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Preface

The field of information logistics and knowledge supply investigates methods, technologies and applications supporting demand-oriented and efficient information and knowledge provision in enterprises. In particular in knowledge-intensive industry and service sectors, information is a major factor in production processes, and knowledge reflects an important asset of the enterprise. Similarly, public organizations and governmental bodies are dependent on accurate and timely information supply for efficient and high quality processes and services. Intelligent information supply has become an important issue that is characterized by just-in-time, demand-oriented and context-sensitive information.

ILOG 2014 was the 7th workshop in a series which focuses on approaches, methods, technologies and solutions for reducing information overflow and for improving information flow in organizations. The workshop had the aim to bring together people who have a strong interest in the innovative use of these technologies and approaches in the context of enterprises and public organizations. The workshop took place on September 23, 2014, in Lund (Sweden) as part of the 13th International Conference on Perspectives in Business Informatics Research (BIR 2014). Based on at least three reviews per submission the international Program Committee selected 6 high-quality papers for inclusion in this volume. The authors of these papers include both researchers and practitioners from different disciplines. The ILOG 2014 program reflects different facets of the workshop topics, including processes and architectures of information logistics solutions, as well as tools and systems related to information logistics.

We dedicate special thanks to the members of the international Program Committee for promoting the conference, their support in attracting high-quality submissions, and for providing excellent reviews of the submissions. Without their committed work a high-quality workshop like ILOG 2014 would not have been possible. Our thanks also include the external reviewers supporting the paper selection process and the authors of submissions and presenters at the workshop.

September, 2014

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Information Logistics Tools and Systems

Survey on Information Monitoring and Control in Cross-enterprise Collaborative Business Processes

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Abstract. The difference between Collaborative Business Processes (CBP) and ordinary sequential business processes (BP) is in the necessity for decentralized coordination, flexible backward recovery, participants notification about the current state, fast adaptability to changes in participants' work, multiple information systems, individual authorization settings of the participants, etc. The paper presents a literature survey of four CBP paradigms (namely oriented on activity flows, documents, cases, and business artifacts) conducted from the perspective of a vendor of the Enterprise Resource Planning (ERP) system. Restrictions of the case are implicit information flows in BPs, diversity of ERP integrations with customers' information systems (IS), a lack of mechanisms for BP monitoring, backward recovery and for user notification about the current state and tasks as well as inability to make changes in customers' ISs. The paradigms are reviewed and analyzed regarding these restrictions.

Keywords: cross-enterprise; collaborative business process; process monitoring

1 Introduction

In order to create innovative business products, share knowledge between people and business, or increase the control and quality of service, enterprises need to collaborate with each other, thus delegating or providing some pieces of work to other enterprises [1]. First introduced in [2], such processes are called Collaborative Business Processes (CBP). The specifics of CBPs is that they are not coordinated by one central workflow (WF) engine, but rather by multiple engines collaboratively. Research on CBPs have two aspects. The first, personal, collaboration includes support of personal negotiations, personal knowledge sharing as well as coordination and planning of activities (e.g., in the so-called industrial clusters [3]) by using networks, voice, video and audio IT solutions (e.g., [3, 4, 5, 6]). The second, let us call it "computer system driven", collaboration includes support by a business-to-business (B2B) Workflow Management System (WMS) that "defines, creates and manages the execution of workflows through the use of software, running on one or more workflow engines (WE), which is able to interpret the process definition, interact with workflow participants and, where required, invoke the use of IT tools

and applications" [7], like FITMAN [8]. CBPs are more dynamic than sequential processes without collaboration and involve more complex communications between enterprises, especially in relation to non-functional aspects [1].

CBPs among enterprises are called also cross-enterprise [9], cross-organizational [10], multipartner [11], and intra-enterprise [2, 12] processes. The main distinction from inter-enterprise CPSs is that they involve several autonomous enterprises in the business process (BP) execution. This requires decentralized coordination (choreography) among enterprises' BPs, since centralized coordination (orchestration) usually cannot help here (because of loosely coupled collaborations). Choreography is not trivial, since business independency and sometimes unwillingness/inability to introduce changes into the already implemented IT solutions is at the fore also for our business case [2].

Among other IT implementations, Enterprise Resource Planning (ERP) systems also support cross-enterprise CBPs [13]. It might have specific restrictions (discussed further) that make it hard to control and monitor such processes, e.g., private/public and explicit/implicit information flows, diversity of ERP integrations with customers' information systems (IS), a lack of mechanisms for collaborative process monitoring and backward recovery, and inability to make changes in customers' ISs. The goal of our research is to find out an answer to the question: "What existing solutions and techniques could be promising to solve issues caused by restrictions of the ERP business case discussed in this paper?" In order to achieve this goal, we have carried out a survey of techniques and mechanisms which are used for cross-enterprise CBPs. The results of the survey will indicate techniques and mechanisms for deeper research on BP monitoring and runtime user guidance during experimental modeling activities.

The paper is organized as follows. Section 2 provides a brief discussion of the cross-enterprise CBPs and their management. Section 3 illustrates the context of the ERP business case as well as its restrictions. Section 4 presents a view on existing solutions within the CBP management regarding the ERP business case. We conclude with the summarization of main results.

2 Cross-enterprise Collaborative Business Processes

Usually B2B collaboration systems are static. This means it is not possible to create/adjust BPs dynamically according to the constantly changing needs and constraints of the businesses. Instead processes are described in some hardcoded notations, e.g., BPMN (Business Process Model and Notation). Some research try to tackle this issue by applying semantic business process management (BPM) approaches, e.g., hierarchical task networks and Web ontologies [9, 14]. However, they are dealing rather with the task of generation of BPEL (Business Process Execution Language) specifications, but not with the task of running and monitoring execution processes thereafter.

BP monitoring has been widely applied in ISs (e.g., [15]). It usually involves some form of event-based processing, when it is possible to attach some action(s) before/after an activity. Such events are mostly used for monitoring the compliance

within the enterprise, but they also can be used to send notifications to some external endpoints, e.g., for informing other systems/enterprises. Such systems usually utilize some form of a rule/condition engine, so that the events are fired only when the condition is met. However, in order to make a decision for a particular implementation, it is important to evaluate its appropriateness in the context of the used WF engine, e.g., whether addition of event processing involves changes in the BP definitions or can be applied transparently to it.

As mentioned in the introduction, in the cross-enterprise processes non-functional requirements, like privacy and confidentiality, might play even a more crucial role than functional ones. For managing interests and protecting privacy of the involved enterprises, CBP management system should provide different perspectives/views for a particular party. However such adoption of views inevitable increases complexity both in overall process representation and maintenance of ever changing BPs.

We are mostly concerned to add event processing and data state identifying capabilities to the legacy/non-process oriented systems. Namely we need to know how to ensure monitoring and runtime user guidance without influencing legacy applications and still be able to apply some form of BP modeling and integration with third party workflows. Currently there exist at least four paradigms to BPM [16]:

- Activity-flow oriented, when the activities and their predefined sequences are used at firsthand, but the data that must be processed is perceived as second-class citizen [1, 2, 17];
- Document oriented, when it is important to finish some document using a strict authorization mechanism, document partitioning and templates [18, 19, 20];
- Case handling, when it is important to resolve a case without necessarily specifying the order of activities, obtaining some minimum amount of data or making predefined number of decisions [21, 22];
- Business artifact-centered (a special case of data-centric paradigm), which combines and models both data (information model) and process (lifecycle model) aspects as a single unit [16, 23, 24, 25, 26, 27, 28].

The first paradigm is quite mature already and implemented in many enterprise information systems. Many WMSs offer general modeling and execution of structured BPs. Besides pure WMSs, ERP systems such as SAP, Oracle, Baan, PeopleSoft have also adopted this technology [21].

The second and the third paradigms are dedicated for knowledge-intensive applications, where decision making could be based on unspecified data and facts and usually involves mental activities or where a WF highly depends on the runtime context [21, 29]. The document-oriented paradigm provides a flexible decision making mechanism and a strong authorization mechanism, whereas case handling aims to provide rather full data than partial one, allow editing data before and after an activity is executed, decide about availability of activities based rather on the current information than on the previously executed activities.

The last paradigm, originally proposed in [23], initiated many further studies and applications because of “a natural modularity and componentization of business operations and varying levels of abstraction” and the familiarity of the artifact concept

to the business people [16]. Business artifacts can be mapped onto a WF engine, thus enabling attachment of other BPM capabilities, including specification and monitoring of business rules and KPIs [16]. Artifact-centered research continues to be actively developed, especially in the context of declarative style for lifecycle specification and their tool support [24].

WF monitoring starts with the execution of a BP instance in the WF engine. Usually it is implemented in a form of event logging and logs more or less complete information. Another form that must be mentioned is process mining from event logs [30] or execution records [29]. Modern process mining tools use the control-flow dimension of a WF by using, e.g., Workflow Petri Nets [29]. Within ERP, bi-partial monitoring agents called probes can be used [31, 32]. They contain a memory for BP allocation and a logic for BP monitoring. However, deployment of agents over a business process may be hard to automate.

3 The ERP Vendor's Business Case

ERP systems can be divided into two groups, namely ERP I and ERP II [13]. While ERP I systems focus on integration of back-office information systems, ERP II systems (which we consider here) focus on collaboration among companies and their customers, serve all sectors and have web-based open architectures. ERP II are complex systems that have more difficulties in coordination among partners as well as in management and assessment, and, thus, can lead to more frequent failures [13].

Let us illustrate the general features of our business case. An ERP vendor has many customers, mostly, small and medium size enterprises. Each customer uses the vendor's ERP solution for his specific business needs, integrates it with its own and third party ISs and ERPs, and collaborates with other enterprises. The complexity of the case is that a single BP may have several participants from different enterprises, which collaborate to get some business value, as well as may involve functions provided by other vendors' ISs. However, the ERP vendor has access and ability to change/enhance functionality only in his own product.

Let us look at the simplified example of the cross-enterprise CBP. Participant 1 initiates the business process, executes his own activities, and then requires collaborative activities from other enterprises, e.g., agreement of Participant 2 and approval of Participant 3. In the worse case, Participant 1 might not even know about the necessity of approval by Participant 3, since this could be Participant's 2 confidential information. Besides, Participant 1 cannot monitor other participants activities and his own created documents until the final status of them will be available for all allowed participants.

From the ERP vendor's viewpoint, this problem will look more complicated (Fig. 1). User tasks may be automated in the ERP and other ISs. There is no automatic coordination between tasks, i.e., only the experienced users might know about the correct order of tasks and how to conduct them. The participant who initiated the WF (e.g., Participant 1) does not even know what happens within the business process until the last "link" in the task chain is completed (e.g., registering the completed

document in the database by Participant 3). Therefore, there is the necessity to know how the collaborative business process is executed in reality. In our case, it could be some external monitoring process that follows changes of data and BP states.

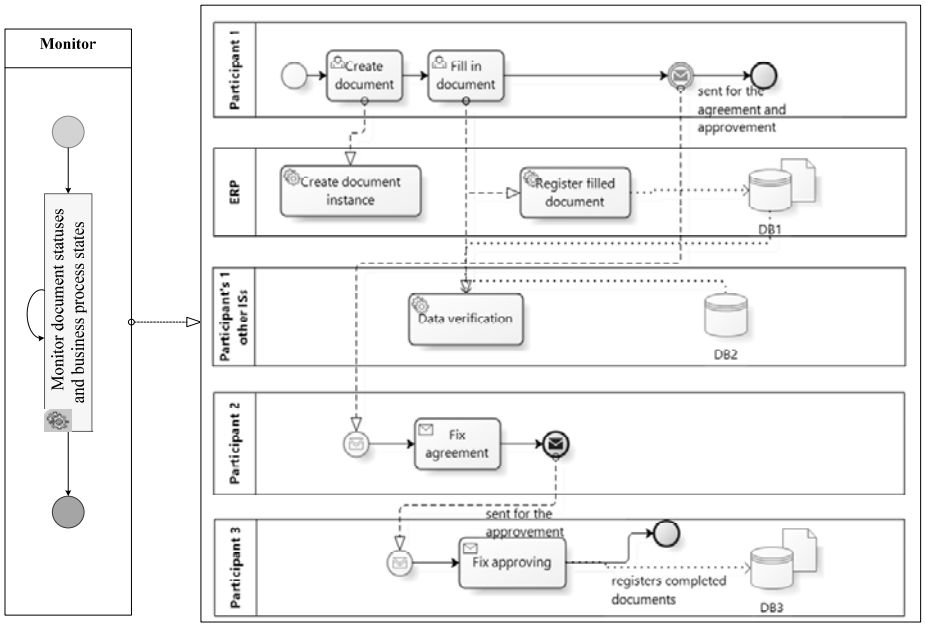

Fig. 1. The simplified CBP from the ERP vendor's viewpoint

In the context of legacy systems, when a running WE might not exist, or when knowledge about business processes are only in the users' heads, or at best in some decoupled description, knowing how a process is being used in reality becomes even more crucial. If it would be possible to detect changes in the business objects or obtain information about ongoing/completed activities, this information could be used to generate some form of further user guidance. For example, by showing what activities a particular user should perform next. We should note once more, that the particular ERP vendor's customers mostly are small and medium size enterprises, and they are not able to make great financial investments into purchasing and introducing expensive BPM products.

To sum up, the main issues within the business case that we are analyzing in this paper lie in the field of information logistics and are the following:

- Each participant has its own ERP solution, integrated with other ISs. The ERP vendor has no access to these systems' internals. It is not welcomed to change the existing IT solution, and it is not possible to change other information systems.
- There is no mechanism to monitor the current state of the business process and data, if they are under other participant's or system's control. Only the direct user of the corresponding system is able to find out this information by querying data. Other participants don't have such rights due to an access control restrictions.

- There is no notification mechanism about consequent participant's tasks even when the document or activity is completed by another participant, and the participant has access to the database entries.
- Information flows are not transparent for participants. Experienced users do know their own tasks and task execution order, but are not able to see the whole picture. Thus, a participant who has initiated the business process might not know about all other participants involved in the execution as well as about the results of execution of their functions or tasks within the business process.
- There is no informational support regarding the required actions within the task execution, only experienced users' knowledge.

Our idea is to introduce runtime user guidance to support participants' work with the vendor's ERP by monitoring the current state of BPs and data. One approach to tackle this case is to employ some form of monitoring data changes in the data store (e.g., database). However, usual approaches that use trigger or transaction log analysis mechanisms might not be sufficient, because it is not possible to detect all kind of data usage with them. For example, selection queries are not logged in the transaction logs. Instead we must use specialized database activity monitoring modules (e.g., Microsoft's SQL Server database Change Tracking or Oracle's Audit Vault and Database Firewall).

Next sections are devoted to analysis of existing solutions in the field of CBPs. Since ERP systems are mostly process and data oriented, but quite often may require backward recovery, only the first and the last paradigms are considered relevant to our case and will be studied in the next section.

4 Existing Solutions in the CBP context

Accordingly to the issues and corresponding constraints mentioned in the previous section, we have defined criteria for paradigm/solution analysis that we will use further: maturity of the implementation technique, specification languages, execution principles, monitoring mechanisms (active or passive), easiness of current state and task identification, flexibility of decision making mechanism, communication and BP coordination/synchronization mechanisms, authorization and privacy, integration with other ISs, and a compensation mechanism (transaction backward recovery).

4.1 Activity-flow Oriented Paradigm

The first technique is *peer-to-peer collaborative business process management* [2, 33], where a role [17] or an agent [2] can create an instance of the CBP, initiate his own ”peer-side” instance, and then notify his peer to instantiate the peer's side instance. In case of roles, the workflow must be well-understood, specified and shared by all participants. Holding privacy of enterprise activities within the workflow is the challenge in this case. In agents-based processes, an agent must know its communication paths with other agents and a corresponding part of the workflow state space. For roles the workflow could be specified using CPDL (Collaborative

Process Definition Language) in an XML document, then compiled to DOM (Data Object Model) tree of Java objects, then to a Java class. For agents it could be any executable workflow specification. The process is executed as a set of peer process instances (which share the same process definition and may have private data and sub-processes) run by process management systems of the participants [2]. The monitoring is realized as a collaboration among multiple engines which *share one common predefined workflow specification*. Besides, each agent has its own engine and querying server which collaborates with other agents' querying servers, thus getting data about the current process state and data statuses. Another way is implementing monitoring agents within the ERP that collect metrics from the ERP database and log files, make an analysis and inform the ERP users about analysis results [31]. The decision making is decentralized and could be based on predefined roles within the shared workflow [2] or on a set of predefined links to partners related to the possible process states [17] which contain also data about requested and suggested tasks. Communication is implemented as peer-to-peer messaging mechanism [2], however simple message interchange (at conversational level) is not enough when a workflow is complex and includes intra- and inter-enterprise collaborations. In this case process-level coordination is critical. Authorization can be role-based [2], when each participant has its own role within the shared workflow and the rights to manage access permissions within his/her role. If the multipartner collaboration uses the peer-to-peer messaging mechanism, then the solution could be embedded as a set of separate external WMSs [2], or completely implemented in the single WMS [17] that controls and coordinates all process invocations.

