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Analyzing Loosely Structured Business Processes Using a Minimal Software Prototype

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ABSTRACT
To analyze business processes in an organization by interviewing or observing human participants are time-consuming and problematic; it is difficult for participants in the processes to describe how they really work, especially if the processes investigated are so called loosely structured. In this paper, we suggest an alternative approach to business process analysis (BPA) in which a minimal software prototype of a business process support system (BPSS) is introduced before the processes models in the BPSS are defined in a more structured way. The analysis of the prototype's event log is the basis for BPA and the definition of the more structured processes. Our approach is part of an emerging research area within business process management, called process mining. However, in contrast to other research in this area, we are applying process mining on loosely structured processes using the state-flow view of processes.

BACKGROUND
The current state of the art when an organization is about to acquire a system for business process support (BPS) involves a thorough analysis of the organization's processes. The goal of this analysis is to create a process map. The map is then used when creating or adapting the BPS system to fit the needs of the organization. Creating a map makes existing processes explicit and manageable. The analysis may also result in some real surprises: new processes are discovered, old processes are conducted in new ways and processes that were thought to exist do not [13].

This analysis, while being necessary, is very expensive. It takes time and highly skilled specialists to do it. They approach the task in two principally different ways. The first way is to collect information from knowledgeable people inside the organization. This is done through interviews, having workshops or other types of such activities, see for example [12]. The idea is to let people explain how they see the organization, its processes and their role in them.

The other way is to follow people around to watch those work and study organizational documents like manuals. The idea behind this approach is to gather factual information about the rules that governs people's work [4]. Normally a combination of the two approaches is used to produce as accurate an analysis as possible. Still the results are not predictable when it comes to the final product which is a fully deployed BPS system well adapted to the organization and its processes. Often the organization ends up with a system that does not meet the expectations. In [13] several reasons are given for this, e.g. that the processes are often more complicated than anticipated.

In this paper, we suggest an alternative approach to business process analysis. The setting where we use this approach is in what is called loosely structured or highly dynamic processes [9]. The characteristics of this setting are that processes are often long-lived and that it is hard to predetermine the necessary ordering of activities to be performed. Furthermore, often there is a lot of people and communication involved in the processes. Exceptions from normal workflows are also common, so much so that it makes sense to say that exceptions are the rule. In such a setting processes are often defined by stating their goals and enactment constraints [5].

The essence of our approach is to build a very basic BPS system and deploy it in the organization. Basic means that the system has just the amount of functionality that the users need to accomplish their tasks. We then let the users use the system for a period of time while measuring the usage. Finally, an analysis of the system usage gives the sequences of activities that make up the organization's processes. And this is what we are looking for; an analysis of an organization to reveal the business process perspective of it.

Our previous work on analyzing organizations and subsequently deploying systems has ended in the following typical result: the systems built did not in fully meet the expectations of the users [2]. The main criticism from the users has been that it was hard to understand the systems, their user interfaces were too cluttered, and it was in general hard to navigate through it. Furthermore, changing the way of working in addition to learning the new system with a lot of functionality was considered overwhelming. Our conclusion based on these experiences is that we need a method for analysis of the organizations to get a better validation of the systems produced.

The proposed approach is one possible way of extracting information that is valuable for the analyst to have. The information can be used as a foundation when constructing interviews or workshops and it is useful for formulating hypotheses before doing actual action research. The question is: what constitutes a basic, minimal system in a loosely structured distributed setting as described above?

We claim that such a basic system must provide the following minimal functionality to be able to support users in their daily work:

A historical database. The database automatically stores information on all events and all past states of all processes, documents, and other types of business objects.

Planning capacity. The system needs to include a principle of dynamic and distributed planning. Dynamic means that users can use the system to plan their work when this is needed, distributed means that users can plan activities to be done for each other.

A navigational system that allows the end user to freely navigate through the space of interconnected processes present and past.

The motivation for this claim is that in such a business setting it is necessary for a user to know in which process he is and how it came to the current state. This is fulfilled by the combined functionality of the historical database and the navigational system. The user also needs to be able to communicate with other actors and plan for the future. This is fulfilled by the planning capacity of the system.

