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Documentation of Flexible Business Processes – a Healthcare Case Study

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ABSTRACT

In many industries, such as manufacturing and logistics, semi-formal process models have become a common means to reason and communicate about business processes. However, in a dynamic and flexible environment the suitability of semi-formal process models as an instrument of process documentation may be challenged. Hospital processes are typical examples of business processes that are characterized by both the existence of well-defined procedures and the need for operational flexibility. This research investigates the current practice of process documentation in healthcare by means of a case study in a German hospital. We aim at getting an understanding of how flexible processes may be documented to give medical staff effective guidance and how this documentation has to be managed in order to provide value in everyday routine. On the basis of our findings we give suggestions on how to effectively implement process documentations in similar settings.

Keywords

Business process management, process documentation, flexible processes, healthcare

INTRODUCTION

At the end of the 1980s it became apparent that an organization based on the principles of division and specialization of labor would eventually lead to a local optimization of resources combined with significant coordination costs. It turned out that often "[…] the efficiency of a company's parts comes at the expense of the efficiency of its whole" (Hammer and Champy, 1993). The works of Davenport (1993), Hammer and Champy (1993), Scheer (1994), and others have prepared the ground to address this problem. As a result, business processes have been discovered as vehicles to gain a holistic view of an organization and to optimize its efficiency.

The documentation of business processes forms the foundation to analyze, design, and communicate about business processes. To document a business process helps to create clarity about its structure, inputs, outputs, resources, roles, dependencies, and goals. In many industries, such as manufacturing and logistics, business process models – semi-formal, mostly graphical representations of business processes – have been established as a common means to reason about business processes. These diagrams adhere to defined grammars and rules and document the logical sequence of activities, the resulting products and services, the required resources and information, as well as the involved organizational units of a business process in a formal or semi-formal manner (Lindsay, Downs and Lunn, 2003). While the modeling approach works well in environments with high predictability and repetitiveness, there are many dynamic environments, where it is not feasible to formally model a complete process in all its variants including all possible paths and exceptions (Sadiq, Sadiq and Orlowska, 2001).

Recent years have seen a number of studies concerned with flexibility within business processes. Approaches such as workflow evolution (Casati, Ceri, Pernici and Pozzi, 1998), exception handling (Russell, van der Aalst and ter Hofstede, 2006), declarative workflow techniques (van der Aalst and Pesic, 2006), case handling (van der Aalst, Weske and Grunbauer, 2005), pockets of flexibility (Sadiq, Orlowskaa and Sadiq, 2005), and ad-hoc workflows (Han and Shim, 2000) advance different aspects and shades of flexibility within business processes. However, this research has been carried out by scholars who focus on implementation and automation of business processes through workflow systems. Although many of these

approaches also address aspects of representation of business processes, their focus is clearly on technical issues. The consideration of flexibility within real world (i.e. not IT-supported) processes plays a minor role. Furthermore, the proposed representation approaches are not meant for a human audience, which uses documentation to gain an understanding of a business process and its environment.

Thus, the purpose of our research is to explore how flexible business processes can be documented effectively (i.e. complete and correct) and efficiently (i.e. economical in terms of time and costs) for the purpose of informing human beings. In this context, we define flexible business processes as business processes which cannot be specified completely at the time of their definition and might vary from execution to execution, e.g. in terms of the set and sequence of activities carried out (Sadiq et al., 2001). Our understanding of documentation in this study comprises both the representation of a single business process as well as the management of a collection of business process descriptions covering the complete process landscape of an organization. Possible means of process representation range from mere textual descriptions to formal process specifications and may also include video or audio formats.

From this research objective two research questions can be derived:

(RQ1)   How can flexible business processes in dynamic environments be described?

(RQ2)   How can descriptions of flexible business process in dynamic environments be managed?

The primary goal at our early stage of research is to establish a general understanding of the phenomenon of flexible business processes and to identify problem areas as well as first possible solutions regarding their documentation. As an exemplary domain we chose the healthcare sector since it is a domain where flexible business processes are predominant (Quaglini, Stefanelli, Lanzola, Caporusso and Panzarasa, 2001; van der Aalst et al., 2005). Since the phenomenon in focus (flexible business processes) is complex and tightly interwoven with its context (dynamic environments) we chose the case study methodology as a means for an in-depth investigation (Benbasat, Goldstein and Mead, 1987; Dubé and Paré, 2003). This study is meant to fuel our research by constituting an initial comprehension of how practice handles the documentation of flexible processes.

We proceed as follows: First, we give a brief account of process management and documentation in the healthcare sector and elaborate on why processes in a hospital context match our comprehension of flexible business processes. Next, we present our research methodology by elucidating the ratio for choosing our case organization, naming the data sources applied, describing the process of data collection, and detailing our procedure of data analysis. We then present our case study findings regarding the implementation of process documentation within the organization under study and the problems that we identified in the field. We conclude by giving some suggestions for refinements, which might improve the success of future implementation efforts in similar contexts.