The second technique is *workflow-view-based process collaboration* [1], where processes are views on the workflow from the participant's viewpoint, and their instances may form a network. Still, the common synchronization means is defined by the workflow specification. Specification could be written in BPMN, WS-BPEL (Web Service BPEL), ebXML (Electronic Business using eXtensible Markup Language), or RosettaNet, and then they can be run in some WMS [1]. Unlike [2], the specification is implemented and executed by a single WMS engine, and communication is controlled and managed by this engine. The open challenges are analysis of visibility constraints between entities, process view coordination and deployment of process views for partner organizations [1]. The monitoring uses tracking of a network of process instances that have multiple collaborative relations with each other. Unlike [2], in a variety of workflow views, each process has its own view on the common workflow and may change authorization settings. Tracking in a network of process instances could be a useful compensation mechanism for backward recovery, notifying corresponding partners about failures.

Another kind of views on the workflow are web services (WS). Their implementation, monitoring and coordination is well elaborated during previous years. However, currently service networks might not correspond to business services and their combination requires good understanding of their business properties (ontology based semantic services is the promising answer to this issue), and their coordination is not flexible. Specifications, like WS-BPEL and WS-CDL, use predefined processes or rules to solve questions on inputs/outputs, message

correlations, etc., but do not take into account dynamics of business processes in collaboration. They require more transactional support because standards and protocols like BPEL4WS, WS-Coordination, WS-Transaction, WSCI (Web Service Choreography Interface) and WS-CDL have too fixed compensation mechanism [1].

4.2 Business Artifact-centered Paradigm

While activity-flow oriented business process modeling is oriented on the activity/task flows and considers data flows as secondary, but document/case oriented modeling – vice versa, another paradigm is centered around the data. A very promising data-centric paradigm is the business artifact paradigm that uses a combination of data and process flows as a single building block called (business) artifact [16]. "Artifacts are business-relevant objects that are created, evolved and archived as they pass through a business" [16] (e.g., a *deal*).

Artifacts are specified by two models (or schemas [26]), namely an information/data model and a lifecycle model [25, 27]. The information model specifies data about the business objects during their lifetime. The lifecycle model specifies tasks and their order (way) in time, when they must be invoked on the business objects in the state-based form. There are two notations for the lifecycle specification [26]. The first one is Finite-State-Machines (FSM) for lifecycles without multiple state paths. The second one is Guard-Stage-Milestones (GSM) for lifecycles with complex branching. Decision making is implemented by rule definitions in form of Event-Condition-Activity (ECA), where artifact data serve as business terms in the rules. The current state and data statuses are kept in the artifact and business rule instances and are available on demand. Thus, monitoring could be provided in a simple way – by inspecting artifact instances directly [27].

Participants might use only a part of artifact's lifecycle, however they will be familiar with other stakeholders needs and their own needs [25]. In this case coordination could be implemented by using log files and controllers of processes, artifacts, and business rules [27]. Artifact specifications may be mapped into workflow designs and executed by a WE, but this leads to losing information about business rules, since they are degraded to control flows and become hardly manageable [27]. Some authors encourage to use special artifact-oriented management systems [25, 26, 27]. In such systems business rules may be modified/removed/added at run-time. Authors suggest using two kinds of management systems: procedural and declarative. The imperative (Siena for FSM models [28] and Barcelona for GSM models [24]) systems are similar to the WMS. The declarative artifact system is under development. It is passive, since allows querying and retrieving artifact information, invoking business events and notifying about the pre-subscribed events [26]. Passive systems could be integrated easier than imperative ones. However, currently artifact-centric management systems mostly have prototype implementation. At the present realization of this paradigm in WMS is faster and more mature, however requires additional efforts in monitoring and business rule flexibility [27].

The artifact model is represented as an XML document and interpreted directly [16]. All these systems foresee participants' access control over artifact data [16, 26] using the CRUDAE (create, read, update, delete, add, edit) mechanism.

Table 1. Characteristics of the activity-flow and business artifact oriented paradigms

Features	Activity-flow oriented	Artifact oriented
Technique	mature	immature
Specification (standardization, tool support, levels of abstraction)	standardized, broad WMS support, levels of abstraction (conceptual, design, executable)	not standardized but could be mapped to WMS supported standards, tool support only by prototypes, levels of abstraction (conceptual, design, executable)
Execution (engines, collaboration, contexts)	XML + Java, one or several WEs; process instance or agent collaboration; the WF/process context	the artifact or WF engine; artifact collaboration; the artifact/process context
Monitor	active within WMSs	active within WMSs or active/passive within artifact management systems
State and task notification	kept implicitly within WF instances (requires additional calculations)	kept explicitly within artifact instances (fast access)
Decision making	glued with control flows (more static)	at the conceptual level is separated; at other levels is glued only if WMS are used
Communication	peer-to-peer messaging, notification by a WE	notification by a WE or artifact engine (in passive systems after the request or after artifact state updates)
Coordination	agent/process choreography, shared WF specification, single WF	artifact lifecycle choreography, shared artifact specifications, (in case of WMSs) process orchestration or choreography
Authorization	roles, agents; private/public processes and data	roles; private/public processes and data
Integration	WE must be tightly integrated with other ISs in order to manage WFs	- if the WE, then must be tightly integrated with other ISs in order to manage WFs; - if the artifact engine, then may be realized as a passive system.
Compensation mechanism	too fixed for dynamic collaboration if standardized, otherwise requires additional effort	direct retrieve of information from the artifact's historical data

The compensation mechanism could be implemented in the context of business artifacts, since all states are known and historical data are logged.

In overall, this paradigm is at the early stage of elaboration and its implementation may require additional research on implementation, e.g., in the context of databases, concurrency control of artifact instances, and data integrity [16].

4.3 Summary

Summarizing all features (see, Table 1), we can conclude that conceptually the business artifact paradigm has almost all features of the activity-flow oriented paradigm and is more flexible. It has a different viewpoint in the flow of work activities and data, but may be successfully mapped to the already matured activity-flow oriented paradigm and existing tools. However, in such case the implementation will lose separate logic of business rules, since it will be distributed within control flows. Another advantage of the business artifact-centered paradigm is in its potential implementation as a passive (monitor) system that is one of our business case needs. However, this paradigm is new and its realization in an artifact management systems could have various technical challenges.

5 Conclusions

Small and medium businesses, which the ERP vendor targets, are not able to introduce expensive WE solutions, as well as adaptation of legacy ERP for WF based execution usually is not possible without completely redesigning the architecture. As a compromise, BP monitoring and runtime user guidance during cross-enterprise CBP execution could be introduced. However, there are various complex technological issues to solve among other, e.g., state change detection in the process and data flows, access control, determination and notification about subsequent tasks.

Analysis of the available techniques for managing cross-enterprise CBPs concluded that for the business case discussed we should focus on activity-flow oriented and artifact-centric approaches. The former is mature and has developed tool support, but is imperative and less flexible. The latter one might be more promising, but its practical application and tool support are weak and are to be studied in more detail.

This research is ongoing and we continue elaborating on the selected approaches. We plan to research technical implementation of their principles during experimental modeling activities based on the real cross-enterprise CBP.

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Towards Visual EAM Analytics: Explorative Research Study with Master Students

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Abstract. Enterprise Architectures (EA) consists of many architecture elements, which stand in manifold relationships to each other. Therefore Architecture Analysis is important and very difficult for stakeholders. Due changing an architecture element has impacts on other elements different stakeholders are involved. In practice EAs are often analyzed using visualizations. This article aims at contributing to the field of visual analytics in EAM by analyzing how state-of-the-art software platforms in EAM support stakeholders with respect to providing and visualizing the "right" information for decision-making tasks. We investigate the collaborative decision-making process in an experiment with master students using professional EAM tools by developing a research study and accomplishing them in a master's level class with students.

Keywords: Enterprise Architecture Management, Visual Analytics, Decision-making process, Collaboration

1 Introduction

Enterprises are complex and integrated systems of processes, organizational units, resources and technologies with a multitude of relations and interdependencies. Enterprise Architecture Management (EAM) aims at providing an integrated view on all these aspects of the organization in order to support business & IT-alignment, optimization scenarios, quick adaption to environmental changes and many more purposes. Since EAs are complex structures, it is very difficult to keep track and to work out relevant characteristics. In particular changing an architecture element requires the evaluation of impacts on other elements. The impacted elements have to be analyzed by several stakeholders from their individual perspectives, which require that the relevant information have to be prepared in an adequate manner. In practice, for this purpose EA visualizations like landscape or cluster diagrams are commonly used. Matthes et al. [1] outline the basic functionality of visualization techniques in an EAM tool survey. The ISO Std. 42010 [2] calls visualizations describing an architecture of a system as views. Furthermore the Std. defines so-called Viewpoints, which are the link between the views as part of the architecture description and the

stakeholder's concerns. Viewpoints define the construction, interpretation and usage of views. Concerns reflect the information needs of stakeholders. Each stakeholder is an expert in a particular area of the enterprise and requires specific viewpoints to analyze an impact for his purpose.

An adequate visualization of relevant information is an important aspect of supporting stakeholders in their specific tasks and decision-making needs, but also has to be accompanied by understanding what exactly the relevant information is that meets the stakeholder's demands. Work in the area of information logistics showed that information demand is depending on the tasks and responsibilities of an organization role [3]. Thus, a crucial precondition for achieving demand-oriented information supply is to understand the roles' and stakeholders' demand.

Furthermore decision-making in EAM often requires the collaboration of many stakeholders, which have different knowledge. The stakeholders have to communicate to discover possible impacts for an architecture change. Impacts often aren't emergent and can be only found if the stakeholders communicate with each other. Lucke et al. outline in [4] critical issues in EAM by doing a literature review in the field of enterprise architecting. The authors identify open issues including identifying the "right" stakeholders for a particular situation and the stakeholder's communication with each other.

This article aims at contribution to the field of visual analytics in EAM by analyzing how state-of-the-art software platforms in EAM support stakeholders with respect to providing and visualizing the "right" information for their needs. Thomas et al. describe visual analytics as "the science of analytical reasoning facilitated by interactive visual interfaces" [5]. Thereby the information has to be visually represented. Furthermore the visual representation has to enable interaction possibilities for humans [6]. Thus EAM is a broad field, we focus on the social decision-making process including the analysis of necessary information using visual and collaboration capabilities. The decision-making process is a precondition for well eligible and transparent architecture decisions.

As a starting point and mission of this paper we investigated how the decision-making process is done by master's level students with little experience in EAM and how they are able to analyze Enterprise Architectures using capabilities of professional EAM tools. For selecting EAM tools we use the tool classification of the EAM tool survey guided by Matthes et al. [1]. The authors identify several dimensions for classifying EAM tools. One of them is "flexibility vs. guidance" (c.f. [1] p. 344). Using this dimension EAM tools can be classified in "metamodel driven", "methodology driven" and "process driven". Each type uses a specific approach how to support users in doing EAM. Whereas EAM tools based on the "process driven" approach include a lot of guidance and rigid structures how to do something, EAM tools based on the "metamodel driven" approach focus on the EA information itself with less guidance and flexible structures. The "process driven" approach for example is especially suitable for big enterprises with a great IT. Our hypothesis is that the result of the collaborative decision-making process is strongly dependent on the type of the approach of the dimension "flexibility vs. guidance" and the team structure. To cover all characteristics of "flexibility vs. guidance" we use one tool for each characteristic. Thus there are a lot of EAM tools on the market, we decided to use

tools we have some experience and access. All tools selected have a substantial prevalence in practice.

The main contributions of the paper are (1) the set-up for the research study, including tasks to be performed and an EA designed as study object, (2) experiences in executing the study with master students, and (3) the actual study results, i.e. to what extent visual analytics currently is supported by EAM tools. The remainder of this article is structured as follows: In Section 2, we revisit the state-of-the-art in visual EAM analytics. In Section 3, we describe the research study. Firstly, we introduce the business scenario including several tasks. Afterwards we derive a metamodel to describe the information needed for solving the tasks. Secondly the research process for performing them is introduced. In Section 4, we present the case study evaluation and conclude with a summary in Section 5.

2 Related Work

In this section we want revisit related work of Visual EAM Analytics. Thomas et al. describe visual analytics as "the science of analytical reasoning facilitated by interactive visual interfaces" [5]. Keim et al. detail this definition of visual analytics in [7] as a combination of automated analysis techniques and interactive visualizations. The authors emphasize effective understanding, reasoning and decision making as goals of visual analytics. Keim describes the visual analytics process as "Analyze first, Show the important, Zoom, filter and analyze further". This process entails an analysis phase before visualizing the information, which contrasts with information visualization techniques. In addition to get rid of the information overload problem, only important information are visualized.

In practice of EAM, there aren't visual analytics capabilities. Instead information visualization techniques are applied. As described in Section 1, Matthes et al. [1] outline the basic functionality of visualization techniques in an EAM tool survey. In addition Roth et al. [8] outline typical viewpoint types like "Cluster Map" or "Flow Diagram" and investigate the visualization capabilities of EAM tools. However interactive functionalities in combination of automated analyzing techniques to enable visual analytics are not part of this survey. Hanschke provides an operationalization of to EA analysis and planning via so-called "patterns". These patterns are described in the appendices A to C of [9] and designate notable phenomena in an EA and how to identify their occurrence. For analyzing the EA Hanschke uses visualizations. However interaction functionalities are not part thereof.

Buckl et al. describe in [10] an approach to automatically generate EA visualizations from an EA model. In [11] Schaub et al. describe a conceptual framework to automatically generate interactive EA views. The framework bases on the work of [10]. The interaction possibilities focus on interactive editing the underlying EA documentation. Therefore, functionality like transaction support is added to the approach.

Jugel et al. describe in [12] an interactive cockpit approach towards visual analytics. The cockpit approach is well established for activities like controlling power plants or space missions. A cockpit is characterized as a room, in which several

screens simultaneously provide different viewpoints on the system under consideration. The authors apply this idea to the situation of EAM and describe requirements of such a cockpit in an abstract manner. One of the requirements is so-called "What-If analyses", which provides automated analyses based on user interactions in the cockpit and the visualization of the results thereof. In [13] Jugel et al. detail the requirements by describing interactive functions and their conceptual realization.

3 Research Study

In this section we describe the research study. Firstly in Section 3.1 we introduce the business scenario. Thereby we prepare tasks, which the participants have to solve. A metamodel based on the tasks is introduced to accomplish the information needs. Secondly we describe the procedure for performing the research study in Section 3.2.

3.1 Business Scenario

For performing the research study, a business scenario including the EA documentation is needed. Firstly we want to introduce the tasks before we describe the EA to analyze. Imagine the participants are external consultants who are employed to reveal optimization potentials in an enterprise's EA. In particular the client is interested in potentials in the functional business support, information systems and technical components. Therefore the specific tasks can be divided into the areas technology and landscape management. In the field of technology management, the client requests the following tasks:

T1.1 Analysis of technical components using architectural domains
T1.2 Analysis of technical component's usage in information systems
T1.3 Identification of consolidation potentials for technical components (e.g. many components with similar functionality, like webservers)
T1.4 Identification of technical components that are often used together by information systems (stack analysis)

In the field of landscape management, the requested tasks from the client are:

T2.1 Analysis of the information system landscape
T2.2 Identification of abnormalities like redundancies in business support or covering lacks

Next we construct an EA, which the participants in our research study are supposed to use when working based on the different tasks. We derive a metamodel, which covers the different aspects (see Fig. 1). Thus each tool usually has another naming and definition for the metamodel artifacts, we are using the naming and definitions of iteraplan[1], because it is open source and everybody can have a look. Performing **T1.1**

[1] http://www.iteraplan.de/en

the metamodel artifacts *Architectural Domain* and *Technical Component* are needed, while performing **T1.2** requires the artifacts *Technical Component* and *Information System*. Thus **T1.3** and **T1.4** are based on the analysis tasks **T1.1** and **T1.2**, no additional metamodel artifacts are needed. Lastly **T2.1** requires the artifacts *Information System*, *Business Unit*, *Business Process* and a mapping between them named *Business Mapping*. **T2.2** is based on **T2.1** and therefore further artifacts are needed.

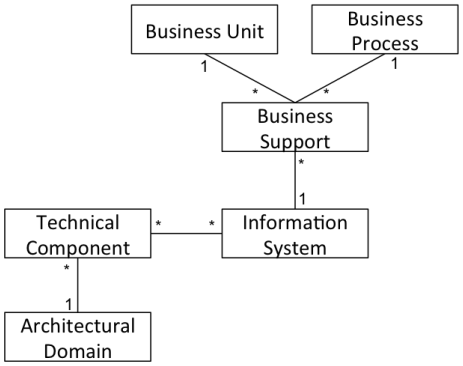

Fig. 1. Metamodel of EA for business scenario

Based on the metamodel a model is needed that contains all the elements contained in the EA. Thus the scenario has to be realistic, a moderate complexity is necessary. Our model is designed consisting of 25 business processes, 9 organizational units, 95 information systems, 9 architectural domains, 99 technical components and 656 business mapping elements. The model is prepared for performing the tasks described above. For example there are lacks and redundancies in business support and several technical components with similar functionality are in the same architectural domain.

