MODELLING EVOLUTION OF KNOWLEDGE-BASED INFORMATION TECH-NOLOGY ORGANIZATION: THE CONCEPT AND PERSPECTIVE

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Abstract: Increasing pressure on the efficiency of the companies leads to transformation of their Information Technology (IT) organizations from technology-oriented to service-oriented, based on the Information Technology Infrastructure Library (ITIL) model. The evolution of these IT organizations can be supported by the knowledge-based systems based on the rules determined through aggregation and refinement of existing organizations' evolution and fuzzy logic modelling. The paper describes details of building such models and describes its applicability in business practice.

Key words: ITIL model, knowledge-based systems, IT organization evolution

1. Economic downturn and its consequences

The global economy is currently under strong influence from global economic downturn. Since September 2007, the most country economies are facing recession or slowdown.

In the world of tightened margins and unsure profits, business efficiency becomes increasingly important. The companies are revisiting their product portfolio and – above all – are seeking to increase their efficiency through reengineering of their operations.

The main tool for that is improvement of business processes. Modern company is structured around repeatable units of work made up by step-by-step execution. A typical company defines and executes processes like: ordering, manufacturing, sales, document processing, financial reporting, etc. These processes are repeatable, defined and quantitatively managed. Data gathered from them is used on a daily basis to assess and improve company's performance efficiency.

2. Increasing importance of information technologies

Another trend is the deep and wide utilization of information technologies. Virtually every business today utilizes information technologies: computers, peripherals, software, internet. Last 10 years dramatically changed the position of information technology in the business. Some time ago it was used mostly for tasks like document processing, accounting and e-mail. Nowadays, most business processes are impossible to be carried out without support of information technologies. Most of the business data resides inside the information systems and most of the communication in the company or between the companies is carried out by electronic means.

In this way the business becomes increasingly dependent on the technology. At the same time, the complexity of the technology is increasing. A typical business manager, to say nothing of the average user of the information system, is not aware of the technology details that make up his or her daily working environment.

The need arises to ensure the proper business response of the information technology without overwhelming the non-IT personnel with the complexity of technology solutions.

3. Special role of financial companies

Financial companies are, in many ways, the vanguard of this trend in the modern economy. There are several reasons for that:

- Their strategic resource is information

- Their strategic competency is managing information (contrary to popular belief, which says banks are about managing capital)

- The business processes have to be highly optimal and highly transparent

- They exist under strong pressure from regulations and regulators

- Only strong presence of information technologies can guarantee all of the above

- That's why the banks need new, more sophisticated model of IT organization.

4. New model of service IT organization

In the traditional IT organization, described in details in [1], (we call it for the purpose of this paper 'technology-oriented' organization), the IT department values and objectives are defined mostly by the engineers and are technology-related. In such organization the IT personnel is 'excited' by using the most modern technologies. The tasks are performed not because they are justified by business rationale, but because they are necessary or perceived as important from the technology point of view.

A good example is purchase of new server. In technology-oriented organization the fact of the purchase and actual model of the server purchased is determined from the point of view technological parameters, vendor or compatibility with existing equipment. In the service-oriented organization, this kind of investment is driven by business consequences: increased number of users, new process steps, new business data to be aggregated or measured. Such an investment should be justified by costs and benefits analysis and approved by management as a means of improving the company's competitive position or operational efficiency.