The claim is supported by research and practice. For instance, in [8] a system is built where one of the main features is that the artefacts produced in the system is stored in a repository and is being made navigable by all uses of the system. The system has also some semi-automatic planning capacity where users depending on the current state of a process can get help when going to the next state. In [11] a system is built based on a workflow engine, a repository and software agents that supervise the users and suggest the measures to take in a given state. The suggestions are based on previous experiences of similar processes stored in the repository.

The use of mining process logs as a means for business process analysis has been discussed and argued for. In [1], process mining is defined as ”the method of distilling a structured process description from a set of real executions”. One process mining objective is to measure the performance of process instance enactments. To have these records means that the factual performance of a process can be compared to the expected with the possibility to do optimizations. Several process mining techniques has been developed within the area of information systems engineering (see [1] for an overview). Our approach differs from the ones described in [1] in that we focus on loosely structured processes, and not fairly well defined workflows.

In this paper we report on a project which has as one of its goals to investigate the approach to analyse organizations in order to produce business process support systems that better fit their needs. The project is described more in detail in [2].

THE SYSTEM AND ITS UNDERLYING MODEL

Since we are dealing with organizations predominantly organized around loosely structured processes, we need to explain what we mean by business processes in this setting. We will also explain the underlying model of our software system, how it is related to business process support and how the system can be used when analyzing organizations.

According to a general definition of a business process, see, for example [7], a business process is a partially ordered set of activities performed to reach a well-defined goal. A process engages a number of participants, which can be divided into two categories: passive and active participants. Passive participants are consumed, produced or changed through the execution of activities, for example, a document being written, an organization being reorganized, or a patient treated in the hospital. Active participants, or agents, are those participants that perform activities aimed at the passive participants. Human beings, as well as artifacts can fill both the roles of passive and active participants.

Administrative processes that exist at the organizations we analyzed do not have predefined passive participants, except documents of a general nature, nor do they have a very well defined distribution of responsibilities between the members of staff, i.e. task assignment can be done “on the fly”. In other words, they belong to the class of loosely structured processes.

Based on the specific nature of the business processes in question, we have found that the state-flow view [5] of processes offers a suitable framework for modeling processes in this setting. In particular, it is instance-oriented and requires tracing the changes in the part of reality that concerns a particular process instance. For more details on how to choose an appropriate, for the business task at hand, view on business processes, see [6].

A flavor of the state-flow technique described in [3] has been adapted and is the theoretical foundation upon which our software system is built. This flavor is based on ideas from the mathematical systems theory [10]. Since the state-flow view of processes is not widely spread in the theory or practice of business process analysis, we briefly present the basic notions on which it is founded.

Underlying Model

The main concept of the state-flow view of processes is a process’s *state*. A process’s state is aimed to show how much has been done to achieve the operational goal of the process and how much is still to be done. A state of a process is represented by a complex structure that includes attributes, and references to various active and passive participants of the process. A state of a process does not show what activities have been executed to reach it; it only shows the results achieved so far.

The process is driven forward through a set of stipulated states until its goal has been reached. The operational goal can be defined as a set of conditions that have to be fulfilled before a process can be considered as finished. A state that satisfies these conditions is called a *final state* of the process.

The process is driven forward through *activities* executed either automatically or with a human assistance. Activities can be planned first and executed later. A *planned activity* records such information as type of action (e.g. goods shipment), planned date and time, deadline, etc.

The process’s state is used as a primary tool in deciding on what should be done to reach the process’s goal from the current state. All activities planned and executed in the frame of the process should be aimed to minimize the difference between the current state and the projected final one. However, in some cases, a *history* of the process’s evolution in time is important when deciding on actions. The history is defined as a time-ordered sequence of all previous states.

So, included in the process’s state are all the activities currently planned for the process. As a result, the process’s *generalized state* beside its *passive part* (attributes and references mentioned above) will get an *active part*. The active part, i.e. the process’s plan, will be responsible for moving the process forward. Making the plan an integral part of the generalized state allows us to define the notion of valid state that can be applied not only to the final states of the process, but also to any intermediate state.