3.2 Research Process

The master's level course consists of 25 students. We divided them into 5 study groups with 5 students. Study groups 1 to 4 get an EAM tool to study with. Study group 5 has the task to develop the business scenario and to document the EA in the tools. At the beginning the students get the tasks described above and an EAM tool. In the following the learn and test phase begins, which takes one month. In this phase the student teams can study the tools and try out the given tasks based on the showcase scenarios of the tool vendors.

Afterwards the research study is performed. Thereby the teams process the research study separately under observation of the lecturers and study group 5. At the beginning the client (one student of study group 5) present the business scenario and answer open questions. Then the teams have got two hours time to analyze the EA and to do the tasks. Afterwards the study groups present their results to the client and write an experience report.

4 Results and Evaluation

In this section we describe the student's experiences while accomplishing the tasks of the research study described in Section 3.1. We assess the experience reports and combine them with the observation impressions from study group 5 and us. The students' experiences strongly depend on the used EAM tool. As described in Section 1 the tools have different approaches regarding flexibility and guidance. All approaches have their right to exist and are apposite tailored to different enterprises that do EAM in a special way. Our fictional enterprise described in the business scenario can be seen as an enterprise with a small EAM department that hasn't implement complex guidance and decision-making processes. Moreover the students aren't experts in EAM and not part of the enterprise, but external consultants in our scenario. Thus the students have struggled with complex tools with a great functionality in managing large groups in EAM that are common in large enterprises.

Nevertheless all study groups have found a lot of optimization potentials. But the way how they have found their results was different. We have identified a usability conflict between flexibility and guidance. Tools that are very flexible and easy to use without much induction effort are quickly stretched to their limits, because they typically have much less functionality. On the other side, tools with much functionality, which covers many guidance aspects, aren't easy to use and require a great induction effort. With such tools, the students became lost in the variety of different menus and they quickly lost the overall context they want to analyze.

The visualization capabilities of the tools strongly depend on the usability aspect. Tools with an easy usability typically have less visualization capabilities, because of system-side preconfigured visualizations. Users are only able to change these visualizations by limited parameters. Thus students, who used such a tool, didn't use the visualization capabilities very much to get their findings. In contrast students using tools with greater visualization capabilities struggled with complex configurations. In addition most study groups were not able to display several views of an aspect in the tools in parallel. Therefore the students had to click through several menus to get from one view to another and lost the overall context again. One of the tools supports a dashboard approach, which is able to display several views in parallel. However there aren't many interaction possibilities in the tools. The interaction possibilities are limited to link two views with each other or to jump to the object's documentation in the tools.

We confirm the statement in Section 2, that there are not visual analytics capabilities in EAM. The capabilities in EAM confine oneself to information visualization. All students have used pen and paper to document their findings. There isn't a way to annotate views by adding notes or visually highlighting in the tools like described in [13]. The export and printing of views seem to be a common vehicle to annotate views. But this approach has several disadvantages. Printed views aren't up to date and annotations have to be repatriated to the EA documentation, which is a potential source of error and causes additional expenditures. Furthermore only the person, who has the printed view in his drawer, has the findings. This situation leads to less communication with other stakeholders about analysis findings and planning scenarios. Another important aspect of visual analytics is the capability to combine

visualization aspects with an automated analysis in the background. For example a user interacts with a view by touching an element and initiating an impact analysis, which automatically highlights impacted elements on the view.

Finally we consider the student's experiences in collaboration and communication by using the tools. Like described above printing views and annotate them brings along disadvantages in communication and collaboration with other stakeholders. Collaboration and communication functionalities are multifaceted in the used tools. Such functionalities range from enabling workflows for documentation and approval of changes to subscriptions of architecture elements and activity streams. Especially subscriptions of architecture elements and activity streams can be helpful to be up to date. However activity streams can lead to information overload, which is counterproductive. Moreover subscriptions to get news about the subscripted element require a proactive activity of the stakeholders. Thereby the problem is a stakeholder can't know at a particular time in what elements he is interested in the future. In our opinion the functionalities are insufficient for a decision-making process to change an EA. A big challenge is to find involved stakeholders, which can't read off from an organigram. Here involving enterprise social networks to analyze discussions between stakeholders in the past may help to find the right persons for a particular situation. Additionally a mechanism is needed to inform involved stakeholders automatically for example by using an activity stream with intelligent automatic filter and subscription mechanisms.

5 Conclusions and Future Work

In this paper we present a research study investigating visual analytics capabilities in state-of-the-art EAM tools and the collaborative decision-making process support. We accomplish the research study with master students to get first results. Our results show that the visual analytics approach is not used in the investigated EAM tools. Furthermore the support of collaboration between stakeholders that is necessary for decision-making is low. In our opinion, the focus of the tools lies on EA documentation and not in supporting collaboration or decision-making. However some tools support workflows to satisfy the enterprises' processes and guidance, but give no support in how to get the best decisions or relevant stakeholder identification.

From an information logistics perspective, the study results indicate a need for more work on typical roles in EAM and their information demands. The different tools show commonalities in what information is provided and how it can be visualized in EAM, but they do not show support for the same EAM roles. To identify typical roles in EAM and to elicit their typical demands, e.g. using the method for information demand analysis [14] and the means of information demand patterns [15], would probably be useful for both, the EAM tool developers and the way of analyzing support of visual analytics of these tools.

Future work in this area will include the repetition of the research study in other contexts and with additional EAM tools. On the one side we envision to use the study with industrially experienced enterprise architects for external validation of the results in practice. On the other side, we plan to repeat the study with more students at

another university to contribute to an understanding how the student's prior knowledge in EAM and enterprise modeling affect the results of such a study. Furthermore we will refine our approach presented in [12] and [13] to support stakeholders in the decision-making process by using the visual analytics approach and improving the stakeholder's collaboration and identification.

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Caring of Intentionality in Business Process Models Using Business Process Patterns.

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Abstract. The paper introduces the problem of process intentionality as a basic condition for fulfilling the contents of the idea of process-orientation in process models. Consequently it discusses the role of the business process modeling methodology in achieving the substantial effects of the idea of process-oriented management. In this context it introduces the concept of business process patterns as a part of the Methodology for Business Process Analysis and Management (MMABP) and explains their important role in the methodology. Different conceptions and meanings of the popular concept of BP Patterns are discussed before the specific meaning of this concept in the MMABP is explained. The basic BP Pattern is described and explained in detail together with connected principles and features of the MMABP with the help of the Business Process Metamodel. Specific respect is paid to the role of BP Patterns as an expression and explanation of the most important principles and rules for modeling business process details.
In the final section some wider consequences as well as future development of the concept of the Business Process Patterns in the context of the MMABP are discussed.

Keywords: business process management, business process modeling, intentionality, Enterprise Architecture, design and analysis patterns, process based management, MMABP methodology.

1 Introduction

Business process management undoubtedly represents the most significant movement in the management theory in last several decades. Nevertheless, it represents the crucial movement also in the field of information systems development. It is mainly because of the natural complexity of these ideas which typically cover many different dimensions of enterprise management including the technology on the first place. Technology plays the central role there; it is a trigger as well as an enabler of possible important changes in the company behavior in terms of exploiting the new possibilities created by the technology development [7]. To achieve such effects it is necessary to well understand the technology and its possibilities on one hand together with understanding the business area and connected content aspects (like managerial,

social, psychological, political, and other) on the other hand. The complexity of the approach is absolutely crucial there. Neglecting just one of these important aspects reliably leads to the final failure.
Consequently, the primary critical success factor of the implementation of these ideas is an ability to mentally cover all necessary dimensions of a problem. This factor typically causes many misunderstandings like overestimating the technical aspects of the business process together with omitting the non-technical ones which is typical for IT-oriented people, or, in turn, ignoring the technical aspects which is typical for managerial approaches.

2 The problem

Importance and popularity of the Business process management phenomenon historically led to the creation of specialized process modeling languages and standards. During the last two decades many different standards for business process modeling have been created from different purposes and for different reasons. Most of them are not in use already. Two of them can be regarded as dominant: Business Process Modeling Notation (BPMN) [11] and Architecture of Integrated Systems Notation (ARIS) [17]. Business Process Modeling Notation (BPMN) as a language for modeling business processes [1] is a most important standard fulfilling the above stated requirements for the standardization. Among other popular standards ([18], [9], [17]) only the BPMN became widely accepted by users as well as by CASE tools producers, and is developed concerning other related significant technology standards [19], [20], [16] which is the basic condition for fulfilling the full meaning of standardization. This fact qualifies the BPMN for being a leading professional standard in the field of business process modeling and it is also the reason for choosing it as a basic notation for business process models in the MMABP methodology (see the following chapter).
As process modeling languages has been created by the IT community they naturally suffer from the overestimating of technical aspects of business process and omitting the non-technical ones. Moreover, in terms of the approach of the leading modeling standards UML [16] and BPMN [11] these languages are not aimed on expressing the methodical principles. They rather support the modeler with the general frame for modeling following basic, general restrictions which is methodologically independent in principle. The main task for a methodology is than completing the language with other, still uncovered, aspects which are often connected to special aspects of the subject and purpose of modeling. Thus these *standards for modeling business processes, as they are, are naturally insufficient in terms of the principles of business process management*. They have to be always completed by the methodology the main task of which is to bring additional rules, constraints and tools for eliminating the mentioned insufficiencies.
One of the most important problems often occurring in business process models which do not sufficiently respect the non-technical aspects of business processes is a

lack of intentionality (purposefulness). As we regard this problem as crucial in terms of process management ideas expressed in [7] the following text focuses on it.
In the legendary article [21] Norbert Wiener expressed the idea which fatally influenced the later development of cybernetics: "a*ll purposeful behavior may be considered to require negative feed-back*". The concept of *negative feed-back* is explained there as follows: "*...the behavior of an object is controlled by the margin of error at which the object stands at a given time with reference to a relatively specific goal. The feed-back is then negative, that is, the signals from the goal are used to restrict outputs which would otherwise go beyond the goal.*".
According to the basic work in the field of process-driven management ([7]) business process always follows some goal. The goal is a fundamental attribute of a business process as it is regularly used in matured methodologies like in [9] for instance. That means that **business process is always an intentional process**. By the term *intentional process* we mean the process of **purposeful behavior of interested object** following some goal.
Concluding from previous two paragraphs we can find that the **business process**, as it is an intentional kind of a process, **have to have some negative feed-back** which ensures restriction of its outputs in order to keep them in the margins of its goal. This characteristics strongly distinguishes the business process from the process in general (ie. in just technical /physical sense) as well as from processes which do not need any feed-back like machine-managed or automated processes running without a contact with their environment.
In case of business process feed-back means some **input to the process from its environment which is causally connected with some process output**. The value of the input should influence the following behavior of the process in terms of keeping it in the margins of its goal. This means that "intermediate" inputs to the process (i.e. none-starting inputs to the process coming between its starting and end points) are critically important parts of the business process distinguishing it from other, non-intentional (i.e. non-business), processes. Working with processes we have to take into the account even the time dimension; every input to the process from its environment has to be synchronized with the process run. Thus in each part of the process where some input which will influence the following process run is expected the **process state** has to be placed. Process state means such point in the process structure where nothing can be done before the input to the process occurs, i.e. point of **waiting for the input**. The concept of process state is present just in some process modeling standards (like IDEF, see [18] or Petri Nets based languages[1]), partially present in some others (like ARIS[2], see [17]), many standards do not support it. Widely accepted process modeling standard BPMN ([11]) does not recognize this concept at all.

1 Although Petri Nets, where the phenomena of states and synchronization are essential, are not originally intended for modeling business processes there are some interesting attempts to use them for this purpose in the community, like in [3].

2 ARIS methodology mixes the concept of *process state* with the concept of *event* which is confusing and may contradict with the idea of negative feed-back.

Regarding the importance of the above outlined problem together with the insufficient support in most of process modeling standards it can be said that the primary task for every process modeling methodology is to **allow the modeling of process states ensuring the critically important presence of the negative feed-back** no matter which notation and/or modeling standard is used.

3 The concept of Process State in the MMABP Methodology

The ideas described in this paper are the part of the MMABP methodology (Methodology for Business Processes Analysis and Design). MMABP distinguishes between two main types of models: business process versus business object models. In both types of model the methodology recognizes the global model (system view) and the detailed model. The modeling tools used by the methodology are based on common standards BPMN [10], UML [15], and Eriksson/Penker Notation [8]. The essence of the methodology is defined in the formal meta-model [12] as a part of the development project OpenSoul [11]. The metamodel consists of three main packages which correspond to the main dimensions of the business system model mentioned above: Business Substance Metamodel, Business Process Metamodel, and Business Models Consistency Model. The patterns which are the main subject of this paper are based on the principles defined in the Business Process Metamodel and express them (see Fig. 1).

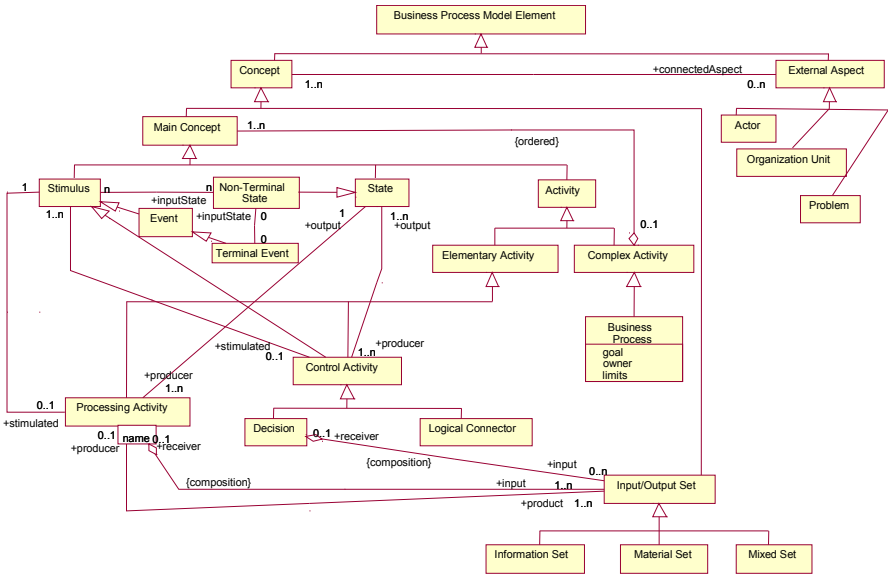

Fig. 1. Business Process Metamodel [12]

As the metamodel shows the concept of **state** is one of the crucial concepts in the methodology. Besides the fact that it is one of three basic process elements (together with *stimulus* and *activity*) it plays the specific role of "connector" of two main kinds of process activities: *processing activity* and *control activity*. This fact is closely connected to the concept of negative feed-back according to the definition in [21]: processed outputs are connected to inputs which influence the following process behavior. Further explanation of the metamodel can be also found in [13].
The information contained in the metamodel is complete but hardly understandable as many facts are expressed there as a consequence of other facts. Therefore, in order to express the methodological principles in better understandable form, the metamodel is completed in the MMABP with the **business process patterns**. Business Process Patterns in the MMABP methodology express the general solutions for typical situations occurring in the process of modeling the business processes. Business Process Patterns complete the methodology with the further information about how to create models which are fully consistent with its principles and rules. They can be also used as the general examples of typical segments which the business process should consist of. These segments can be instantiated for the particular situations and used as basic building blocks of the business process model.
In terms of the main idea of this paper – ensuring the intentionality of the business process - the key pattern from the MMABP called *Basic Process Flow Pattern* is especially important. Therefore the following text focuses on this pattern in detail.

4 Business Process Patterns

The concept of pattern is very popular in the field of IS development methodologies and connected areas for a couple of decades already. This term has been introduced in this field inspired by the concept of "architectural patterns" introduced by the architect Christopher Alexander in [1]. Alexander defined the basic general aspects of so-called "pattern language" like syntax, grammar, and dictionary and put the basics for its systemic use in all fields where the concept of design is naturally relevant.

In the field of object-oriented analysis and design this concept has been introduced already in 1992 by Peter Coad [4] in the form of several simple structures of analysis objects generally usable (under given conditions and with respect to the given meaning of objects) in any OO system. The most significant and complete elaboration of this phenomenon can be found in the book from Martin Fowler [5]. Fowler describes there a dozens of analysis and design patterns divided into several categories according to different domains of their use. A comprehensive detailed view on the use of the concept of patterns in the field of IS development can be found in [23], and its specialization in the field of OO analysis and design together with a precise literature overview in [3].

In the field of business processes the concept of patterns is most frequently used in the context of workflow management. The most visible initiative in this area is the Workflow Patterns project [9], a joint effort of Eindhoven University of Technology

and Queensland University of Technology which is aimed on "providing a conceptual basis for process technology". In the project the various perspectives of needed support by a workflow or a business process modeling language are examined. In accordance with the main focus of the workflow management mainly the technical characteristics of the process are emphasized, i.e. those characteristics which follow from the general theory of algorithms. Nevertheless the Workflow Patterns are typically oriented on the dynamic (process) aspects of the business process which is their main difference from the analysis patterns in the field of OOA.