5. Service-oriented organization and ITIL

The service-oriented organization has been described in details in [2] and [6, 8]. The fundamental building block of the service-oriented organization is the IT service [7, 13]. In the idealistic situation, it responds directly to the business process: follows the sequence of steps of this process and recognizes its parameters (e.g. process throughput, response times, availability hours, availability percentage, etc.). Such situation is illustrated in Figure 1.
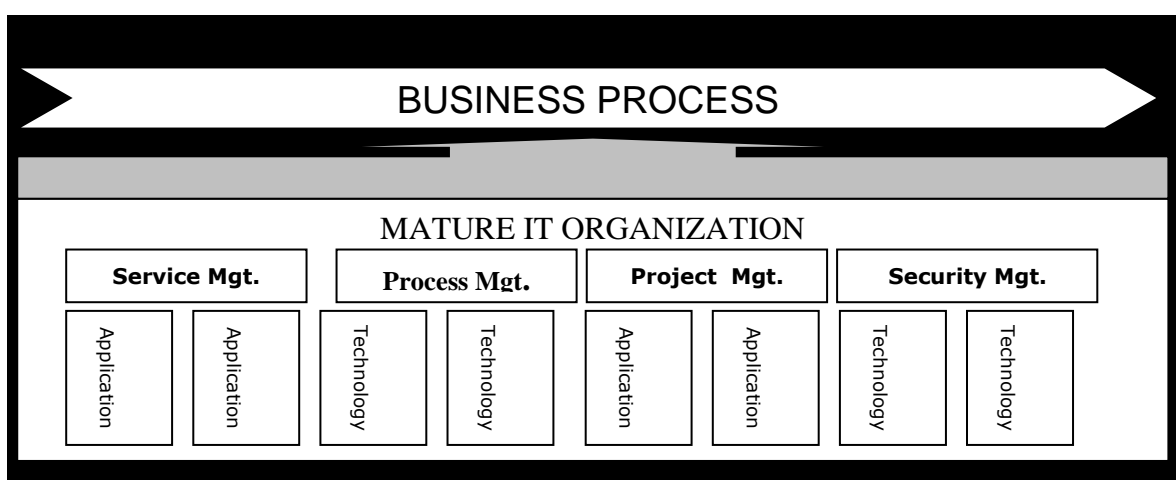

Fig. 1. Service as a response to business process detaching complexity of underlying technology from the business customer and business user.

In real life, the parameters of IT service are the compromise of business needs, technological possibilities and cost. A good example is the cost – ideally, the business would get 24x7, 365 days a year, 100% availability [14]. Hardly any company is able to provide that without building sophisticated, mission-critical infrastructure full of redundancies, disaster recovery and support. In banking world, this is achievable (with difficulties) only for user-critical services, e.g. credit card payments. For other services, the IT organization can provide 'reasonable' service parameters, e.g. 98% hours availability, availability hours 7-20 Monday to Friday.

Even harder than agreeing appropriate service levels, is building the organization that is able to meet them. As shown in [4], the research on that started in early 90s and continued through last decade of the previous century. The gathering of practical experiences led to establishment of IT Infrastructure Library (ITIL).

The ITIL model version 2 consists of 9 areas ("yellow books") covering main aspects of IT organization management:

- Service Delivery

- Service Support

- Information and Communication Technology (ICT) Infrastructure Management

- Security Management

- The Business Perspective

- Application Management

- Software Asset Management

- Planning to Implement Service Management

- ITIL Small-Scale Implementation

However, the most widely adopted parts of the ITIL are those related to IT Service Management (ITSM): Service Support and Service Delivery. The former is focused on providing IT services on the agreed levels, managing the service outages (Incident Management), root causes of the incidents (Problem Management), changes (Change Management), bulks of changes (Release Management) and underlying infrastructure (Configuration Management). It takes more 'operational' view on IT operations. The latter is focused on building services according to the customer's expectations and building the capabilities to deliver them on agreed level within justified costs. It consists of the following processes: Capacity Management, Availability Management, Service Level Management, IT Service Continuity Management and Financial Management.

In May 2007 the revision 3 of the ITIL (called ITIL3) was announced [3]. It is a superset of ITIL2, more taking service-centric perspective and focusing on evolution of the service.

6. The perspective of IT Organizations in Poland

A research undertaken in 2009 by Information Technology Management Group in the Faculty of Economics and Management in Gdansk University of Technology gives a snapshot of the status of IT organizations in Poland. The research was carried out on the population of 53 IT organizations in an electronic form.