When an activity is executed, a process changes its state. Changes concern both the passive and active parts of the state. The active part, i.e. plan, changes due to the executed activity disappears from the process plan and some new activities are planned instead of it. Changes in the state constitute an internal time axis of the process. To link this axis to the real time, event registration is performed each time an activity is executed. A *registered event* is a record that links the change in the state of a process to the reality outside the process. A list of all events that happened within the frame of a given process constitutes the *chronicle* of the process, i.e. its written history.

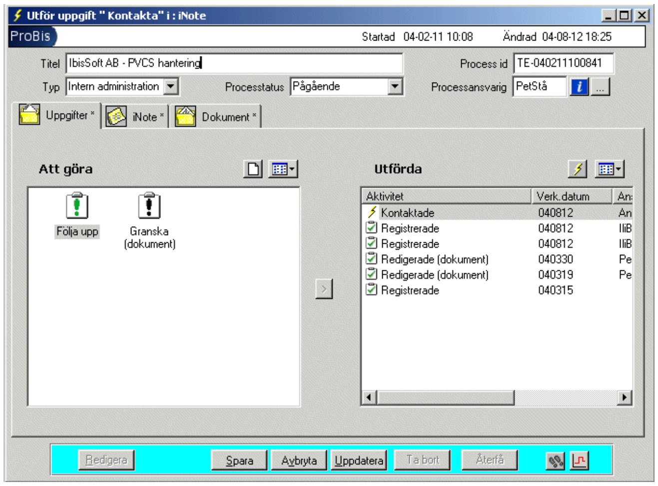
The System

ProBis is a business process system based on the state flow view of processes. It is implemented as a database interface with group communications capabilities. The system, among other things, provides:

- A virtual calendar that allows the users to plan tasks to each other, and gives immediate access to all information required for completing individual tasks. The latter includes information on the currents situation and all relevant events and documents in the past and future.
- Automatic support of history recording that allows not only to see what happened in the past, but also how things looked like at that time.
- Document management that facilitates getting access to any internal or external document without knowing its name or storage placement. The documents are found through association to their usage (e.g., purpose of creation).

The system is built with a core, basic functionality and a possibility to add specialized modules to enhance and extend the core. The flexible, modular architecture of ProBis has given us an opportunity to try out new analysis approaches in a relatively easy way. Current version of the system is built as a client/server solution, where clients run under Microsoft Windows, and a server runs an SQL DBMS. The historical

Figure 1. The iNote Module of ProBis (in Swedish)



database is implemented as a set of stored procedures and triggers. The user interface is built with the help of the Prolifics application development tool from Prolifics, Inc. More details on the architecture and implementation of the system can be found in [4].

SETUP AT A TEST SITE

We are currently testing the approach to analyze an organization at a Swedish trade union, called SRAT. At this test site, the users are presented to a very basic view of the system. As was pointed out in the architecture section above the system is very modular and at the test site we only use three modules, called iNote, xTeam, and Project.

iNote is the most basic of the three. In this module, only general facts about the process are collected in a structured way. The basic premise for the use of this module is that all participants are registered as users in the system and has access to it. This premise has implications for the way of working in a process as all participants can be expected to use the system to communicate and work through it. Figure 1 shows a screen dump of the iNote module of Probis. The left pane in the figure contains a to-do list of tasks while the right pane contains a list of tasks that has been done. A task is performed by moving an icon from the left pane to the right and entering information about this tasks performance. The icons in the right pane are a graphical representation of the information stored in the system logs. The second module, *xTeam*, differs from iNote in that at least one of the process participants does not have access to the system. The implication is that the way of working changes as some communication relevant in a process cannot take place through the system. It must be registered afterwards if it is to be visible and searchable in the system. The third module, *Project*, differs from xTeam in that physical meetings are coordinated and administrated through the system. The results from these meetings are protocols that are to be attached to the process. So, the difference in the modules reflects the difference in the way of working and participating actors.