Hans-Erik Eriksson and Magnus Penker in [8] transferred the concept of pattern to the field of the business system contents. They recognize several categories of so-called. "Business Patterns" which correspond to the essential concepts of their specific methodology aimed on the use of the UML [15] for modeling the business systems. One of these essential concepts is also the concept of business process. The authors introduce different patterns in three categories describing basic structural aspects of business processes and their mutual relationships. The novelty of their approach lies in the strong orientation on the business contents which gives their patterns the methodology dimension. Nevertheless in accordance with the focus of their object-oriented methodology only the structural characteristics of the process are described. Erikson/Penker patterns thus cannot be fully regarded as process (dynamics) oriented.

There are several definitions of the concept of pattern in the field of analysis, for instance: "an idea that has been useful in one practical context and will be probably useful in others" [5], "abstraction from a concrete form which keeps recurring in specific non-arbitrary contexts" [7], "formalized triple of problem, solution, and context which solve domain-specific problem by encapsulating specialist knowledge" [2] (translated by [3]), “self-contained model template with well-defined connectors to application environments capturing knowledge about best practices for a clearly defined task” [22] (*task pattern*). All these definitions nevertheless contain the same popular common ideas of "reusability" and "knowledge sharing". At the same time these ideas characterize in fact the essence of the concept of "methodology" as well.

Process Patterns in the MMABP

There are two main kinds of Business Process Patterns in the MMABP methodology:

- **Basic Business Process Flow Pattern** which defines the basic procedure and decision points of the process of model creation. This pattern is absolutely essential in the MMABP, it expresses the main principles, rules, and other aspects of the MMABP approach to the business process modeling and therefore it is explained in detail in this paper.
- **BP patterns for particular situations** which cover typical situations frequently occurring in business process models where it is possible to find

some generally valid structures, principles and constructions which should be fulfilled by the process description undoubtedly.

There are three most general patterns: Complementary Events Pattern, Repeating State Pattern, and <<inclusive OR>> Pattern. As the complementary patterns for particular situations are not so closely connected with the problem of process intentionality as the basic pattern we do not pay more attendance to them in this paper.

Basic Process Flow Pattern

The Basic Process Flow Pattern expresses the basic structure of the process model which respects the essential rules of the MMABP methodology. These rules express the "technical" necessities which mainly follow from the general theory of algorithms as well as the specific aspects of the business process which distinguish the business process from a process in general (i.e. just technical) sense. The lately mentioned rules follow from the theory of BP management and reengineering which is anchored already in the basic work in this field: [6].

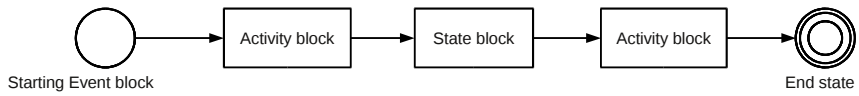

Fig. 2. Basic Business Process Flow Pattern (BPF Pattern) [12]

Basic Process Flow Pattern (see Fig. 2) expresses the essence of the process flow using three methodically essential types of the process elements: events, activities, and states.

According to the Basic Process Flow Pattern the business process should be described as a sequence of *Activity blocks* interrupted by *State blocks* starting with just one *Starting Event block* and resulting in one or more *End states*. Fig. 3 illustrates an exact definition of these basic blocks. The definition is written in the semi-formal metalanguage based on the simplification of the standard Extended Backus-Naur Form (for details and explanation of the EBNF see [14]). Used meta-symbols have following meanings:

- A = [element1 | element2 | element3] means that the item *A* can be either *element1* or *element2* or *element3* exclusively.
- A = { elementX } means that the item *A* consists of one or more *elementsX*.

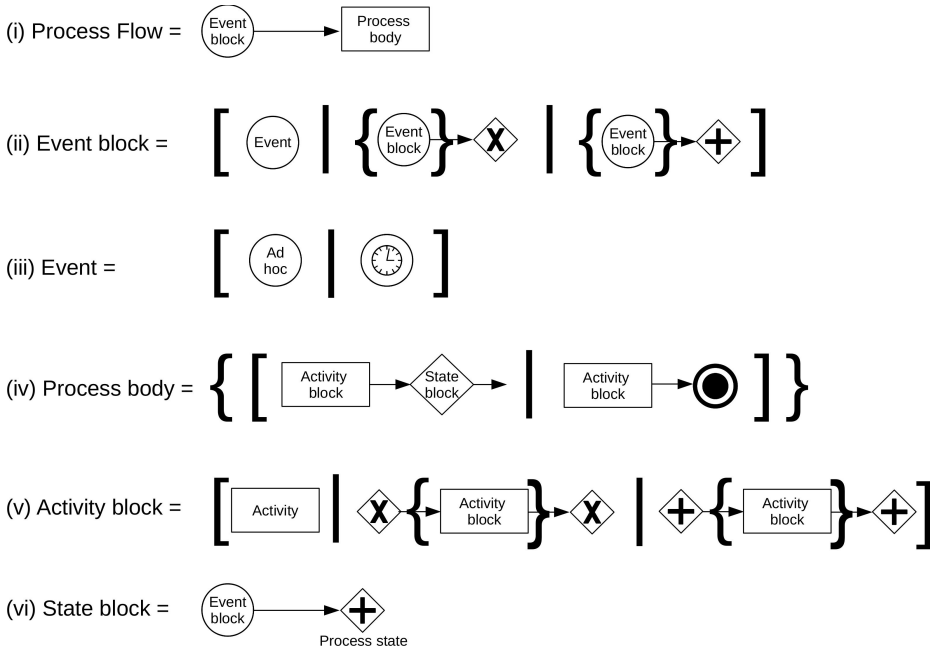

Fig. 3. Definition of basic blocks and concepts of the BPF Pattern

Particular definition sentences can be read as follows::

Def (i): Process flow begins with starting Event block followed by the Process Body.
Def (ii): Event block is either a single event, or structure of mutually exclusive Event blocks, or structure of mutually synchronized Event blocks.
Def (iii): Event can be either an ad-hoc event or a timer.
Def (iv): Process body consists of one or more pairs where each pair consists of an Activity block followed by either State block or End State. If the pair ends with State block the description should continue with another pair (see the arrow after the State block). End state always means the end of the process.
Def (v): Activity block is either a single Activity, or structure of mutually exclusive Activity blocks, or structure of parallel Activity blocks.
Def (vi): State block is a synchronization of internal process flow with expected event(s) expressed as an Event block (in other words: waiting for the event(s)).

Event block represents the external influence which the process always has to respect. It works either as a trigger or a limiter of the process. In both cases it has to be unambiguous which means, among others, that is has to represent a single point of time. Therefore it can be either a single event or a time-elementary structure of

events. If it is a structure it can express either the synchronization of parallel events (event blocks) or the set of possible mutually exclusive alternative events (event blocks) in order to be time-elementary.

Activity block represents an action element of the process. It can be either a single activity or a structure of activities (activity blocks). Similarly as in the case of event also an activity should be unambiguous. Therefore, if it is a structure, it can express either the synchronization of parallel activities (blocks) or the set of possible mutually exclusive activities (blocks). It cannot express a sequence of activities as it would be a violation of the elementariness rule. The methodical reasons and meaning of the need for the elementariness of activities in the process description is discussed in more detail below.

State block represents the essential need to synchronize the process run with expected events. This need follows from the fact that the event is always an objective external influence and thus it must be respected. From the physical point of view such respect means synchronization – waiting for the event (event block). As the BPMN notation do not recognize the concept of process state there is no other way than to express the process state with the general symbol for synchronization – the "AND gate". In order to distinguish between the general synchronization and its specific meaning as a process state we complete the BPMN with the stereotype <<*process state*>>.

One of the most important ideas expressed in this pattern is that *there can not be a sequence of process activities uninterrupted by the process state*. This rule reflects the essence of the **definition of an elementary process activity**:

(a) the process activity is regarded as an elementary one if there is no objective reason for its interruption,
(b) the reason for the interruption of the activity is objective if it comes from outside of the process.

Rule (b) of this definition means that each objective reason for the process interruption is represented by an event (external influence) in fact. Thus any activity of the process, no matter how technically complex it is, must be regarded as elementary if there does not exist an external influence (event) which the process has to respect (i.e. wait for). This consequence well illustrates the fact that the elementariness of a business process activity is not only its physical but much more a functional attribute as the business process itself is always more than a physical process (algorithm) only. This way the methodology prevents the analyzer from the pointless unlimited dividing of the process activities which is a frequent mistake in the field of BP modeling. The necessity of such safety fuse in the methodology against the unlimited division of activities is given by the fact that in the field of process-oriented modeling the aggregation is a dominating type of abstraction (unlike

in the field of object-oriented modeling where the generalization is a dominating type of abstraction). This fact manifests itself in the principally unlimited possibilities of division of activities known as a rule: *any single process activity can be decomposed into the structure of sub-activities – a process* (as it is also defined by the process metamodel at Fig. 1). As the division of activities is physically unlimited the methodology has to define some logical – functional definition of the very low level: the level of the process elementariness.

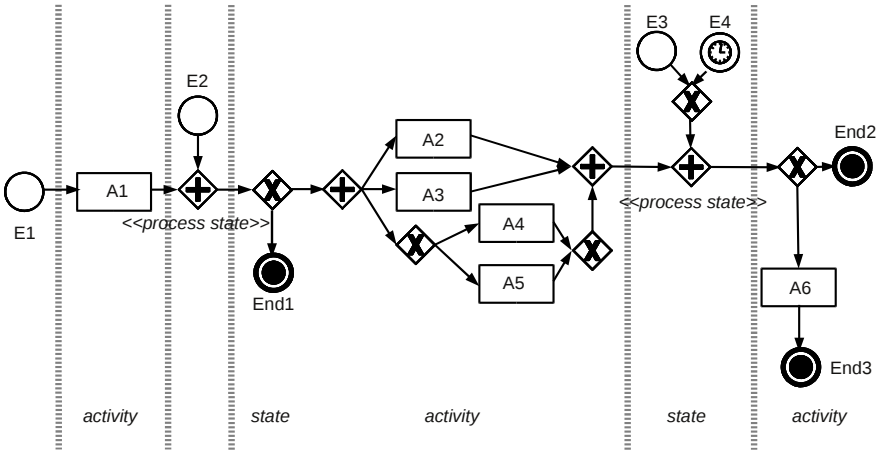

Fig. 4. Correct Business Process Flow Example (source: author)

Fig. 4 shows the symbolic example of the process which can be regarded as correct according to the Basic Business Process Flow Pattern. The process can be seen as a sequence of several parts each representing one block of a particular basic type (see the division of the whole process by vertical dashed lines). It is beginning by the starting event block which consists of just single event E1 in this case – the starting event of the process. The staring event is followed by the activity block consisting of just single processing activity A1. According to the pattern the activity block is followed by the state block in the form of synchronization of the process run with just a single event E2. Following activity block represents more complex structure of activities: it consists of two main alternatives: either the process end End1 or the structure of three parallel activities where the first two are single processing activities A2 and A3, and the last one is a structure of two alternative processing activities A4 or A5. Following state block represents the waiting for two alternative events E3 or E4. The last activity block is a structure of two alternatives: the processing activity A6 followed by the process end End3 or the immediate process end End2.

The example at Fig. 4 illustrates that and how any algorithmic structure of the process can be checked whether or not it fulfills the basic definition of the business process expressed by the Basic BP Flow Pattern: *the business process is a sequence of Activity blocks interrupted by State blocks starting with just one Starting Event block and resulting in one or more End states*.

5 Conclusions

This paper presents the role of the business process modeling methodology in achieving the substantial effects of the idea of process-oriented management. It explains the importance of process intentionality as a basic condition for fulfilling the contents of the idea of process-orientation in process implementation. In this context the paper introduces the concept of business process patterns as an important part of the business process modeling and management methodology. The popular concept of *pattern* is widely used in many different meanings. The common value of this style of presenting in all areas which makes it so popular is the possibility to express important rules a very understandable way. The MMABP business process patterns are specific by their focus on the rules for modeling business processes which include the technical aspects of the process modeling together with the content aspects which follow from the theory of process based management. The essence of these methodology rules is expressed in the Basic Process Flow Pattern which explains how the way of modeling the process should generally respect the main ideas of the process oriented management. The system of patterns has been added to the MMABP based on the experience with its use in dozens of business process modeling projects. Further experience confirmed the importance and suitability of this form of methodical support especially for its integration effect: it naturally integrates different methodical principles in different, mutually connected, views on the business process system. Respect to states between activities in the form of waiting for the external event leads the modeler to the respect to associations with other processes which are giving the process the meaning of the part of the process system. Prohibition of the sequence of activities without a state between them underlines the methodical idea that the prime purpose of the process description is to map the human influences in the process (decision mechanism) instead of the unimportant sequence of activities which is ensured by the technology. The process management means primarily the way of management instead of the technology.
Other mentioned patterns support the methodology ideas in typical specific situations. These partial purpose patterns complete the basic process flow pattern and should be understood strictly under given methodology assumptions. Moreover, their development is principally unlimited; as the evolution of the methodology goes on together with the penetration of specific areas of its application the number of these specific purpose patterns will increase as well.

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Collaborative Recommendation System for Improved Information Logistics: Adaption of Information Demand Pattern in E-Mail Communication

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Abstract. Today e-mail communication information is widely used in organizations to distribute information. The increasing volume of received e-mails hinders an efficient work. It becomes more and more difficult to identify relevant e-mails inside this enormous volume of information. This work presents a solution in a multi-user environment by improving an established e-mail client extension based on information demand pattern with a recommendation system. The contributions of this work are (1) a concept and implementation of a solution for a single-user environment using information demand pattern and (2) a concept and an architecture to use the solution in a multi-user environment.

Keywords: Information Logistics, Information Demand Pattern, Recommendation Systems, E-Mail

1 Introduction

In spite of many isolated applications information overload is still a problem in our modern working environment. In order to face this problem not only a single application but also the integration of well-established solutions is the key. Every day, a wide variety of information is produced. This emergence has greatly increased in recent years. The society has changed to an information society. The availability of information can be viewed as an obstacle for a demand-oriented information supply, but finding the information by the person who needs them. This development does not

stop in front of companies, so that they see themselves confronted with an ever-increasing amount of information, as studies have shown [11].

Information logistics as an application field of business information systems takes care of this problem and has the goal to achieve an improvement of the information flow in organizations by providing a demand-oriented information supply. Information logistics offers methods, concepts and tools to achieve an improvement. Under the concept of demand-oriented information supply the right information at the right time, in the right quality, in the right form and at the right place for the seeking person is understood [12].

For a demand-oriented information supply in addition to the lack of information, especially the flood of information in companies is regarded as obstacle. Öhgren and Sandkuhl showed in an empirical study that around two-thirds of the Swedish Manager of the top management and middle management suffer from information overload. In that survey 37% of the participants answered that they receive "far too much information" and another 29% receive still "too much information" [13]. The phenomenon of information overload is often equated with a too much of information. Speier et.al. however point out that the amount of information, as well as the complexity and the time available for the working person are in relationship to each other [14].

In companies, e-mail has established itself as an important communication medium. Also here a flood of e-mails can be observed which Volnhals and Hirsch have shown in a study. This has negative effects on the quality of decision-making by managers and can lead to economic consequences as well. It is pointed out that information overload can be defined as the amount of information that a cognitive processing capacity exceeds [15].

Soucek and Moser, however, have identified in a survey three facets of information overload through e-mail. These are the mass of incoming e-mails, inefficient workflows and a poor quality of communication [16].

To improve the demand-oriented information supply within e-mail communication an extension of an e-mail client was proposed by Stamer [17]. This extension uses an information demand pattern (IDP) as input about the information a worker needs. The extension filters the e-mails according to his or her needs and provides a better information supply. This solution fits well to a single-user work environment. But normally workers within a team interact with each other during their work. Therefore integrating a recommendation system in order to enable interaction between the local extension installations enhances this solution.

The contributions of this work are: (1) a concept and an implementation of a solution to filter e-mails in a single user environment by using information demand pattern; (2) an architecture and a concept to establish the aforementioned solution in a multi-user environment such as a workgroup using recommendation systems technologies.

This work is structured as follows: Section 2 gives an overview about recommendation systems and information demand patterns in general. Section 3 describes the architecture and functionality of the proposed IDP-based recommendation system. Section 4 summarizes the results, gives some conclusions and an outlook on further research.

2 Background

Due to a better understanding of the solution presented in section 3, this section introduces the key principles of recommendation systems and gives an overview about information demand patterns.

2.1 Recommendation Systems

Recommendation systems have become widely used nowadays as they help to mitigate information overflow of current life [3, 4]. Any recommendation system involves two entities: users and items. User is a person (we may also imagine some software agent playing the role of a user, but this scenario is rarely addressed in the field, if at all) interested in interacting with items of certain kind. Products, services, web pages, blogs etc. on the other hand, may represent items. There are two crucial points that justify the development of a recommendation system in some domain: a) some items are more interesting (or useful) for a particular user than others; b) there are plenty of items, and the user has no chance to examine them all in order to find the most useful ones. Recommendation systems have much in common with search engines, but then differ in a sense that a user must query a search engine, but recommendation system acts more in a proactive way offering a user items that might be useful without explicit requests. Classical examples are movie, books, and music recommendation systems.