PROCESS MANAGEMENT AND DOCUMENTATION IN HEALTHCARE

Hospitals can be considered as a collection of highly specialized experts brought together to care for and cure patients. Hence, it is not surprising that historically hospitals were organized along functional units (Gemmel, Vandaele and Tambeur, 2007). The evolution of the hospital organization has been characterized by specialization within functions and centralization of resources to capture economies of scales. This organization involves "multiple agents who have partial information, disparate (local) goals and limited communication capabilities" (Kumar, Ow and Prietula, 1993). The development of clinical pathways in the early 1990s introduced a new way of process-oriented thinking in hospitals (Zander, 1992). Originating from the manufacturing industry, clinical pathways (originally called critical pathways) can be defined as schedules of medical procedures designed to perform an efficient program of treatment (Gemmel et al., 2007). Clinical pathways disseminate the awareness that the treatment of a patient (input) must be considered as a sequence of activities which are performed in a team of different professionals (resources) to attain a certain goal (output), e.g. to cure the patient (Coffey, Richards, Remmert, Leroy, Shoville and Baldwin, 2005). Recently, empirical investigations have shown that a high degree of process-oriented coordination has a moderate but significant positive effect on the efficiency of hospitals (Vera and Kuntz, 2007).

Clinical processes are typical examples of processes that are characterized by both the existence of well-defined procedures and the need for operational flexibility (van der Aalst et al., 2005). Even though there exists a general consensus among physicians about what treatments (process definition) are necessary for what disease or injury, the individual composition and sequence of therapies (process instance) can vary extensively from case to case. This need for flexibility is due to several factors:

- The crucial process input is not a standardized physical artifact but a unique human being, i.e. a patient.

- Often, there is incomplete information about a patient's condition and history of medical treatment.

- A patient's condition may vary during process execution.

- The most important resources applied in medical treatment are not machines but human experts.

- Decision-making is not based on rigorous business rules but on human experience and assessment.

Thus, including all possible sequences of activities and exceptions in a semi-formal, graphical representation of a clinical process would result in a highly complex model, which requires enormous efforts to create, understand, and maintain. There is research on the application of semi-formal process modeling for clinical processes. For instance, Vissers (1998) modeled healthcare processes on a very abstract level to understand the nature and structure of this domain. In contrast, Waring and Wainwright (2002) generated rather detailed process models of hospital processes in the course of an exploratory study on the complexity of integrated IT systems in the healthcare sector. However, process documentation in the context of these studies is driven by analytical objectives. It is not meant to provide procedural guidance to human beings participating in healthcare processes. Our case study aims at filling this gap.

RESEARCH METHODOLOGY

In the course of this research we try to understand how to document flexible healthcare processes effectively and efficiently for a human audience. Hence, we have to investigate how documentation of business processes in dynamic environments is done in practice and what problems arise. Thus, our research is about documenting the experiences of practice within a setting where the context is of vital importance. It is about analyzing a phenomenon in its natural environment where the boundaries of the phenomenon are not clearly evident at the beginning of the research project (Benbasat et al., 1987; Dubé and Paré, 2003; Yin, 2002). Therefore, the case study methodology is deemed appropriate for the purpose at hand.

Site selection

A German hospital with more than thousand beds in twelve different units and more than two thousand employees provided the case for our descriptive, contemporary, single-case study. This site was chosen for two reasons:

First, the hospital in focus has just undergone a certification procedure of the Cooperation for Quality and Transparency in Healthcare (KTQ). The procedure focuses on the assessment of how the interdisciplinary healthcare processes are put into practice, whereby the interaction of different professions and different hierarchical levels are of special interest (Cooperation for Quality and Transparency in Healthcare, 2009). The so-called KTQ-Manual plays a prominent role within the certification procedure since it provides process descriptions that serve as a benchmark for both the internal and the external assessment steps. Moreover, the KTQ-Manual functioned as a framework for the development of an individual process handbook for the hospital (cf. chapter on case study findings). As the whole hospital was subject matter of the certification process, there was a vivid understanding of the role of procedural guidance materials across all units. Every employee has a current opinion regarding this issue. Moreover, the current "quality management" department will become responsible for several hospitals of the same district in the near future. Simultaneously, its name will change from "quality management" to "quality and process management" indicating the increasing significance of the process management subject in our case organization.

Second, the hospital's admission process is handled by an interdisciplinary central admission center. From a process perspective it serves as a hub every hospital unit is connected to and thus provides a rich setting for analyzing process guidance in a hospital context. By choosing the admission process – starting from the central admission center and branching to every hospital unit – as our unit of analysis, we were able to shed light on a phenomenon from different perspectives by talking to many interviewees from various disciplines.

Data collection

Data were collected by means of a multi-method, qualitative data generation approach. The primary mode of data collection was conducting topical, semi-structured, open-ended, face-to-face interviews. Over a period of three consecutive days in October 2008 we interviewed seventeen different people within ten interview sessions (cf. Table 1). In order to assure a broad set of perspectives on our research question we composed a very heterogeneous group of interview partners. The source of variety was twofold: First, the interviewees came from the central admission center itself and all units that are connected to it downstream the admission process. Thus, there was a high degree of versatility regarding the different medical disciplines that were represented within the group of interviewees. Second, the interview partners came from all three types of professions, which may be found in a hospital: medical, nursing, and administrative staff.

