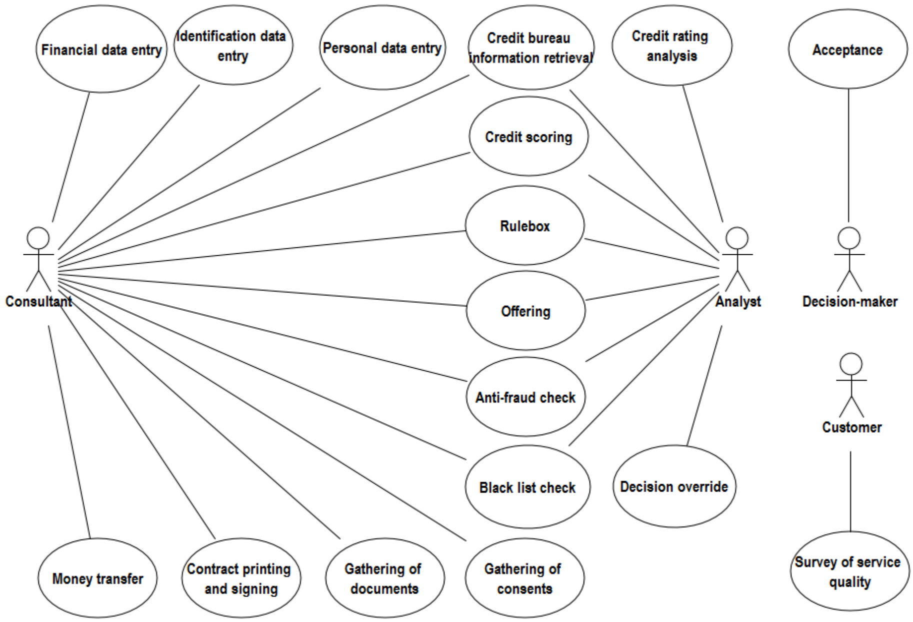

Figure 1: Typical use cases in the process of credit sale

confirmation stage, staff workload in relation to the number of the acquired contracts, business value of the acquired contracts, quality of contracts (measured, for example, by the share of credits in worse situation after the defined time), client's satisfaction (expressed by means of answers to questions in a questionnaire) etc. A task of deciding on the process model is usually realized by bank workers in a proper business role focused on doing analyses and implementation of optimal solutions (process engineer, business analyst, etc.). Figs. 2-4 show different variants of ordering several initial actions in the discussed process.

One of the KPI which will have a significantly different value in each of the exemplary variants is an indicator that can be called 'offer preparation time' and defined as the time between the start of the process and display of the list of offers prepared for the client. It will be the longest (the least beneficial) in the first variant and the shortest in the second one. On the other hand, the indicator that was called 'share of acceptances in approval center' will probably be the most beneficial in the first variant. Maybe the last variant would allow reaching the optimal solution, but it only is a hypothesis.

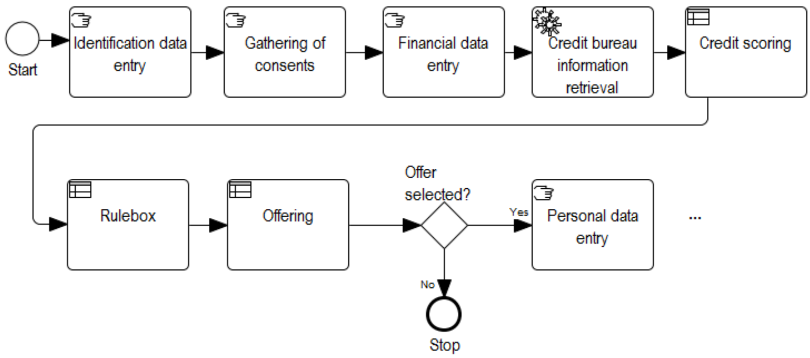

Figure 2: Variant 2 - ‘defensive’