There are three basic approaches to recommendation systems development (not to mention hybrid recommendation systems, which usually employ some ensemble of basic approaches) [5]:

- Content-based recommendation systems (CB),
- Collaborative filtering systems (CF) and
- Knowledge-based recommendation systems (KB), also known as constraint-based recommendation systems.

These approaches differ in the rationale that is behind the recommendation process, information used as well as information and mathematical models of users and items.

Content-based recommendation systems [6] are based on the premise that if a user likes some item he or she will probably like similar items. So, there are two pieces of information that make this kind of systems viable: the information about which items a user likes and a pairwise similarity between other items. The former is usually collected during the user's interaction with a system and the latter requires some domain-specific analysis of item's properties and characteristics. Similarity measures for movies, blogs and books are quite different. Typical pitfall of this kind of systems is the lack of diversity.

Collaborative filtering systems [7] are based on the premise that if two users share some significant part of their interests, other interests may also be common. For example, if it is known that two users assigned high ratings to "Green mile" and "Apollo 13" movies and one of these users did not watch "Forrest Gump" the system may infer that "Forrest Gump" may be of some interest for that user. It is important to

note that this inference have nothing about the fact that Tom Hanks starred in all the mentioned movies, but it is based solely on the fact that the users similarly rated some movies. So, the only information that is used by this kind of systems is users' attitude to various items. This attitude usually takes the form of ratings assigned to items by the users, but also may be derived from some user's behavior peculiarities. As this approach does not rely on item's properties it is rather universal and can be applied to almost any domain. The significant drawback however is that without significant number of ratings the statistical inference becomes unreliable.

Knowledge-based systems [8, 9, 10] are powered by a set of rules that connect users, context and items. Recommendations here are provided as a result of logical inference and/or constraints resolution. Such systems can also be seen as a kind of expert systems. The development of a knowledge-based system requires a significant effort, as all the rules and trends that are automatically inferred (and updated during the system lifetime) by recommendation systems of the other approaches must be formalized and manually represented in some machine-readable form by knowledge engineers. Hence, KB recommendation systems are usually developed in domains where there are experts that can provide comprehensive formalization of item space, for example, for browsing product/services catalogues of some company.

2.2 Information Demand Pattern

The concept of information demand pattern originates from work in the research and development project Information Logistics for SME (small and medium-sized enterprises) (infoFLOW). infoFLOW included seven partners from automotive supplier industries, IT industry and academia. The objectives were to develop a method for information demand analysis [21] and to identify recurring elements in information demand, i.e. patterns of information demand.

Lundqvist has shown in a study in companies that the information demand of an employee depends on the role in the organization that he or she fulfills. The structured collection of this information, which is necessary for the processing of work tasks, was underpinned by the development of a methodology for information demand analysis and validated [18].

After detecting the information needs of a role in a company, Sandkuhl presented the concept of information demand pattern. As with patterns in other disciplines of computer science, these patterns have the purpose to detect a proven solution to a problem in order to reuse it in other application scenarios. With information demand patterns, the identified organizational knowledge is collected in a structured and reusable way. The term information demand pattern is defined as follows according to [19]:

An information demand pattern addresses a recurring information flow problem that arises for specific roles and work situations in an enterprise, and presents a conceptual solution to it.

Information demand pattern consist of five integral components:

- *Name of the pattern,*
- *Organizational context,*
- *Problems,*
- *Conceptual solution and*
- *Effects*.

The *name* is used to identify the pattern. This is usually the name of the role, which the pattern describes.

The *organizational context* explains the application context in which the pattern can be applied. This can be departments, functions or domains.

Problems represent the difficulties and challenges that the person is facing in filling their role in the company. In addition, the duties and responsibilities of the role are subsumed under this point also.

How the described problems of the role can be solved is shown in the section *conceptual solution*. It is divided into three areas to consider: information demand, quality criteria and timeline. Information demand describes the information that is necessary to fulfill the duties and responsibilities of the role. The quality criteria describe the quality in which the information must be available such as the general importance of the accuracy, the time and the completeness of the information. The timeline represents the time at which the required information must be available at the latest.

The *effects* part describes effects that may occur if the information is not available or not in time. The possible effects occurring may be associated with the following dimensions: economic effects, time and efficiency, quality of work, motivation, learning and experience and customer [19].

The concept of information demand pattern has been studied in several other works and its applicability has been validated [20, 25, 26].

3 Architecture and Functionality of IDP-based Recommendation Systems

The overall architecture of the proposed contribution is described first in this section. It will be shown how an e-mail client extension can work together with a recommendation system in order to provide a demand-oriented information provision by using e-mail filtering technologies. It will be shown how the solution can be implemented in organizations.

3.1 Architecture in Enterprises and Organizations

Demand-oriented provision of information is important to avoid disadvantages by information overload. Therefore the extension of e-mail clients described in section 3.2 can be used to present the right information at the right time to a user as information logistics proposes. The quality of the results of this solution for a single

person depends on the quality of the given input – here information demand pattern. On the one hand this solution does not consider the changing demands of the user depending on their current working context. On the other hand there are no connections between the users to benefit from a continuous information exchange. Therefore the solution will be enriched with a recommendation system, which will be described in detail in the following section.

Figure 1 shows how our proposed solution can be implemented in an organizational context. Inside this organizational context there are several user contexts. These user contexts represent users in his or her working environments, who fulfill a role inside the enterprise. During carrying out their duties, roles in organizations have a typical information demand, which is determined by their tasks and responsibilities. This information demand can be gathered with an information demand analysis and described with an information demand pattern. This information demand is somehow abstract, which enables the pattern to be used in different contexts like in other enterprises. Therefore it is necessary to specialize or to tailor the information demand to the exact user context. Due to the fact, that information demand pattern are right now only textual descriptions, these patterns will be transformed into a machine-readable und machine-interpretable format by using technologies like indexing. This indexed information demand pattern is used by the next step as input. After preparing the information demand pattern for use in an organizational structure the specialized information demand of a role helps to provide a demand-oriented user support, which shall help to increase e.g. efficiency of the role while accomplishing his or her tasks. From a technology perspective this will be implemented by extending the e-mail clients of the users with a plug-in. This plug-in will do locally filtering of e-mails to offer the user e-mails he or she needs at the moment to accomplish their tasks. Due to the fact, that most of the employees in organizations use e-mails to communicate with internal or external partners. Since the above described user contexts are somehow isolated from each other, we propose context-based recommendations for organizational support. This means that there should be interaction in between the different user context in order to generate benefits through information exchange. Therefore we propose to use a recommendation system. The previous installed plug-in provides feedback about the user behavior to the recommendation system. The recommendation systems itself responses to all installed e-mail plug-ins in order to adapt the e-mail filtering with newly gained information by other users.

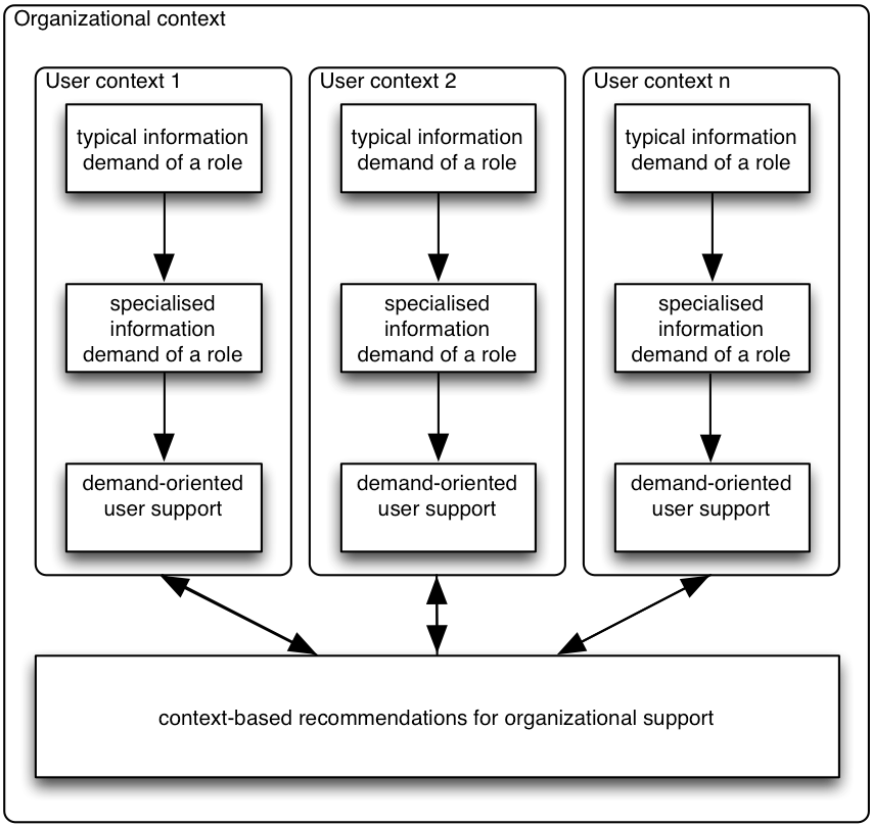

Figure 1: Solution Implementation in Organizational Context

3.2 E-Mail Client Extension

Information demand patterns were presented as a way to capture the information demand of roles in organizations in a structured way to make them reusable. These collected information demands associated with tasks and responsibilities, should continue to be used now to offer a solution to reduce the problem of information overload while communicating via e-mail.
The target is to support a person, who fills out a role with defined tasks, through an automated provision of information at the time when the information is needed. The field of application of the concept can be a company or an organization, which uses e-mail as a communication medium and is suffering from information overload. The user will be presented for the completion of his duties necessary e-mails in an appropriate manner at the appropriate time. Interpreting the information within the e-mail will remain with the user. The presence of an existing information demand pattern, describing the supported role, is adopted as a precondition for the application of the concept.

Information demand patterns are described so far in a semi-structured textual form. This form is neither readable nor interpretable by computers. Therefore, it is necessary to make the information demand patterns first machine-readable. It is proposed here to use ontologies or the Extensible Markup Language (XML).
Within information demand patterns the specific information needs are only described linguistically and are not interpretable by computers, therefore it is proposed to assign first keywords by hand, which describe the information and thus make them identifiable. Automated indexing may help later to reduce this effort.
Information has its highest value for business at the time it is needed. Information received after that date may be worthless. Obtaining it previously, its value is still low. The information must be presented to the user, if needed to fulfil the assigned tasks. This point emerges from the timeline of the information demand pattern.
In identifying the relevant e-mails not only just incoming e-mails are recorded, but also already existing e-mails are optionally labelled in order to carry the point account that draws closer a defined time point increases the value of information in e-mail. Cyclically repetitive algorithms can implement this.
The relevant e-mails to the performance of a task are now identified; they must be presented at the defined time. Highlighting about the marking of the e-mail can do this. The use of virtual folders provided by any modern e-mail application can be helpful to present the relevant e-mails to the user. It is to be noted that only the relevant e-mails are presented to the user. The user coordinates and interprets the content.
The inclusion of the proposed approach in the e-mail communication can be done locally by the user as well as on the side of the e-mail server. As an advantage of this implementation, broad support from any devices such as PCs, smartphones, Tablet PCs or Web access to e-mails is conceivable because filtering the content of e-mails happens centrally. The contrary is a higher cost to the implementation, as well as the possibility to extent the e-mail server with new software. The concept can be implemented as an extension of the used e-mail program as well. Modern e-mail programs offer interfaces to do this. As a disadvantage, it is here to note that, in this case, no support from other devices is feasible.
The concept is offered as a way to reduce information overload within the e-mail communication in organizations. It can be expected that the automated provision of e-mails for the user will lead to a timesaver. As economic benefits, an increase in efficiency and an avoidance of wrong decisions can be stated.
An appropriate and previously specified information demand pattern can be viewed as a limitation of the proposed approach. Also, the collected information demand must be made sufficiently identifiable by keywords. It is likely that the quality of the presented e-mails to the users thereof will be significantly dependent on. It is conceivable to transfer the duty to create the information demand pattern and the duty to determine keywords to central organization units. Economies of scale can be used if there are several similar roles in the organization.

3.3 Recommendation System Supporting E-Mail Client Extension

Goals of the recommendation system

Goals of the recommendation system:

- Adjust IDP-formed tasks based on actual workers activity. Initially, all IDPs are created by some authorized entities and reflect general view on specific worker role or tasks.
- Help to classify pieces of information (e-mail messages) as relevant/irrelevant to some IDP.

Informally, the goal of the recommendation system is to provide dynamic adjustments to the IDP-based structure of the information workflow.

In the context of this work, recommendation system analyzes an interaction between workers and e-mail messages within the scope of each IDP and adjusts importance of e-mails in other workers' mailboxes based on this interaction.

Generalization and propagation of user-item relations is usually achieved through collaborative filtering that is the main principle of the proposed recommendation system. However, holistic approach to tailoring an IDP structure to the organization workflows goes beyond the traditional collaborative filtering scheme and involves variety of information processing techniques and models.

Recommendation system input data

One of the crucial aspects of recommendation system development is identifying input data useful for fulfilling the recommendation system goal. For each type of input data, the rationale that underpins its usage for recommendations should be identified. Input data selection then affects mathematical models and algorithms that are used for making recommendations. For the proposed recommendation system the following types of input data are used:

- E-mail messages' textual content and additional attributes (message id, sender etc.),
- Workers' actions on e-mail messages,
- IDP descriptions and
- Workers' profiles.

Each type of input information is discussed in detail below.

E-mail messages' textual content and additional attributes. To propagate actions that a user applies to e-mail messages in his/her mailbox to other users' mailboxes a system must relate messages in different mailboxes. It can easily be done with multiple recipient messages as a sender program usually assigns message identifiers for outbound messages and these message identifiers will be the same for each recipient. Message identifier is put into "Message-ID" field of the message header ([RFC 5322]) and can be read by the receiver. Single recipient messages need some other approach. So the similarity measure between e-mail messages is introduced for relating messages of different mailboxes. This similarity measure accounts not only for message contents, but also for supplementary message attributes (sender, list of receivers). Furthermore, the textual contents can be used to automate message classification to IDPs.

Workers' actions on e-mail messages. These actions are interpreted as implicit information about how useful an e-mail message is for a given user in a particular IDP. Captured actions paired with their interpretation are listed below:

- A user deletes an e-mail message. Means that the e-mail message is irrelevant to this IDP and probably should be ranked lower for other users or even removed from the respective IDP-folders of other users.
- A user ignores (does not open) an e-mail message. Means that the e-mail message is likely to be relevant to this IDP however is received too early.
- A user opens a low-ranked e-mail message before a high-ranked one. Means that there is a sign of ranking inversion and opened e-mail probably should be ranked higher for other users.
- A user marks, flags, highlights an e-mail. Means that the e-mail message is important and should be ranked higher for other users.

IDP descriptions are employed to determine the scope of actions propagation. For example, if two workers perform similar tasks (and therefore, follow similar IDPs), then there is a chance that they consider the same information as important. So, similarity measure between IDPs is introduced. The similarity measure accounts for information demands, their keywords and structural relations between organization units, performing respective IDPs.

Workers' profiles. The set of roles assigned to a worker and workers' efficiency measures that can be used to share the experience of highly professional employees.

Recommendation system output

Recommendation system produces an output in the form of expected importance of each e-mail message in the mailbox. Expected importance is then used to rank e-mail messages presented to the user to make sure that most relevant and actual e-mail messages are placed on the top of e-mails list, attracting most of the worker's attention.

An important feature of the proposed recommendation system is that there are two principal components affecting e-mail ranking: (a) a set of rules from an IDP description, reflecting the information workflow design; (b) usage-based rules inferred from the practice of information processing by workers. During our research, these components are considered not reducible to one another as they aim different goals: conceptual description of the IDP vs. tailoring this IDP to actual information workflows and informal information processing patterns of an organization. Therefore, the recommendation system must merge e-mail rankings produced by either of these components.

Technological model

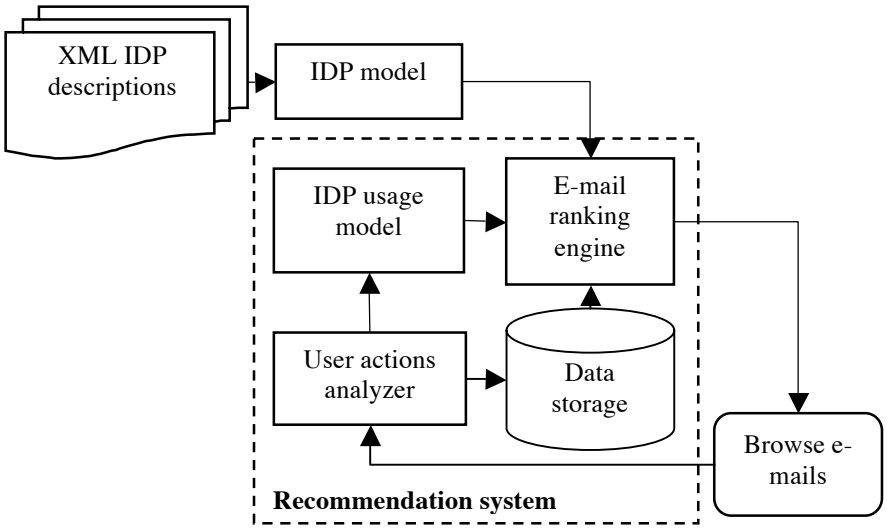

Figure 2: Recommendation system in the context of e-mail client with IDP support

As it is shown in figure 2, recommendation system functionality comprises four blocks discussed in the rest of the current section.