The difference impacts the system logs and therefore the possibility to analyze the organization through them. When all participants are using the system the logs gets information rich. When almost all information in a process is attached meeting protocols the logs becomes poorer and this consequently makes the process harder to analyze. However, we do not foresee any insurmountable difficulties in doing this work.

CONCLUSION

In this paper we described an approach to better introduce business process support systems (BPSS) into organizations. Our approach can be seen as part of an emerging research area within business process management, called process mining. However, in contrast to other research in this area, we are applying process mining on so called loosely structured processes. The approach consists of the flowing steps:

- Provide a BPSS that only offers basic process support. This means that users get just the amount of support they need to perform their work and not more.
- Capture how active participants actually work by studying the event log in the BPSS.
- Make use of the information captured in the event log when analysing the processes together with the active participants/users of the system, to developed more structured process models.

The approach offers several theoretical benefits. Firstly, it makes it possible to introduce a BPSS that is easy to understand for users since the functionality of the system is as reduced as possible. Secondly, it captures automatically how active participants actually work. The captured information is a basis for the business process analysis. Thirdly, when subsequently a more structured process support system is introduced, the user of the system understands the benefits of this structure. The objective of trying this approach is to improve process analyses and ultimately provide systems that better fit the needs of organizations. We believe that analyzing loosely structured processes using a tool based on the state-flow model view of processes gives us the necessary concepts to be successful.

REFERENCES

1. Aalst, W.M.P van der, and Weiters A.J.M.M.: Process mining: a research agenda, Computers in Industry 53, 2004, pp 231-244
2. Andersson, B., Bider, I., Perjons, E.: Integration of Business Support with Knowledge Management. A Practical Perspective, To be published in: Proceedings of 5th International Conference on Practical Aspects of Knowledge Management 2004 (PAKM'04). Springer Verlag. 2004.
3. Andersson, T, Andersson-Ceder, A, and Bider, I: State Flow as a Way of Analysing Business Processes - Case Studies, *Logistics Information Management,* MSB University Press. Volume 15, No 1, pp. 34-45, 2002. http://www.ibissoft.se/English/Cases.pdf.
4. Baskerville R., and Myers, M.D.: Why Action Research and Information Systems? *MIS Quarterly*, Volume 28, No 3, September, 2004.
5. Bider I.: *State-Oriented Business Process Modelling: Principles, Theory and Practice*, PhD Thesis, DSV, Stockholm University/Royal Institute of Technology, 2002.
6. Bider I., *Choosing Approach to Business Process Modeling – Practical Perspective*, Research Report, IbisSoft AB, 2002, Revision 2003. http://www.ibissoft.se/English/Howto.pdf.
7. Hammer, M., and Champy, J.: *Reengineering the Corporation - A Manifesto for Business Revolution*, Nicholas Brealey Publishing, London, 1994.
8. Henninger, S.: Using Software Process to Support Learning Software Organizations, *Workshop on Learning Software Organizations Proceedings*, Kaiserslauten, Germany. 1999.
9. Jørgensen H.D., and Carlsen S.: Emergent Workflow, Integrated Planning and Performance of Process Instances, In: *Workflow Management '99*, Münster, Germany, 1999.
10. Kalman R.E., Falb P.L., and Arbib, M.A. Topics in Mathematical System Theory. McGraw-Hill (1969)
11. Pavassiliou, G., Ntioudis S., Abecker A., and Mentzas, G. A.: Supporting Knowledge-Intensive Work in Public Administration Processes, *Knowledge and Process Management,* Vol. 10, No 3, pp. 164-174, 2003.
12. Persson, A.: Enterprise Modelling in Practice: Situational Factors and their influence on Adopting a Participative Approach, PhD Thesis, DSV, Stockholm University/Royal Institute of Technology, 2001.
13. Wargitsch, C., Wewers, T., and Theisinger F: Organizational-Memory-Based Approach for an Evolutionary Workflow Management System - Concepts and Implementation. In: J.R. Nunamaker, editor, *Procs. of the 31st Hawaii Int. Conf. on System Sciences*, Volume 1, pp. 174-183, 1998.

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