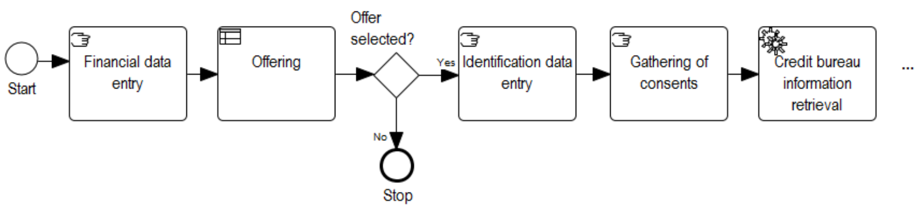

Figure 3: Variant 1 - ‘offensive’

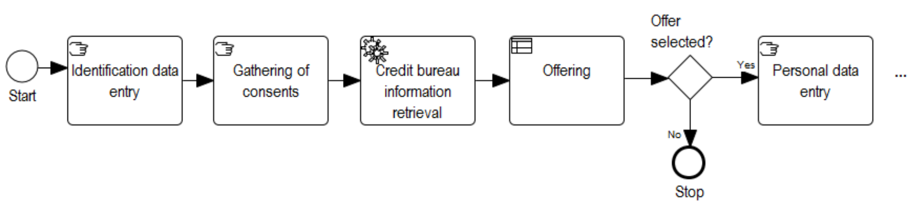

Figure 4: Variant 3 - ‘maybe balanced’

6. Current trends compared to proposed solution

Nowadays, in the area of workflow management yet another type of alternative solution in comparison with the RBR approach is distinguished – the approach based on business cases called *Case-Based Reasoning* (CBR), in which problems are solved by re-using previous solutions to similar problems, after their necessary adaptation to the new situation. The authors of [17] propose combining the two techniques: solutions found within CBR serve to build rules within RBR. Early freezing of definitions of processes should be rejected, and observation, learning, and continuous adjustment should be practiced when knowledge and experience of the organization grows. Recent years have brought very interesting practical solutions in the area of non-formalized approach to process management. The *Adaptive Case Management* (ACM) approach [11] and *Case Management Model and Notation* (CMMN) standard have been elaborated, and first management tools which implement such idea have also appeared. It should be recognized as an important and a valuable step in the direction of 'paradigm switch' in process management domain. The ACM approach ends with a process-centric and automatic way of problems solution towards knowledge- and communication-based one. The approach proposed in the current paper is close to CBR as both methods can be classified as 'agile' methods of process management in which a key role is played by actors involved in actions as well as the function of feedback and knowledge extension by experience. The ACM is used as a part of proposed practical solution, but one more step is suggested on the way towards the new kind of automation of process management. Another modern direction in BPM related to proposed approach is process mining technique [1] developed as a part of data mining area. One aspect of process mining is a control-flow discovery, i.e., automatic construction of the process model (e.g. a Petri net, BPMN graph) describing the causal dependencies between activities. Some parts of the solution proposed have the same functions as the process mining technique, so it seems to be useful for the future development to include that technique as a part of the solution. The insights provided by approaches similar to proposed are very valuable for the development of the next generation of Process-Aware Information Systems (PAIS) [5]. The PAIS are defined as a software system that manages and executes operational processes involving people, applications, and information sources based on process models. The system proposed may be partially treated as a kind of PAIS, but it seems to exceed PAIS definition since it has constituents which have non-process nature. After research of similar areas, it may be said that proposed solution consists of elements that are under current development, but they are not tied together to challenge such holistic approach as proposed.

7. The next step – emergence

According to the [6] emergence refers to what happens when a system of mutually related and relatively simple elements organizes itself, showing more intelligent better-adapted responses of a higher level. This definition points the increase of the system 'intelligence' thanks to which there appear more complex 'behaviors'. Referring to the science of knowledge theory, the increase of intelligence can be treated as a simultaneous increase of both declarative knowledge ('knowledge that') and the procedural knowledge ('knowledge how'). It is an important advice from the perspective of further discussion related to the implementation of the theory of emergence in a software system.