First of all, entire IDP model is divided into two parts: static (or, IDP model) and dynamic (or, IDP usage model). Static part is enforced by organization information workflow engineering and is composed of human-generated rules about how to classify e-mail to IDP and how to assign importance to e-mails inside some IDP. This part is knowledge-based and pieces of knowledge here are classification rules connecting message attributes (sender), keywords, and optionally facts, extracted from the message by a context-free pattern analysis algorithm (see [1, 2]), with IDPs and current message importance according to some IDP.

The dynamic part, or *IDP usage model*, is employed to adjust base IDP model to actual information workflows of the organization. This part also has a form of classifier but it is learned from workers interaction with e-mails by some machine-learning algorithm.

User actions analyzer. E-mail client tracks user actions and passes their descriptions to this component of recommendation system. Each action description includes: action type (removing, flagging, opening an e-mail etc.), IDP instance, user, action time, message browsing context (identifiers of other e-mails that are ranked higher in current users' browsing context). Actions data are used to estimate current e-mail importance in the context of given IDP. These estimations are saved in recommendation system data storage. Furthermore, user actions and estimated importance are used to build adjusted IDP models by training classifier that predicts IDP from message text and attributes.

E-mail ranking engine. Hybridization of knowledge-based and collaborative approaches. Knowledge-based part is powered by IDP description provided by knowledge worker and a processed form of e-mail message. Collaborative engine looks for similar users and then for each e-mail retrieves estimated importance of similar e-mails from recommendation system data storage. Knowledge-based and collaborative lists are then merged to provide user with resulting message list.

4 Summary and Conclusion

Due to the increasing amount of e-mails received every day and the resulting information overflow, this paper proposes a conceptual architecture for enterprises and organizations to support demand-oriented information supply. Therefore well-established information demand patterns are used. Information demand patterns itself are the results from an information demand analysis, which leads to the information demands needed by a worker in an enterprise to accomplish his or her tasks. Information demand patterns are used to feed the proposed e-mail client extension, which enables to provide at the moment needed e-mails to the user by filtering and presenting them in an appropriate manner. Due to the fact that this e-mail client extension is just locally used at the work place of one user, we extended the solution by a recommendation system. The recommendation system monitors users' behavior like deleting, reordering or ignoring messages and proposes the results to other users with a similar information demand. This might reduce negative consequences of information overload like reduced efficiency, wrong decisions and excessive demands of the employees.

The biggest shortcoming of our approach so far is that is has not been fully implemented and validated in practice. The core elements of the proposed architecture, the recommendation system and the plug-in for the e-mail client including transformation of textual IDP, were both implemented and evaluated in practical application, but separately from each other (see, e.g. [17] and [24]). The integration of both into a joint system so far only happened on a conceptual level. From this perspective, we presented work in progress, which has to be continued technically and conceptually.

From a technical perspective, the implementation of the proposed architecture in a collaborative recommendation system with IDP use and e-mail frontend has to be finished. Since the interfaces of both components are well known and suitable for integration, we expect this to cause substantial efforts but no principal problems. The configuration of the system for the actual use in an organization using different IDPs will probably create additional insights regarding the need for further automation. Even for a human actor, to identify overlapping information demands between different IDPs sometimes is not straightforward since the vocabulary used in different IDPs is not necessarily fully adjusted. Automating this mapping might require techniques from text matching and ontology matching [22].

From a conceptual perspective, we plan to investigate the utility and value of the collaborative recommendation system. For this purpose we need a model how to measure or at least estimate the value and a set-up for performing measurements in

everyday practice. Regarding the model for measuring the value, we intend to use our experiences in balanced scorecards [23] and develop a specific scorecard for this purpose. The set-up for practical evaluation will in the first step probably be a team at a university and the demand of the team members regarding information about education and research activities of the team. Later on, we intend to extend this to an industrial setting.

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A Knowledge – based Decision Support System for the Service Quality Improvement in Organizations

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Abstract. This paper focuses on a knowledge – based decision system for human resource management within public administrations, with the aim of improving the service quality. In particular, the construction of decision rules for a generic public administration considers a Skill Gap Analysis among real and ideal workers competence profiles. The procedure foresees the following steps: an analysis of organograms and Job Descriptions; a Knowledge, Skills, Attitudes (KSA) model for Job Descriptions; use of an analyser to transform KSAs of Job Descriptions into an ISFOL – ISTAT model, with integrations of other characteristics; use of a parser to extract information from Curricula Vitae according to the ISFOL – ISTAT KSA model. Finally, a comparison step is useful to understand if employees perform roles, which are coherent with their real profiles. A first experiment allows to test the proposed approach, showing that discrepancies occur in profile choices and confirming what really happens in public administrations.

Keywords: decision system, human management, service quality, Skill Gap Analysis, KSA

1 Introduction

The growing importance in human resources within business organizations implies the adoption of continuous modifications and the development of accurate processes for Human Resource Management. In this sense, the problem deals with the service quality in terms of competences of employees. In last years, this problem has become one of the fundamental research topics, due to the new theories in management fields.

Such studies are not trivial because they rely on two fundamental aspects: the improvement in service qualities, with consequent advantages in logistic flows for organizations; the possibility of identifying weak areas within the businesses plans. Hence, their focus is obviously in human systems management, with particular emphasis on solutions to social questions ([12], [20]), the adoption of opportune rules for business needs ([6], [19]), and accurate mathematical formalisations for problem solving ([14]). A "summa" of all these aspects and phenomena for Human Resource Management is described in [16], with specific details on service quality. In this direction, service science, namely Service Science, Management, Engineering and Design, gives meaningful tools for an accurate description of service systems (see [17], [18]). Moreover, the Viable Systems Approach is also useful (see [1], [10], [13]).

From a practical point of view, the lack in service quality for organizations (see [7], [8]) can be studied via a skill gap analysis within Italian public administrations (see [11]), in order to compare the employees real competences with the ones required for the performed roles. Indeed, an optimal service quality in public administrations is identified in the possibility of providing safe, fast and reliable services to a wide community of common and uncommon people. Eventual improvements for service quality inside public administrations represent a serious topic, especially for the Italian background, where most of work roles are usually assigned on the basis of factors, which are different from merit, competences and experiences. Negative aspects of these phenomena are evident: employees are in the wrong places at the wrong times, leading to delays in common work operations, with creations of bottlenecks, which make the logistic flows, seen as sequences of consecutive operations within the work context, worse.

In this paper, the focus is represented by a procedure, which is useful for the service quality improvements inside the public administrations. Precisely, such an approach allows the analysis of employees competences inside business plans of public administrations, with the aim of identifying weak work areas, and thus defining criteria for a Knowlegde – based Decision Support System (DSS) for the evaluation of the correct employees roles (a similar example is in [3], while analogous studies on competences are in [4] and [5]). Indeed, the possible advantages of such an analysis is evident: from one side, a correct allocation of human resources allows a quite good work quality, hence the logistic flows among the various parts (offices) of the public administration become faster and bottlenecks, due to competence lacks, are avoided; from the other side the guarantee of defining standards for the employment occurs, also in terms of constraints and rules for competition announcements. In any case, the principal beneficiary in this context is the public, either the one, who requires for services, or the one who looks for a job in public administrations.

The proposed approach foresees the following steps: first, in order to construct all characteristics of roles for each worker, organograms of public administrations and Job Descriptions of work profiles are analysed. Then, a competence model, see [15], based on Knowledge, Skills and Attitudes (KSA) and similar to taxonomies (see [2]), is constructed for each Job Description and integrated with other characteristics. Furthermore, a parser allows to extract the competences of employees from their curricula vitae according to the ISFOL – ISTAT[1] KSA model, and a skill gap analysis between competences of ideal and real employees is made. Finally, DSS rules for work roles and employees are constructed. Notice that the steps of the proposed procedure represent a possible way of identifying the correct roles inside public administrations, namely alternative solutions can be identified, also according to contexts, which are quite similar or completely different from the ones described here.

The proposed methodological vision was tested on a real office, precisely at a General and Legal Affairs Office of a Technical – Administrative Department of the Health Service in an Italian region. The analysis involved three different work roles. The chacteristics of profiles, divided into Constraints, Qualifications and KSA, have been kept in an Access Database. Then, using an Access matching algorithm, the skill gap analysis was made among real and ideal profiles. The results indicated that discrepancies occur, showing the gap percentages for each work position, namely: the chosen profiles are not always the most suitable ones for the performed roles. Such a conclusion was also confirmed by a team of "experts" (a possible procedure to choose them is in [9]), who, making manually the same procedure, gave a first evaluation of the correctness of the skill gap analysis.

Unfortunately, the just described approach remains still quite empirical in Italy, due to the complex structure of Italian public administrations. Hence, new studies and experimentations are required in next future. Indeed, a possible preliminary starting point for further research activities is the analysis of curricula vitae of employees and the competence mapping for the KSA construction.

The paper is structured as follows. Section 2 describes the problem of defining correct Job Descriptions inside public administrations, with emphasis on four macro – scenarios, that often occur, allowing to underline problems in real contexts, also in terms of a correct skill gap analysis. Moreover, methodological steps for a correct analysis of competence profiles of employees in public administrations are considered. In Section 3 the case study of a real office in an Italian region is presented, and research results on three different work profiles are analyzed. The paper ends with Conclusions in Section 4.

2 Public Offices and human resource competences

In all public administrations, and in the particular in the Italian ones, there are some logistic flows, whose strength is mainly due to the work quantities and to the service

[1] ISFOL – ISTAT represents an Italian standard for the classification of work profiles and their characteristics. ISFOL – ISTAT KSA models contain further information, which is not always captured by the basic KSAs for work profiles.

quality. Although this vision appears to be quite simple, some weaknesses points are evident for the following reason: the competences of each employee are not always sufficient and suitable for some services. A such meaningful phenomenon often implies a total reorganization of human resources in order to redistribute work loads and employees, so as to improve the service quality. Within the public administrations context, the key point is a correct knowledge of profiles for all employees, in terms of their competences.

Hence, the starting point for a correct Knowledge Management is a competence model, see [15], whose representation is defined in terms of Knowledge, Skills and Attitudes: Knowledge is the set of support information for a determined task; Skill is the practical capacity for the development of the task; Attitude is a specific behavior in some situations. The competence model, which relies on Knowledge (K), Skills (S) and Attitudes (A), is shortly indicated as KSA Model (see [7]), implemented by some Light-weight Ontologies, written in SKOS language and similar to taxonomies (see [2]). Such ontologies allow the description of a particular domain in a hierarchical way and define simple relations. Each element of type K, S and A has a score, that discriminates the competence levels for a knowledge domain.

Beside KSA models of work profiles of employees, other possible forms of competence representations are possible, such as the ISFOL – ISTAT standards, which enrich the possible descriptions obtained by simples KSAs. Hence, a possible analysis within public administrations starts considering possible profiles according to the ISFOL – ISTAT standards based on KSAs, with consequent identification of ideal work profiles, which have to be compared with the real ones owned by the employees in a next phase of skill gap analysis.

To achieve this aim, the starting idea is to study a whole business plan, which consists of an organogram, a function flow chart, Job Descriptions and Job Specifications. The focus is on Job Specifications, with consequent analysis of Job Descriptions characteristics. In real contexts of public administrations, four macro – scenarios are possible and only one of them occurs. In particular, such situations are as follows.

Situation 1: *Job Specifications follow a structural and formal approach, according to ISTAT – ISFOL standards*. This case is the most suitable for a correct problem solving and represents the solution to which public administrations tend to converge nowadays. The representation of this type of knowledge is achievable with a high degree of accuracy via Knowledge Extraction techniques, based on vocabularies and ontologies.

Situation 2: *A non – structured and informal approach, based on ISFOL – ISTAT criteria, describes the Job Specifications*. In this situation, a generic Job Specification obeys ISFOL – ISTAT standards, but some difficulties of representation arise. Knowledge Extraction techniques are useful to reconstruct this type of Knowledge with a sufficient degree of accuracy. Indeed, such methodologies are more difficult than the ones described in Situation 1, as the description is informal, namely: vocabularies and ontologies are not always adequate for problem solving and further integration techniques involving Knowledge Management are often required.

Situation 3: *Job Specifications follow a structural and/or semi-structured, formal and/or informal approach, according a non – ISTAT – ISFOL standard*. In this case, Job Specifications refer to a standard, that is different from the one used by the system.

Obvious difficulties occur if documents are not structured and not formalized. The difference among the various standards usually considers unusual vocabularies and different Skills and Attitudes. Such a situation is still workable – as it refers to a standard – if correspondences and rules with the ISTAT – ISFOL representation are found. The Knowledge representation foresees a preliminary analysis and matching step (of automatic, semi – automatic and manual type) to establish rules to translate the non – ISTAT – ISFOL standard.

Situation 4: *A non – structured, informal and non – standard approach describes the Job Specifications*. In this last case, Job Specifications do not follow structures and standards, leading to the impossibility of a correct Knowledge representation.

A data flow diagram, which represents the situation 3, is in Fig. 1.

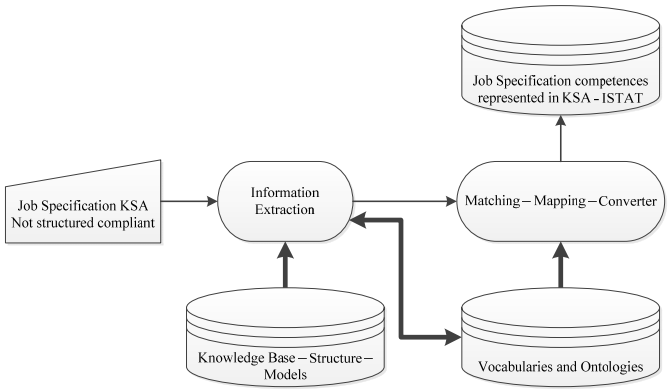

Fig. 1. Complex data flow diagram for the representation processes of situation 3

From previous considerations and, in particular, for the most usual case (represented by situation 2), the possible steps, useful for a support process for a DSS design, are the following:

- *Analysis of organograms of public administrations and Job Descriptions of each employee*. This initial phase is useful to construct all characteristics of roles for each worker.
- *Construction of a KSA model for each Jop Description*.
- *Integration of KSAs with other data*. In this step, some contingent constraints are evaluated and used to create an enhancement of the basic KSA models. As for the integration information, work styles/conditions and behavioural attitudes are also considered.
- *Analysis of public administrations employees curricula vitae and their matching with KSAs*. The curriculum vitae of each employee is reduced to a competence profile in KSA using a parser, realized at the University of Salerno. Such a tool has a vocabulary, which is identical to the one used by ISFOL for the description of the professional units. Moreover, beside the ordinary ISFOL terms, a further integration of the vocabulary allows the descriptions of additive knowledge and professional experiences. The

importance of this procedure is the possibility of defining KSAs of employees with the same characteristics of ISFOL – ISTAT standards.

- *Skill gap analysis between competences of real employees and the ones of ideal employees.* This phase represents the core of the whole proposed approach. Indeed, KSAs of real employees are used to create a match with the ideal profiles described by KSAs obtained in step four. These results are useful to show if real employees are the most suitable ones for the performed roles inside public administrations.
- *Definition of DSS rules for work roles and employees.* In this final step some decision criteria are constructed for the correct management of the logistic flows inside public administrations. Notice that, for a specific public administration, DSS rules are obviously strictly dependent either on the characteristics of the business plan or on the analysed work profiles.

In what follows, Fig. 2 shows a first architectural view of the DSS.

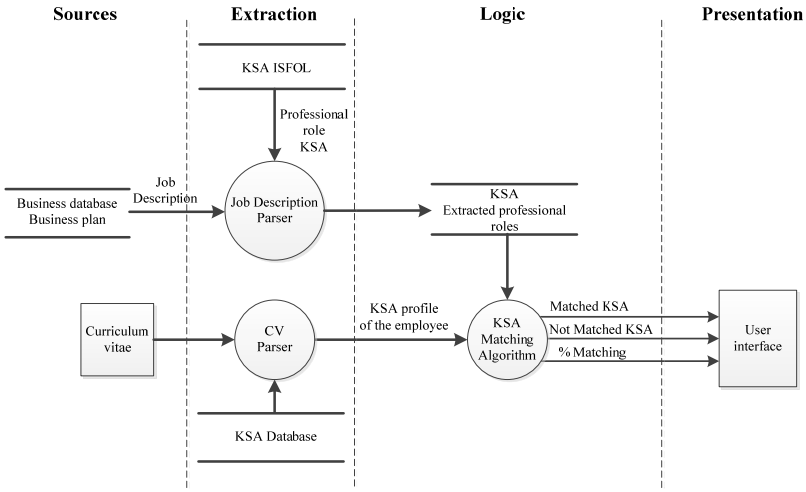

Fig. 2. An architectural view of the DSS

3 Case study of a real office in an Italian region

The described approach was analyzed to study the dynamics of a real office, precisely a General and Legal Affairs Office of a Technical – Administrative Department of the Health Service in an Italian region. Notice that the following example, tested on real employees, who belong to a real office in a public administration, shows how the characteristics of employees are not always suitable for their work roles.