It showed that ITIL is the predominantly used standard and version 2 is the most popular one. 26% of the surveyed organizations are using it and further 8% is intending to. Most of the organizations prefer to offer services through a defined contract (Service Level Agreement, SLAs).

Another research, carried out by Computerworld Weekly Magazine in September 2009, shows that most of the companies (over 70%) implemented basic service management processes: incident management, problem management and change management.

These results show increasing interest in the service-orientation and ITIL. The question arises: are Polish IT organization prepared to transform themselves from the traditional IT organization into the service-oriented one? If yes, can the research offer the support in this transformation?

7. Missing model: the organization evolution

However, the ITIL shows the goal, but doesn't describe how to achieve that. It describes the set of processes with their overall characteristic. For example, it describes the Incident Management process as a way to control the incident (service outage) from reporting by the user or infrastructure monitoring tool, to successful closure by restoring the service.

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The actual sequence of the process steps or its characteristics is not given by the standard or supporting documentation. The authors emphasized in [5] and [6] the fact that it should be specific to the business rationale, size of the organization, supporting tools or required availability. However, they provide a simple scale for measuring the process completeness or maturity. IT Service Management Forum (itSMF), the supporting organization of the standard, provides the tool for determining it in the actual IT organization. This scale is illustrated in Figure 2. It illustrates the increasing maturity (top – highest maturity, bottom – lowest maturity) or capability of the single process. The question that arises in the actual organization is: how it should be transformed into the intended direction?

Level	Description
5	Customer Interface
4.5	External Integration
4	Management Information
3.5	Quality Control
3	Products
2.5	Internal Integration
2	Process Capability
1.5	Management Intent
1	Pre-requisites

Fig. 2. Process Maturity Scale

8. The IT organization evolution

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The change in the IT organization is called the organization evolution. The intention is clear: starting from the tradition IT Organization, build the service-oriented organization. It can be performed either by a project, iteratively or taking the 'guerilla approach'. The word 'evolution' is used rather than 'transformation' because of the (preferred) iterative nature of the process.

The progress in this evolution can be measured by reaching the higher stages of maturity, as described in the previously mentioned ITIL process maturity framework [9, 10]. This framework comes together with a simple assessment tool available on-line [14] It allows to determine the actual maturity of the process in terms of the scale presented in Figure 2. In the Fig. 3 an example process evolution (Incident Management) is presented for illustration.
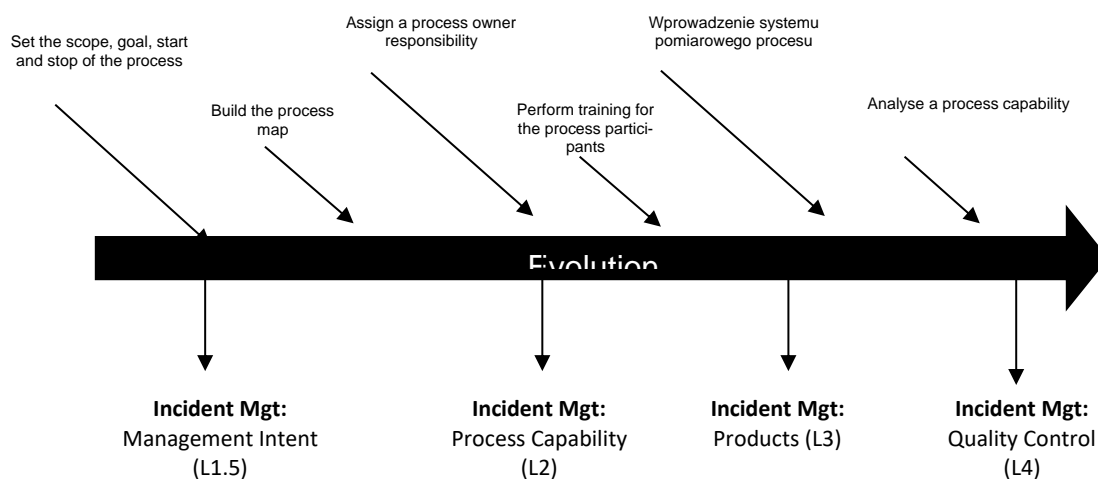

Fig 3. The evolution of the single process

As it can be observed in Fugure 3, as the organization evolves (middle part), the increase in the maturity of the process (bottom part of the figure) is achieved by carrying out certain actions or taking decisions in the IT organization (top part).