Systems organize themselves when relevant conditions are met. In [6] five of them are distinguished:

1) the system consists of a large number of actors ("All we need is thousands of individuals and a few simple rules of interaction"),
2) actors receive feedback from the background,
3) between actors there occur constant and free communication (in this case communication that is incidental and not planned),
4) actors have the ability and skill of recognizing recurring patterns,
5) no authoritarian control exists, instead of it, indirect control regulates the system.

Can those conditions be met in the case of an environment in which business processes are realized? A problem occurs already in the first condition – the size of the system measured as the number of actors performing actions. Who is an actor in case of a business process? If we assume that according to [16] actors (and a part of the analyzed system) are both representatives of organizations that offer products, as well as clients that use the offer, then the condition of involved participants in typical business environments will be fulfilled in most cases. The necessity of access to information feedback (the second condition) imposes requirements connected with monitoring of the information system. The system must compute in a continuous way, indicators that allow for conclusions about the effectiveness of the decisions being made (the previously mentioned KPI indicators) and the results must be known to the process participants. They also have to know what is the connection between actions that are realized by them as well as the decisions made and values of indicators and what influence on their unit benefit or public benefit have particular values of indicators. The condition connected with the existence of feedback (negative or positive) may be met by providing appropriate functions in the software. The third condition concerns communication between actors. This condition is fulfilled in two manners: through direct contact between actors and using relevant communication functions of the information system. In contemporary companies, collaboration is often remote and therefore the condition concerning free communication encounters obstacles. Thus, there appears a particular requirement for the software: it has to effectively provide all relevant communication functions for the analyzed issue on the level not worse than direct communication between involved parties. The fourth condition is relatively the most difficult to fulfil because it requires not only to 'design' the system appropriately (to decide on proper structure and communication mechanisms) but it requires from the system certain 'computing power', that will allow for effective recognition of recurring sequences of actions and decisions in relation to the result of the whole process or even results of the whole population of processes. Fulfillment of this requirement requires, in a special way, the introduction of support by using conceptual and software tools such as hereafter described *Complex Event Processing* approach. The last condition means both lack of direct control (there is no specified actor who manages the process realization) as well as the necessity of the occurrence of certain 'bottom-up' forms of control: in the system there must exist mechanisms of mutual control that will eliminate unwanted reactions, namely those that obstruct its growth. An example of such mechanisms in software systems are systems of opinions and comments that enable to eliminate individuals that use rules not accepted by the community.

8. Emergence of processes

Let us assume that the environment that realizes the business process of cash credit sale has been organized in such a way that conditions which stimulate emergence are fulfilled:

1) there is properly large number of actors (bank workers, customers),
2) the system for sales support calculates and presents effectiveness indicators in a continuous manner,
3) there functions a system of communication between actors that is easily accessible and convenient in use as it 'encourages' making decisions,
4) the system for sales support searches recurring behaviors of actors in a continuous manner, it can relate actions taken in more complex sequences, and it attributes the required effectiveness indicators to them,
5) there exists no 'top-down' management of task completion; neither a person nor software system allocates tasks to do. Actors themselves choose tasks to do within the goal they strive to achieve. There are also no mechanisms for 'top-down' evaluation of task completion. At the same time, there are systems implemented to allow for 'bottom-up' control (e.g. system of comments).

What may emergence effects be expected in such a system? What 'higher organization forms' will appear here? The first element which we expect is self-organisation of the process flow. The system must acquire the final state that is known and well described using relevant rules. It is achieved as result of the realization of specific (formalized) tasks that belong to a certain set, but the order of their realization is not fixed. There is also no requirement concerning completion of all the tasks from the set because also the realization of a sub-set can lead the system to the target state. Regarding process self-organization, we may expect the following recurring elements to emerge:

- sequences of actions within one role,
- decisions in connection with a particular system state,
- sequences of actions and decisions encompassing many roles,
- processes as wholes.