The structure organogram (of public domain) is in Fig. 3 where, in particular, the following roles have been analysed: administration manager, administration secretary and legal expert.

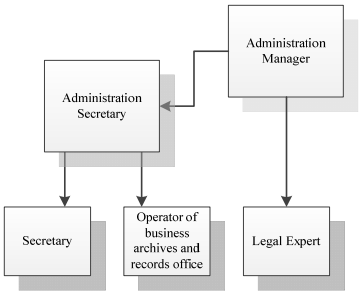

Fig. 3. Organogram of the case study

Beside the organogram, Job Descriptions, which describe roles, tasks and essential qualifications, are considered. Essential qualifications arise from either business characteristics or law articles, in terms of rules and constraints for the employees roles.

From Job Descriptions, suitable KSAs have been obtained and, via associations, an enhancement was obtained in order to define the ideal KSA profile of each work role.

Precisely, the ideal KSA consists of categories Knowledge, Skills and Attitudes, which define the preliminary KSA of Job Descriptions. The integration of KSAs with ISFOL – ISTAT standards is useful to map terms of type Knowledge, Skills and Attitudes into ISFOL vocabularies. The second integration of KSAs with personal data/information allows to: divide terms of type Knowledge into ISFOL ones (briefly indicated by ISFOL K in what follows) and Essential Knowledge constraints; add categories Qualifications and Necessary experiences.

The structure of ideal KSAs is very complicated and is difficult to represent completely but, for a better comprehension, an extract of the ideal KSA for the administration manager role is presented in Fig. 4.

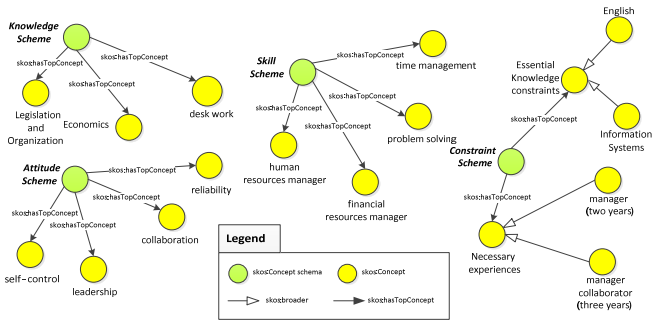

Fig. 4. A portion of the ideal KSA for the administration manager role

As already mentioned in Section 2, the implementation is made via Lightweight Ontologies, written in SKOS language. The representation of the ideal KSA consists of 58 concepts, divided into categories and subcategories, which correspond, respectively, to different skos: Concept schema and skos: Concept.

As for the extract of the ideal KSA in Fig. 4, categories and subcategories are the following:

- *Knowledge*: Legislation and Organization, Economics, desk work.
- *Skills*: human resources manager, financial resources manager, problem solving, time management.
- *Attitudes*: self – control, leadership, collaboration, reliability.
- *Qualifications*: degree in Law, Master in Organization of public administrations.
- *Constraints*, in terms of:
    - *Essential Knowledge ones*: English, Information Systems.
    - *Necessary experiences*: two years as a manager in public administrations, three years as a manager collaborator in public administrations.

For the construction of real KSA profiles, curricula vitae (of public domain) of real employees have been considered. A parser was necessary in order to recognise the needed information through Knowledge Extraction techniques. The used parser was able to identify the vocabularies of curricula vitae and associate them (via similarities, correlations and associations) to the categories of the ideal KSAs (Knowledge, Skills, Attitudes, Qualification, Essential Knowledge constraints and Necessary experiences). Such a system was realized within research projects by a spin off of the University of Salerno and, at this moment, there is a reliability of 70%.

After all real KSAs have been obtained, the skill gap analysis was made using an Access Database for the comparison of real and ideal profiles of each work role. The results are in Table 1 where, for simplicity, the various work positions (administration manager, administration secretary and legal expert) are indicated, respectively, by the acronyms AM, AS and LE. Moreover, for a better comprehension, colums for the required competences and gaps are in gray with respect to the ones for the owned competences and suitability percentages.

Table 1. Results of the skill gap analysis for the different profiles

Competences	**Required ones**			**Owned ones**			**Gaps**			**Suitability (%)**		
Position	AM	AS	LE	AM	AS	LE	AM	AS	LE	AM	AS	LE
Knowledge	12	12	7	8	6	5	4	6	2	66.7	50	71.4
ISFOL K	8	8	5	6	4	3	2	4	2	75	50	60
Essential Knowledge constraints	4	4	2	2	2	2	2	2	0	50	50	100
Skills	16	15	13	9	10	8	7	5	5	56.3	66.7	61.5
Attitudes	22	20	22	15	16	16	7	4	6	68.2	80	72.7
Qualifications	2	1	2	1	0	2	1	1	0	50	0	100
Necessary experiences	2	1	1	1	1	1	1	0	0	50	100	100
ISFOL KSA	46	43	40	30	30	27	16	13	13	65.2	69.7	67.5
Integration	8	6	5	4	3	5	4	3	0	50	50	100
Total	54	49	45	34	33	32	20	16	13	63	67.3	71.1

Notice that competences for a work profile are of the following types: required (column 2) and owned (column 3). The difference between required competences and owned ones gives the competence gap (column 4), while column 5 reports the suitability percentages for each work profile. Indeed, for each work role, required competences represent the ideal KSA, while owned ones the real KSA.

Results of Table 1 are interpreted as follows. For the administration manager, the ideal KSA indicates the following competences: 12 of Knowledge type, divided into ISFOL K (8) and Essential Knowledge constraints (4); 16 of category Skills, 22 of type Attitudes, 2 of category Qualifications and 2 of type Necessary experience. The preliminary KSA, enriched by the ISFOL – ISTAT descriptions, contains 46 competences (ISFOL K + Skills + Attitudes), see row ISFOL KSA. Personal data/information contains 8 competences (Essential Knowledge constraints + Qualifications + Necessary experiences), see row Integration. Hence, for the position of administration manager, the ideal KSA consists of 54 competences, see row Total. Indeed, the real KSA indicates that the employee in the administration manager role has only 34 competences, with a consequent gap equal to 20, namely: the administration manager employee performs his role with a 63% suitability. These results are also indicated in Fig. 5.

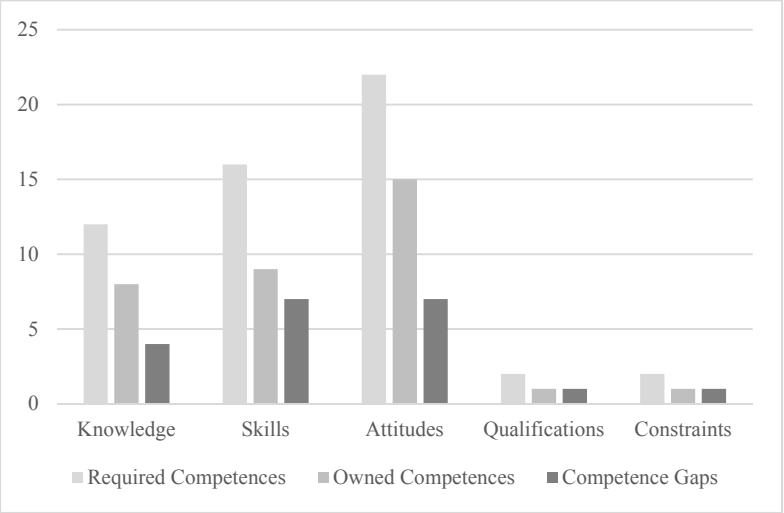

Fig. 5. Histogram of results for the administration manager role

For administration secretary and legal expert roles, the situation is the following: competence gaps for the administration secretary and the legal expert are, respectively, 16/49 and 13/45, with 67.3% and 71.1% suitability. The obtained results are further summarized in Table 2 for each work position, as for Required compentences, Owned competences, Competence gaps and ISFOL KSA, Integration and Total suitability percentages.

Table 2. Short scheme of skill gap analysis results

	Administration manager	Administration secretary	Legal expert
Required competences	54	49	45
Owned competences	34	33	32
Competence gaps	20	16	13
ISFOL KSA suitability percentages	65.2 %	69.7 %	67.5%
Integration suitability percentages	50 %	50 %	100 %
Total suitability percentages	63 %	67.3 %	71.1

The proposed approach appears to be promising, as the discussed results are due to accurate automatic processes, which have not elements of subjectivity in evaluations, unlike the human case. Indeed, a first reliability of results have been also proved by consultation of five experts (E1, E2, E3, E4 and E5). Such experts, unaware of the skill gap analysis, have analysed the curricula vitae and Job Descriptions of the three professional roles described before. Their opinions are in Table 3.

Table 3. Opinions of experts about the three considered work roles

Position	E1	E2	E3	E4	E5
Administration manager	Low	Low	Sufficient	Low	Sufficient
Administration secretary	Good	Sufficient	Sufficient	Sufficient	Low
Legal expert	Good	Sufficient	High	Good	Good

Opinions of experts have an optimal correspondence with the skill gap analysis results. Indeed, also according to their point of view, the less corresponding profile is the administration manager one.

4 Conclusions

In this paper, it was defined an automatic/semi – automatic process for a Knowledge – based DSS design, in order to establish the correctness of Human Resource Management within public administrations, with a particular focus on a General and Legal Affairs Office of a Technical – Administrative Department of the Health Service in an Italian region.

A DSS prototype, whose an architectural view was considered, was designed and realized. The DSS results have been compared with the ones achieved by a team of experts, and appear to be comforting.

In the next future the research activities will focus on: the possibility to increase the parser reliability; the analysis of wider sets of employees and more experiments; the definition of opportune bounds to express judgements about the employees suitability in the roles they perform inside public administrations.

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Knowledge Demand Specification for KMS Decision Support

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Abstract. For implementing a suiting KMS (Knowledge Management System) solution for SME, the demands with regard to knowledge and the specific systemic support should be clarified. Since information in general is the starting point for defining knowledge, the question arises how knowledge and information demand are interrelated. In addition: can this be used for the determination of the according knowledge demand. This paper presents our findings on the usage of the knowledge demand gained within the creation of a framework for value-oriented decision support for KMS for SME.

Keywords: Knowledge Demand, Knowledge Management System, Information Demand, Observation

1 Motivation

Knowledge and information management as such are disciplines accepted within the research community. This includes the acceptance of the fact, that the fields are interlinked and dependent on one another. This is usually reflected using definitions of knowledge being based on information, however needing more context or linkage than information [7], [3]. Taking these assumptions to the level of demand analysis, the question arises whether "building knowledge upon information" holds as well for the knowledge demand analysis. The knowledge demand is supposed to deliver the basis for a decision on contents and systems to be applied within the range of knowledge management in organizations. This work is to present the prerequisites in terms of a knowledge demand for recommending a KMS in a problem and value oriented manner enhancing the framework described in our former work [15], [16]. The focus of this paper for this reason is not to generate a generally valid model on the differences between the information and knowledge demand, but to support the determination of knowledge services [6] which are to support knowledge work within the organization utilizing the knowledge demand. The emphasis consequently lies on the clear distinction between the terms of information and knowledge, instead of focusing the demand towards a new system as such. Nevertheless literature does not provide approaches for the knowledge demand as equally and methodical as they exist for the information demand, e.g. [5].

As for the issue whether to speak of demand or need for knowledge, we solve this problem for our work by considering knowledge demand and need equal terms describing the same goal and remain with the term of demand, since no final clarification can be found in literature. Since the knowledge demand has not been as equally explored as the information demand, yet the concepts of information and knowledge are depending on one another we chose the information demand as a starting point to provide us with answers on the following research questions:

1) How do the demands for knowledge and information differ?
2) How can observations be used in determining the knowledge demand for knowledge service recommendation?
3) How should the consequent demand be integrated within the framework for decision upon KMS Support?

The results and the methodology to gain answers to these questions are described in the following. Section 2 presents the starting point of our work, the information demand and the framework for KMS recommendation. Section 3 describes the conducted observations and their results. Following section 4 shows the integration of the knowledge demand into our framework and finally section 5 presents the conclusions of this paper.

2 Fundamentals

2.1 Information Demand

The general definition on the term of information demand provided by Picot [11] denotes that information demand describes the kind, amount and quality of information persons need for the fulfillment of their tasks within a certain period of time. Moreover, entering the field of information demand from the perspective of information logistics Lundqvist, [5] says that information demand is the constantly changing demand for relevant, up to date, reliable and integrated information, that supports (business) activities, whenever and wherever information is needed.
Putting this into practice results into the method of information demand analysis (IDA) [5] which takes the perspective of focusing on the roles with their tasks and responsibilities. The method itself consists of modeling activities, which strongly depend upon a participatory modeling, involving the individuals being modeled in their roles. This modeling approach uses a number of reference questions to be answered within the process to be able to extract the context of the information demand holding characteristics like: task, responsibility, role, information object and resources necessary.

2.2 A Framework for value-oriented recommendation of KMS for SME

Having by our own research [15] identified a problem arising for SME, namely the missing value-orientation in KMS support, the next step was to address this problem. Here the initial design of a framework addressing the problem of a missing value-orientation and guideline for KMS recommendation for SME is shown. The

framework was build using existing approached known from literature and combining them as e.g. suggested by Design Science research \cite{hevner}, when demanding a thorough use of the existing knowledge base.
The theoretical foundation for this work focusing on value orientation beside the monetary representation is presented by the use of the KMS Success model [4]. Since the concrete operationalization of the model is left open by the authors of the model, missing standardized adoptions lack support the exchange and comparison of precise experiences between individual enterprises as it might be of interest for SME. Nevertheless, the mere operationalization of the KMS success model as described in [4] is not sufficient for the use in SME, since it only shows what can be done after the choice for an implementation. This choice asks for methodological support as well, since even Maier [6] admits, that his architecture is an idealistic holistic construct and therefore demands adaptation. Yet his architecture offers the concept of knowledge services to be implemented for the systemic KM support. Considering these two components as the theoretical settled foundation of the technical perspective, a combination of these into service oriented technical support focused around the value to be offered was the initial starting point of our framework, as shown in Fig. 1.

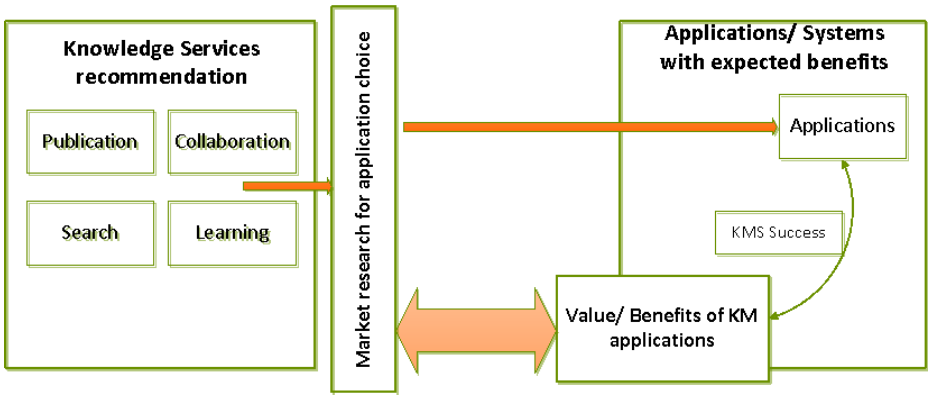

Fig. 1: The initial Framework for value-oriented decision support on KMS for SME

Consequently the recommendation is given on the knowledge service to be implemented by the SME, being implemented towards the value dimensions of the KMS Success model. Referring to models known from the field of CSCW (Computer Supported Cooperated Work), as e.g. the 3C model for groupware classification [14] and considering the validity of the framework as a possible reference we decided on a recommendation of application classes instead of concrete applications. This leaves the individual market research to the SME, yet allows also for further adaptation due to e.g. resources available within the SME. The recommendation on one knowledge service is also not supposed to neglect the other ones but provides the SME with an idea on what to focus first since it has the strongest demand. However, the idea of combining these theoretical components seemed reasonable from what they have to offer. To prove the value of the designed framework an evaluation as it is done for artifacts from Design science [10] is necessary. Doing this with the help of case studies it was revealed [17], that the framework in this state starts too late by directly

addressing the knowledge services to be supplied, and more context for the recommendation, the knowledge demand is needed.

3 Approaching the knowledge demand

3.1 Knowledge demand in the context of our work

Fig. 2 illustrates our general train of thought on approaching the knowledge demand, starting from the point of information demand. In the figure the starting point of the information demand is located on the lower left side. This demand is influenced by knowledge objectives as introduced by [9] as the starting point of his model "building blocks of knowledge management". The information to be delivered is influenced, since the objectives determine the orientation to which knowledge is to be developed and the according information has to be provided. Moreover, these goals are supposed to lead to actions and therewith have an action reference. Even the action reference itself determines a certain information demand, due to the context it creates which has to be reflected within the processes invoking information demand.