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The support for the IT organization evolution would mean to identify the actions and decisions to be taken in the organization, so they allow to move the organization up towards the intended higher maturity of ITIL processes.

9. Experiment: The evolution of large bank's IT organization

Between the 2006 and 2010 large retail bank took the steps to evolve its IT organization into high-maturity, service-oriented and process-driven organization [11, 12]. During this evolution, in the regular period of time the assessment has been carried out in order to determine the organization maturity according to ITIL model.

The results showed significant, but not linear progress in the organization process maturity with time. In general, the assessment results from 2010 show higher maturity that those from 2008, while these show higher maturity than those from 2006.

The researchers from the Information Technology Management Group in the Faculty of Management and Economics of the Gdansk University of Technology carried out the detailed research of this evolution taking a look into six evolution dimensions:

- processes
- services
- projects
- technologies
- knowledge
- organization culture

Out of those, the process dimensions seemed to be the most systematic and the most critical in reaching higher maturity levels. This has been, to large extent, a consequence of taking the Lean Six Sigma perspective by the organization as a whole. Therefore, the change in process area

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was the most sustainable and the most extensive and – in this way – decisive for the overall organization change. All other areas cannot be ignored, but they – so to say – followed.

The information gathered was divided into three groups:

- Management processes – they are typically spread over the period of time; they change roles, responsibilities, qualifications, tools, etc. A good example of the management process is deployment of the IT tool or performing root cause analysis for all significant incidents

- Management decisions – they are single, short acts performed by the senior management of the organization. An example of the management decision is introduction of the detailed procedure for handling the incidents (in the Incident Management process)

- Management artifacts – are products, documents, diagrams established or modified through management decisions. An example of the management artifacts is the template document for change risk assessment.

10. Organization evolution modeling

Having gathered the information about the evolution of the organization, the effort was undertaken to discover and find the relationship between the organization maturity and three kinds of actions described above.

Each such relationship was represented by the following information:

- Process (from ITIL2)

- management process / decision / artifact

- source maturity of the process (1-5)

- target maturity of the process (1-5)

- positive / negative correlation

- strength of correlation (very strong, strong, weak, inconsistent)

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Together, they make up a rule describing the evolution of the organization from a certain point (in terms of process maturity) to the certain point (again, in process maturity according to the same framework) by taking an action (management process, management decision) or presence of the management artifact. The example of such rule is presented below:

Root cause analysis	P	PM	DN	2	BS	+

It should be read in the following way: Root Cause analysis is the Process (P) that evolves the Problem Management (PM) process from any lower maturity level (DN, from Polish acronym for 'any lower') to 2nd maturity level (2), with very strong (BS, from Polish acronym of 'very strong') and positive (+) correlation.

Based on the above principle, there were 31 rules developed which were universal for all the processes, 85 rules for Service Delivery processes, and 47 rules for Service Support processes.