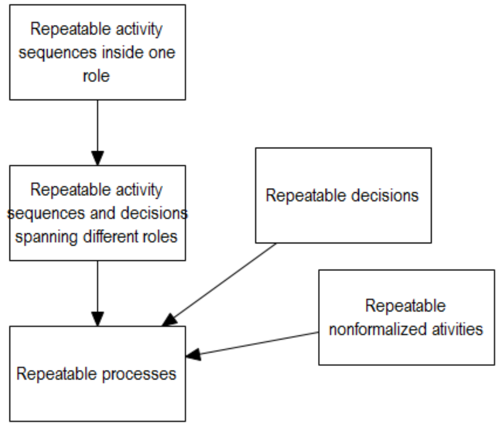

Figure 5: Emerging elements

The second effect that we should expect is the emergence of new activities that do not appear in the set of defined sentences that will be attached to sequences on the same basis as formalized tasks (Fig. 5). These can encompass recurring communication acts or other activities with a clear structure that are not formalized yet. Such a situation takes place mainly in case of growing business needs the meeting of which is not possible by using the system component elements designed until that point.

An effective conceptual and technical tool that serve to detect recurring patterns is *Complex Event Processing* (CEP). It is an approach that encompasses methods of tracking and analyzing sequences of events and finding relationships that appear as well as using the recognized relationships for further deductions and decision making. [9] is most often recognized as the first complete description of the approach. Integration of the business processes realization software with CEP software enables on-going analysis of the stream of events that take place in a process to find regularities according to the defined rules. In the case of the discussed issue, there are several categories of patterns that may be subjected to detection by using CEP, such as:

- detection of frequently recurring simple sequences of actions (without branches and decision nodes),
- detection of recurring decisions connected with the process state and information included in registered data,
- detection of action sequences tied the KPI indicators (e.g. sequences that lead to the most beneficial value for a particular indicator or combination of indicators).

The work of the rule-based CEP engines often leads to the development of declarative knowledge base of the system which can subsequently be used as feedback for the

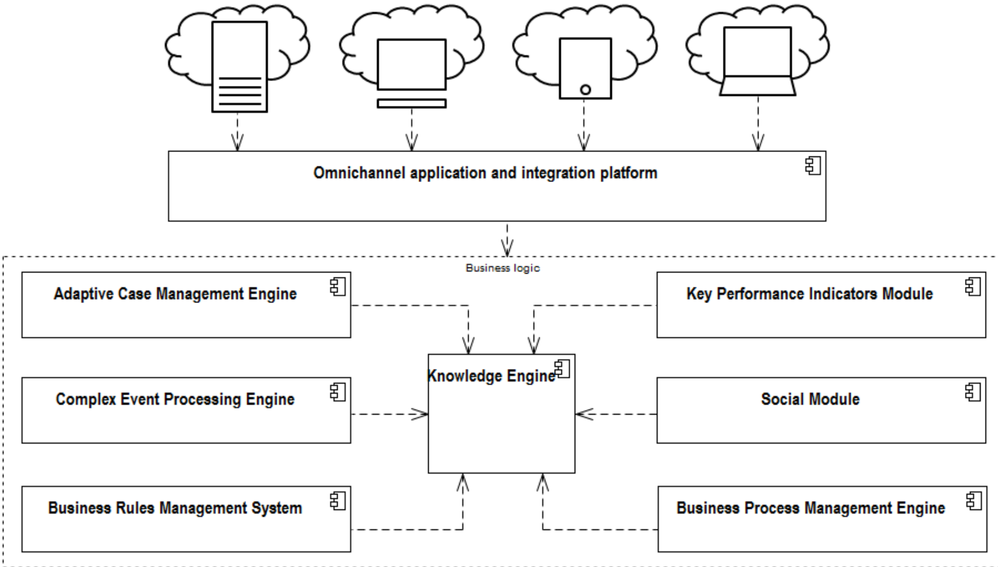

Figure 6: Proposed components of the system

support and automation of actions realized by emerging procedural knowledge. The simplest example of applying such knowledge is a system of hints for the most beneficial ways of process continuation or even automation of the realization of next actions in the case when (according to the defined rules) the system detects domination of one of the paths.