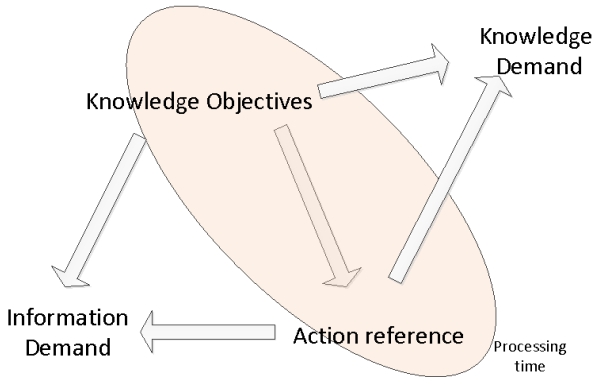

Fig. 2: Relation of information and knowledge demand

Hence when does the knowledge demand arise? The most significant issue for its occurrence from our point of view is the processing time, the time when the actual process or action takes place. During process time information is processed and demands certain actions and decisions to be performed. These however depend on the knowledge of the processor and consequently can invoke a knowledge demand, which certainly differs from the mere information demand of for fulfilling a task within the process.
When looking at the details of the information demand and the accompanying information demand analysis, the focus on the organizational perspective with its tasks, roles and processes can be seen for which the fulfillment should be guaranteed. Yet knowledge demand is more general focusing on the person in its current state of knowing, whereas the information demand reflects the demand mostly depending on

the role the person fulfills [5]. The knowledge demands in contrast focuses on that person, especially when aiming for a KMS support which is to be perceived as valuable by that user of a potential system. The aforementioned characteristics of the information demand will therefore not suffice, since they do not hold information on the individual, its skill set and the recent point in time, where the knowledge is to be applied. Consequently, for our purpose an extension of the concept is necessary to capture the knowledge demand.

3.2 Observing the knowledge demand

Considering the knowledge demand not being derived from the information demand, we had to consider how it can be approached, which lead to the question whether it can be observed. To address this we used the social empirical method of observations [13]. The object of the observations were knowledge intensive processes (KIP) to gather information on the knowledge searched for and used within such processes. Within this part of our research we focus on determining the components of knowledge in use as suggested by the acting competency model by [1].

Planning the observations we decided on conducting an open, non-participating, semi-structured observation. To retrieve useful results the observation should be conducted accompanied by an observation system holding signs, scales and/or categories [13]. Practically categories or mixtures are most common, yet all mark the setting of predefined events to be expected under observation. These have to be settled ahead of the observations either rationally by determining assumptions to be proved or empirically from conducting free observations. Though two preliminary observations were conducted we decided to go with the rational approach starting with assumptions to be proved. The decision was necessary due to the manifold details of knowledge work, which made it difficult to retain comparable data in a free observation. In general, an observation is always expected to be subjective, meaning that the interesting events are only an extract of the whole process taking place and the according documentations focus on the extracts only. Furthermore, we decided against a laboratory setting for the observation for once, since this would demand standardized KIP which is a contradiction in itself, KIP being described as highly non standardized, individual processes [12]. Moreover this would shift the focus to the knowledge needed in this single process, yet for us to see the general observability a more general focus was desirable.

Observation categories. To fulfill the approach using rationally identified observation categories [13], we made several assumptions to be proved with our work, which provided us with restriction criteria under observation.

1. KIP can hardly be worked through at once due to their length and their individual structures, as well as the structures of the working environment. The resulting criteria in use are: number of interruptions, length of the observation.
2. Knowledge demand is dependent on the skill set of the actor. Assuming that once acquired knowledge can be reused it has not to be demanded

repeatedly. Consequently, experience level and education of the observed are influencing the knowledge demand.

3. The operative knowledge demand occurs less often than the operative information demand. As mentioned before knowledge is internalized [8] whereas information changes frequently so updates occur more often. To reflect this we chose the category of used information and knowledge objects with their number of occurrences. This category also serves as an indicator for our next assumption.
4. Knowledge work relies on processing information into knowledge, however not all information is processed into knowledge.
5. Knowledge work depends on social interaction, determining the sources to fulfill the knowledge demand. This can be split into two parts: the demand for knowledge from other persons and the work of other persons within the process to fulfill a task. This assumption aims at the sources used to satisfy the knowledge demand. We therefore observed the applications in use by application classes (Mail clients, ERP systems, databases, text processing applications etc.) as well as whether the observed asked others for help (written or orally) and used internal or external knowledge objects.
6. KIP include regular application of different acting competencies resulting in demands for social competencies, personal competencies, method competencies, professional skills; as such the professional level determines the knowledge demand. Competencies can be considered internalized knowledge the worker is willing to apply for solving the task ahead [1] and consequently indicate the knowledge in use. The differentiation in the competencies is derived from the acting competency model by [1], where the competencies in combination build up the so called acting competency, allowing to perform the process task.

These assumptions show our way of determining the observation criteria to be able to restrict the different observations.

Results of the Conducted Observation. Though observation series are supposed to cover numerous processes we conducted only an overall of 12 due to the length of the observation and the availability of the observable processes. The following table **Table 1** provides an overview of these with a short description and the experience level of their processors.

Table 1. Observed Processes.

No.	Process Description	Length (min)	Processor Qualification
1	Programming deadline assignments	100	Apprentice (1st year)
2	Customer process: planning programming and requirements specification	105	CEO, University Diploma

3	Programming statistics public assistance benefits	60	Senior Software Developer
4	Questionnaire development on user behavior	40	Master Student "Business Information Systems"
5	Process optimization exam organization	90	Diploma "Business Administration", 5 years experience, 1 year on the job
6	Bash Script development for automated log analysis	90	Master "Information Technology" 0.5 years on the job
7	Self-Observation – preparation of seminar paper	120	Master Student "Business Information Systems"
8	Self-Observation – Generating Project documentation	60	Master Student "Business Information Systems", 1 year on the job
9	IT Administration for science institution	120	Master Student "Business Information Systems", 2 years on the job
10	Mirroring databases (new scheme)	60	Master "Information Technology" 0.5 years on the job
11	Allocating financial resources (university)	120	Master "Business Administration", 1 year on the job
12	Exam Organization	120	24 years in the job with according diploma

In general it can be seen that the observations took different amounts of time varying from 40 to 120 minutes, showing already first indications on the length of the KIP observed. In general always two persons observed one KIP with the help of the criteria described above. Consequently the results were compared and triangulated for the individual processes.

Interruption frequency: Overall we recorded 21 interruptions within the processes and in addition one process that needed several days for accomplishment though not being interrupted during observation. The interruptions can be classified into two categories: occurrences in the working environment and process related interruptions. The working environment settles for coffee breaks, meetings and colleagues entering with questions or problems. Two thirds of the observed interruptions were related to that kind. The process related interruptions included waiting for legwork, asking colleagues for help or opinions or waiting for the right information to be entered into the working system. Eventually (once) the process was interrupted due to the fact, that another KIP could be continued, which had a higher priority. However, we also observed processes to be finished, nevertheless we assume our assumption right that a straight workthrough is hardly to be accomplished.
Operative demands: With regard to the amounts of information and knowledge objects we observed the use of 25 knowledge objects and 38 information objects. The mere amounts of the objects therewith confirm our assumption. In addition we found more processes using a high number of information objects whereas the number of knowledge objects used usually is low. Yet the identification of knowledge objects

had to be done by the observer and eventually lead to asking for more details than could be observed.
Processing knowledge from information: the objects do not directly reflect how much of the information is processed into knowledge. This cannot be estimated from the outside. Furthermore, it is hardly possible to see already internalized knowledge applied to the tasks. The assumption can therefore not be supported.
Sources to satisfy knowledge demand: For the technical support: the observation showed the use of various application programs to be used for the accomplishment of the processes. 10 times word processing applications were used, 6 times email clients, also 6 observed the use of messenger systems, whereas in 7 cases a database was used and only 4 cases indicated intranet resource use. Moreover, several general editors, development environments and browser were used during observation time.
With regard to the use of knowledge elements in form of knowledge requested from colleagues or found in documents 93 occurrences were observed. 24 times the observed asked a colleague for help (16 oral, 8 written requests) the remaining 69 times knowledge elements were searched electronically. One third of the elements were located internally (21) whereas the other (48) where retrieved from the Internet. Anyhow, this observation missed the verification whether knowledge or information elements were used. Yet it shows that a partial demand is satisfied through social contacts. How often the process was depending on the input from other persons remained remains unclear due to the short time of the observation and the working interruptions though in processes 6,10,11,12 such interdependencies were found. In process 5 even the wish for someone to interact with was uttered. This assumption provided us with a concrete idea on what to integrate to satisfy knowledge demands nonetheless, which provides real linkage point for a KMS.
Different competencies in action: the overall amount of competency applications observed was 133. Of those 52 were professional skills, personal competencies were 6, social competencies 17 and 58 occurrences were method competencies. Accordingly the professional skills and method competencies sum up to over 80 %. These have to be supported as contents in the knowledge services, whereas the other request for special addressing by e.g. a KMS support.

Summary. Considering the suitability of observations for the determination of the knowledge demand we found that they provide us with a good impression of what is currently used to satisfy the knowledge demands. General habits on IS use can be recorded as well as the communication channels, which is of special interest for the integration in our framework.
Going back to our assumptions we see a tendency of confirmation for number 1, partly for number 4 and 6. For assumptions 2, 3 and 5 we cannot neglect the assumption due to the observation results. The whole observation lacks differentiation between information and knowledge since this can hardly be estimated by the observer, but must be requested from the processor. Accordingly, the observation type should be accompanied by the thinking aloud method. This partially was done by asking the processors on what they wanted to accomplish by using certain objects. In summary we could see that the knowledge demand differs from the information demand but are not able to name every difference in detail. Having a further look at

the methodology, several shortcomings could be found. The observation series cannot claim to be complete, due to its low overall observation objects.
Considering the above mentioned definition of information demand the question arises whether the knowledge demand behaves in a similar way. Lundqvist [5] e.g. says that information demand is constantly changing, however does the knowledge demand do as well? From the first observations made, it already became clear, that knowledge in the process primarily is the knowledge needed to find and process the information necessary to fulfill the process. Accordingly the knowledge demand from that regard changes with the process and the required skills. Consequently, the frequency of demanding new knowledge is lower than the one asking for new information. This however could not be proven completely with this observation series. It would demand an observation on the same process with various as well as the same processors for several times, which can hardly be done in a free setting as was chosen here but demands a laboratory setting.

4 Integrating the demand in the framework

With this section we provide our answer on the third research questions, showing the integration into our existing work. The work presented in this paper is part of our research on the evaluation of KMS systems with the help of the IS Success model [2] or its adaption in the KMS Success according to Jennex/Olfman [4]. The overall goal of that research is the establishment of a methodological approach to the decision making upon value-oriented KMS for SME. Anyway to be able to provide such approach, these models for the evaluation of the success of IS/KMS Systems needed adoption and further extension within their categories.
As a basis of our work, introduced in section 2.2 we extended the outlined framework from [15], [16] with the component of the knowledge demand to be able to provide a problem as well as value oriented recommendation and methodology to gain a decision on which KMS or KM application to use. Based on the knowledge demands as determined here we want to recommend suiting KMS services. The indications from the knowledge demand side certainly allow for some recommendation, when taken as a gap analysis. What is critical is the differentiation to be done between knowledge and information, which partly can be achieved within an observation but needs more interaction with the persons e.g. an interview or a questionnaire.

Assuming the knowledge demand as an essential for the decision on the KMS support, our current approach focuses on the individual knowledge demand to be observed since this focuses on the information systems in use and the shortcoming in the process of gathering knowledge, which can be retrieved by an observation of the usage of IS systems. An organizational knowledge demand determined from the processes and the tasks to be fulfilled certainly allows for conclusions on the contents to be provided for the fulfillment of the process. Our research work bases its recommendation of KMS on application classes for knowledge services as introduced by [6]. The use of these knowledge services within the architecture of a KMS has to be accomplished by the individuals; accordingly their needs define the knowledge demand in question. These partially can be determined with the help of observations

as shown here, since the use of technical and social support could be shown in the observations. Yet the organizational setting of the knowledge demand should not be forgotten, since the organization determines the working context of strategy, tasks and processes to be accomplished. Consequently, the integration in our framework can be depicted as shown in
Fig. **3**.

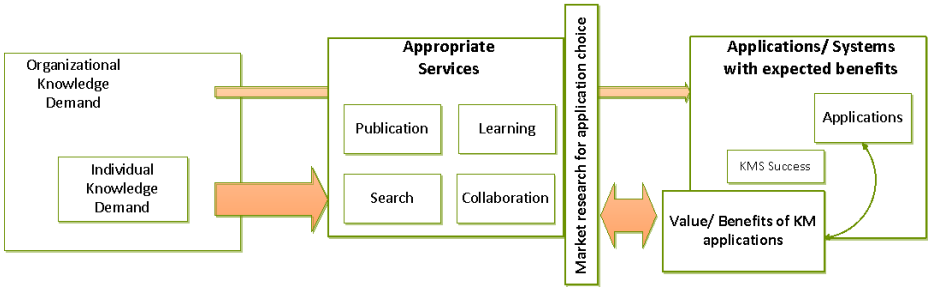

Fig. 3 The extended framework for value-oriented decision support for KMS in SME

As for the determination of the knowledge demand which is essential for the operationalization of the framework into a method, we can state with the work presented here, that this on the individual level can be done by a mixture of questioning and observing the individual employees. A mere observation should not be sufficient; since many aspects of the individual work are to be questioned by the observer, since the thinking and learning processes of the individual are not self-explaining. Nevertheless it should be kept in mind, that observations are very time consuming and with regard to standardization a questionnaire, for instance on the application use can provide equal results in shorter times. Furthermore a matching from criteria to be observed to knowledge services is needed, as illustrated in table Table 2. Taking for example the lookup frequency externally it can be stated that this motivates building up an internal knowledge base. The competency type observed however allows for recommendation on the support of collaboration (in case of high social competency requests), as does the frequency of contacts to others, may it be coworkers or customers. Interesting in this part was also the remark on the wish for someone to talk to about the work within the observations. This wish indicates a strong wish for more collaboration. These comments certainly should be taken into consideration in the decision making on the knowledge services to be supported.

Table 2. Observation criteria to services.

Knowledge service	Observation criteria
Publication	search for external documents, keeping own knowledge documents, contents requested, high amount of local storage
Search	long search times, missing links between documents, questions to colleagues on where to find things
Collaboration	communication with colleagues, use of shared documents, collaboration applications with colleagues and customers
Communication	communication with colleagues and customers, use of

	communication applications
Learning	use of e-learning, skill development within the processes, frequency of processes (e-learning as refresher)

Regarding our research work another refinement in the interpretation of knowledge demand could be made. By focusing on the technical support by KMS for the employees, the knowledge demand we are asking for is primarily the demand on knowledge services. Consequently we are able for now to neglect the concrete determination of a knowledge demand but are focusing on the demand for knowledge services on the individual layer and the organizational knowledge demand described within the processes and knowledge management strategy for the decision support we want to establish with our framework.

5 Conclusion and further Work

Beginning with reflection of the information demand versus the knowledge demand we were able to show our argumentation on the differences between the two. The argumentation alone however cannot hold for all fields concerned with knowledge and information demand, yet provides a point to start for the integration in our research work on value-oriented KMS for SME, especially showing the focus of the knowledge demand on the individual as such, whereas the information demand centers around individuals as roles.
We furthermore were able to show how observations on the knowledge demands could be conducted, showing also the disadvantages of the method for the highly personalized field in general demanding for explanation by the observed. Nevertheless we were able to identify certain criteria of use for the determination of the knowledge demand within our framework. Considering these criteria useful for the recommendation on the knowledge service the question arises, when they are to be observed and how large the sample of observations needs to be. This is worth a thought due to the fact, that observations are a rather long lasting procedure and observing all processes within an enterprise will hardly be possible. As mentioned before it is easier to recheck them or gain an impression on the actual use of applications and habits gained from a questionnaire beforehand. Moreover for the knowledge demand to be considered for our recommendation a look at the personnel development from the viewpoint of skill development might be useful to be able to put forward the right contents, e.g. as a push system. This would also be based on the architecture of a centralized KMS as suggested by Maier [6], filling the personalization layer as well as the publication contents to be provided.
Combining these thoughts and the conducted observations an analysis set for the knowledge demand can be outlined consisting of several method supports:

- process analysis
- personnel development
- questionnaires
- observations

Using all of them should provide a profound impression on what is needed, but on the other hand causes a lot of effort. Consequently a selection would be recommendable.

Therefore another discussion could be helpful, always concentrating on the goal to provide suiting KM services, namely the effect of individual knowledge demand and organizational one. With regard to the contents to be provided both of them are needed, however for the mere knowledge service recommendation the individual one weighs more since it determines the channels used for the satisfaction of the demand. It shows the gaps in supporting systems and provides a stronger indication for the according knowledge services. The according conclusion for the observation conducted here, is that it provided some valuable insight in the knowledge demand and left us with the question on a general difference between information and knowledge demand, though indications could be collected. The actual integration of these two concepts into our framework was shown in section 2.2, clarifying, that the knowledge demand needed for such a recommendation can be narrowed down to a demand on knowledge service support.
With regard to further work to be conducted we are now facing the effort of transferring the framework into a method applicable for SME. Furthermore a validation of the framework in practical application is necessary to prove validity of the theoretically constructed artifact of our research work.

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