11. Evolution modeling in the knowledge-based system

The evolution of the organization is the phenomenon existing in the complex, non-linear and social environment of the IT organization. Number of approaches was considered in [2] for knowledge representation. Finally, the researchers decided to use fuzzy knowledge modeling. The IT_MAS (Multi-agent system for evaluation of information technologies) system, developed at the Information Technology Management Group, was used for the purpose of knowledge modeling. Initially it has been developed to model knowledge about technologies supporting project management, but later it was generalized to support the organization evolution. The decision support model is described in details in [1, 2]. The general idea behind the model is described in Figure 4.
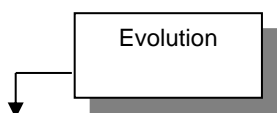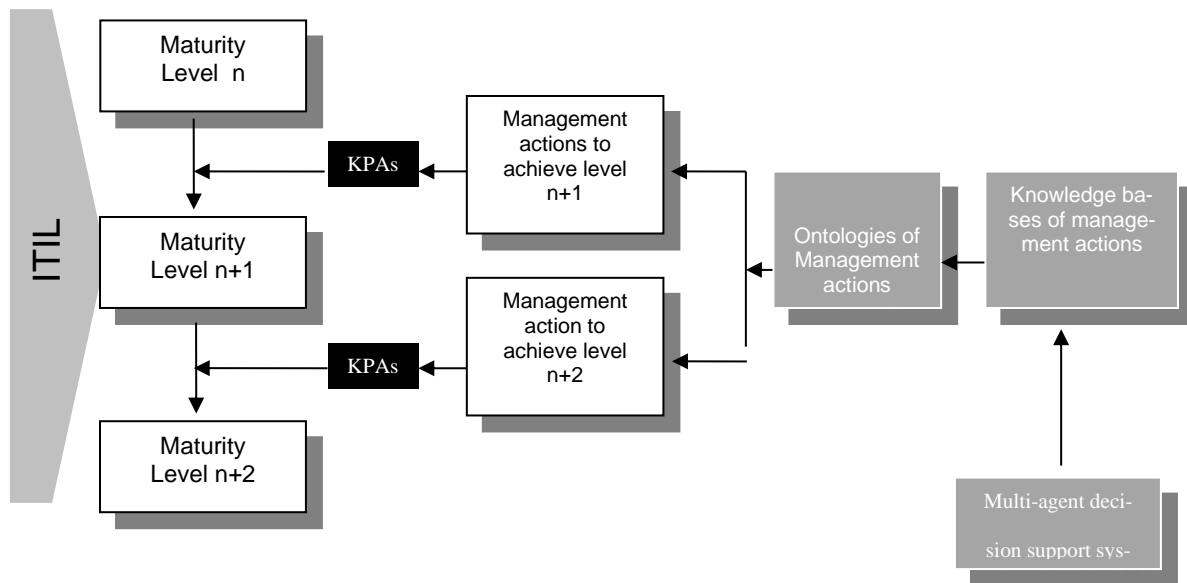
Fig. 4. General overview of the decision support model (KPAs stand for "Key Process Areas", or simply processes as defined in the ITIL model)

12. Experiment: Generalization of the model

In the second experiment, the model developed on the example of the large retail bank was generalized. The researchers were aware of the fact that any rule-based model that is built upon the data provided by the single IT organization, can only be used to support the evolution of this organization. In order to provide the prognostic capability for the model to support other IT organizations, the model should be generalized.

This was achieved by gathering the data from other IT support organization. The representatives of these organizations were presented the rules in the form described in the paragraph "Organization evolution modeling", but the rules were incomplete. One or two pieces of data were not provided – e.g. the process, the source maturity or even the description. They had to fill in the empty spaces with the information that is based on their experience.

Later, the data was aggregated using the following rules:

- if the rule was negatively verified by any of the experts, it was deleted from the model

- if the experts were providing inconsistent information (each of them provided different data), the rule was deleted from the model

- if some the experts were consistent, and some of them not, the rule was changed in terms of strength (e.g. from 'strong' to 'weak')

- if any new rule was added by an expert, the other experts were asked to verify it.

13. Conclusions

The research showed that the evolution from technology-oriented to the service-oriented organization can be driven by decision-support system. This system can use fuzzy rule-based modeling to represent the knowledge about the organization evolution. It has a value of supporting the management decisions by finding right management processes, management decisions and management for achieving higher process maturity.

Having chosen the ITIL2 model, the researchers addressed the most widely used methodology underlying the service-oriented IT organization. The primary area of research – large retail bank – together with generalization provided by other organization, gives the model the ability to drive the evolution of wide area of IT organizations.

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