9. System stimulating emergence

The open question is what set of functions should support information technology system which would help the community to develop emergent behavior. The first attempt to describe such software might be made by taking the emergence conditions mentioned above and by carrying out analysis how to satisfy each of them, keeping at the same time additional goal that coherent and useful software must come into existence. Thanks to the use of such analytical approach, the first sketch of the required system appears. It is shown in the form of the component model in Fig. 6. To confirm the correctness of the analysis and that the software meets expectations, an empirical experiment in the proper business environment would serve. In the next subsections, the responsibility of each component is shortly described.

9.1. Omnichannel application and integration platform

The *omnichannel* business model, described in-depth in [15], is at the moment promoted as the most appropriate way of cooperation between customers and service providers in nowadays business conditions. The omnichannel approach may be seen as the ability to be in constant contact between parts through multiple communication channels at the same time where the same data and process information are accessible and coherent. Such capability should also be present in discussed system as its primary function which would enable access to the other more specialized functions. This part of the system provides a bi-directional asynchronous connection between front-end multi-technological applications handled by actors engaged in communication and core modules described below. Such a function supports the first condition of emergence phenomenon i.e. involving large enough number of process participants.

9.2. Adaptive Case Management Engine

This module acts as the main process engine allowing actors to do their business tasks, giving them the opportunity to optimize the way of doing that and to adapt their behavior when conditions are changing. The ACM engine enables to shape own actor's path to the final goal and at the same time tracks his steps and builds a database for further analysis and reasoning which is provided by the *Knwowledge Engine* component. Thanks to the ACM module, 'bottom-up' model of management is accessible and mentioned above the fifth condition of emergence may be satisfied.

9.3. Complex Event Processing Engine

The CEP approach enables to find recurring patterns in the stream of business events. Several types of pattern matching approaches are described in [9] and implemented in a real software and many of them have found their practical implementation in manifold software applications (interesting examples are described in [10]). In discussed system, the CEP engine recognizes patterns in actors' behavior tracking sequences of chosen tasks, makes abstractions of those events and sends it to the *Knwowledge Engine* component. That function is required to fulfill the fourth condition of emergence mentioned above, i.e. recurring patterns recognizing skill.

9.4. Business Rules Management System

BRMS software typically stores, executes and monitors some business logic which may be externalized from software code-base and described using special executable notation. In process management systems such kind of software usually supports the description of the logic of decision nodes where the outcome depends on the state of the business case under processing and sometimes depends on the state of the external environment. Described system uses BRMS engine to store and execute decision logic made by actors. It is an open and non-trivial issue how such automation may be provided and leads to a more fundamental question about action logic recording.

9.5. Key Performance Indicators Module

The second condition of emergence listed previously concerns continuous feedback about the efficiency of decisions made and activities taken. A typical solution for efficiency measurement in BPM systems is the calculation of *Key Performace Indicators* and further analysis based on them. Special parts of business applications usually visualize such indexes and let to reason and adapt procedures of action by them. Adjustment involves qualified 'process engineers' and in the most cases is not automated. Discussed solution, besides visualization of KPIs, have to automate their application and therefore values of KPIs are sent to *Knowledge Engine* module where they are combined and confronted with decisions made and activity sequence patterns found.

9.6. Social Module

The *Social Module* provides a convenient way of performing communication acts between parties involved in cooperation. Both service providers and customers can easily contact each other, ask the question, give advice, make a proposal or just share experience and knowledge. This module serves not only as popular internet communicator but it works in the context of current business activities carried out by parties and registers and classifies such communication acts enabling further reasoning provided by the *Knowledge Engine*. Tactics governing this extended social module may be theoretically aided by *Speech Acts Theory* introduced in [14] and then broadly developed by many authors and practically adopted in agent-like software.

9.7. Business Process Management Engine

The BPM part of discussed system runs re-usable sequences of tasks, which are products of emergence phenomena. This module is also used to define embedded micro-sequences having a rigid structure which represent algorithms of single activities and as a whole are called from ACM engine.

9.8. Knowledge Engine

A module called *Knowledge Engine* is the central part of the system which main responsibility is to find symptoms of emergence phenomena and to utilize their power. It derives knowledge from other modules and makes it usable. For example, it finds regularity in task sequences generated by choices of actors by confrontation with combined values of measured KPIs. Regular and most valuable patterns are then used as a proposition of future choices with a constant evaluation of gathered effects if such hint was utilized. An intrinsic part of this module is knowledge database built by increasing experience of the system. Very interesting issue, which requires further study, is how to represent procedural knowledge making it useful for process automation.

10. Final remarks

An interesting direction that can be used in further development of the proposed approach is knowledge extension techniques which besides feedback make use also of possible simulations of process continuation as well as evaluation of the results of simulated actions before taking real actions. This idea was described in [2], where the technique was called 'projective simulation'. An additional advantage of this approach is the introduced randomness and probabilistic evaluation which gives additional potential in extending knowledge by using solutions that were not selected and that can be selected due to lack of formal obstacles defined as initial conditions of use cases.

The proposed direction is not free from risk. First and foremost it assumes much deeper immersion of actors in the business environment than it takes place in typical commercial activity. Relatively high awareness of process participants and very high motivation is required to meet this assumption. It is necessary to meet complex technical requirements that enable free and satisfactory participation of actors in communication processes that are necessary for the system to develop. Thus, it is necessary to use modern, often mobile equipment and develop sophisticated software that will provide high-quality information and its usage would be as natural as in the case of bottom-up processes occurring in nature.

References

[1] W.M.P. van der Aalst: Process Mining. Data Science in Action, Springer, 2016.

[2] H.J. Briegel and G. De las Cuevas: Projective Simulation for Artificial Intelligence. Scientific Reports, 2012.

[3] A. Cockburn: Writing Effective Use Cases. Addison-Wesley Professional, 2000.

[4] G. Di Marzo Serugendo, M-P. Gleizes and A. Karageorgos (Ed.): Self-organising Software. From Natural to Artificial Adaptation. Springer-Verlag Berlin Heidelberg, 2011.

[5] M. Dumas, W.M.P van der Aalst and A.H. ter Hofstede: Process Aware Information Systems: Bridging People and Software Through Process Technology. Wiley-Interscience, 2005.

[6] S. Johnson: Emergence: The Connected Lives of Ants, Brains, Cities, and Software. Touchstone, New York, 2001.

[7] H.D. Jorgensen and S. Carlsen: Emergent Workflow: Planning and Performance of Process Instances. *Proc.of the 1999 Workflow Management Conf. – Workflow-based Applications*, (1999).

[8] P. LAWRENCE (Ed.): Workflow Handbook 1997. Workflow Management Coalition. John Wiley & Sons Ltd, 1997.

[9] D. LUCKHAM: The Power of Events: An Introduction to Complex Event Processing in Distributed Enterprise Systems. Addison-Wesley, 2002.

[10] D. LUCKHAM: Event Processing for Business. Organizing the Real-Time Enterprise. John Wiley & Sons, Inc., Hoboken, New Jersey, 2012.

[11] H.R. MOTAHARI-NEZHAD and K.D. SWENSON: Adaptive Case Management: Overview and Research Challenges. *IEEE Int. Conf. on Business Informatics*, (2013).

[12] OBJECT MANAGEMENT GROUP (OMG): Business Process Model and Notation (BPMN). http://www.bpmn.org.

[13] A. RANTRUA, M. GLEIZES and C. HANACHI: Flexible and emergent workflows using adaptive agents. *ICCCI 5th Int. Conf. on Computational Collective Intelligence, Technologies and Applications*, (2013).

[14] J.R. SEARLE: Speech Acts. Cambridge University Press, 1969.

[15] P.C. VERHOEF, P.K. KANNAN and J.J. INMAN: From multi-channel retailing to omni-channel retailing. Introduction to the special issue on multi-channel retailing. *J. of Retailing*, **91**(2), 2015.

[16] M. VON ROSING, H. VON SCHEEL and A. SCHEER: The Complete Business Process Handbook: Body of Knowledge from Process Modeling to BPM. Morgan Kaufmann, 2014.

[17] B. WEBER and W. WILD: An Agile Approach to Workflow Management. Lecture Notes in Informatics, Gesellschaft für Informatik, Bonn, 2012.