The interview sessions took between 40 and 90 minutes and sum up to more then seven hours of interview data. The interviews were tape-recorded and a summary of every session was sent to the corresponding interviewees for the purpose of reassurance. Before conducting the interviews we sent a single page summary of the topics we were going to talk about to every interview partner. The group of interviewers comprises four researchers. An interview guide gave structure to the sessions by listing the general topics we were interested in and giving potential questions of inquiry. All researchers took part in the inquiry and were taking field notes.

In addition to interview data and field notes, process documentation, which has been created in course of the KTQ certification initiative (cf. chapter on case study findings), served as further data collected in the process of this study. Moreover, the IT infrastructure used for the distribution of the process documentation became a subject to exploration.

#	Organizational unit	Interviewees's position (count)
1	Central admission center, quality management	Assistant medical director (1), head of nursing service (1), head of quality management (1)
2	Administrative admission	Admission secretary (2)
3	Neurology	Assistant medical director (1), head of nursing service (1),
4	Quality management	Head of quality management (1)
5	Pneumology	Physician (in charge of admission) (1)
6	Intensive care unit	Chief physician (1), head of nursing service (1)
7	Internal medicine	Chief physician (1), assistant medical director (1),
8	Pneumology, internal medicine	Head of nursing service (2)
9	Psychotherapy	Assistant medical director (1), clinic manager (1)
10	Surgery	Chief physician (1), assistant medical director (1),

Table 1. Interview sessions and interview partners

Data analysis

The researchers that were in charge of data collection also handled the data exploration. At this, the processes of collection and exploration did not occur in a purely sequential order. At the end of each day in the field we discussed the interviews conducted and field notes taken. The findings of this preliminary analysis influenced the interviews of the following days since they amended our understanding of the case's context and pinpointed first results that were subject matter of more specific inquiry during consecutive interviews. For instance, the first and only interview at the opening day of our study (interview #1, cf. Table 1) was about familiarizing the researchers with the phenomenon in its context as we had only little knowledge of the healthcare sector and its processes. The knowledge acquired during this interview was fundamental to understand the admission process as such, what in turn was necessary to be able to formulate appropriate questions within the following expert interviews. After all interviews had been summarized and reassured by the interview partners the data was analyzed regarding the evidence of recurring patterns (cf. chapter on case study findings). These findings were cross-checked by both consulting the process documentation and scrutinizing the technical facilities applied for the distribution of process documentation.

The mode of data analysis taken in this research study reveals several advantages. Since the researches that took part in the project had only little prior knowledge of the domain and the context under investigation, there was only a slight amount of bias originating from the researchers' expectations (Benbasat et al., 1987). Moreover, in our case study evidence was obtained from multiple data sources such as interviews, documentation, and physical artifacts (IT infrastructure). The application of various sources allows for triangulation, which provides greater support to the researchers' conclusions (Dubé and Paré, 2003). The association of several researchers analyzing the data also furthers the quality of the research's results. Multiple researchers have the advantage of enhancing the creative potential in the research process, and the convergence of observations from multiple investigators enhances confidence in the findings.

CASE STUDY FINDINGS

In the course of the KTQ certification various employees of our case hospital generated a great many of process documentations, which are meant to give procedural guidance for their daily routine. The documentation comprises a set of

PDF-documents, which may be accessed either via the hospital's internal computer network or in form of hardcopies distributed among all units. The documents internal structure varies to a large extent. They contain passages of continuous text, structuring elements such as lists and table as well as flow charts. The KTQ-Manual is applied as a structuring framework, which classifies the various documents by different functional categories. Three distinctive types of process documentation may be distinguished: internal procedures, internal guidelines, and imperative statements. While compliance with the later is obligatory, internal procedures and internal guidelines rather serve as a directive than an assertive instruction. The imperative statements define roles and responsibilities of staff. Internal procedures describe medical, custodial and administrative tasks in a more or less process-oriented manner and internal guidelines comprise common knowledge and general guidelines and often originate from literature.

From analyzing and clustering the interview data three main problem areas emerged, which we will use as categories to structure our findings: (1) the documents' content and their inner structure, (2) the way process documentation is accessed, and (3) means of filtering the mere amount of documents to a relevant subset.

Content

The different hospital units had quite diverse views and opinions on the topic of process documentation. However, a number of issues were named frequently across all organizational units as the interviews proceeded.

For instance, a senior physician form the pneumology unit noted that – in his opinion – "medicine is too complex to be illustrated in flowcharts."[1] He complained that many authors of internal procedures specify cause-effect-chains, which are oversimplified or sometimes even non-existent in reality. Furthermore, such theoretic descriptions are either too abstract or too detailed to be suitable to an individual case. His unit successfully managed to avoid creating lengthy process documentations by defining common disease patterns including different sets (e.g. obligatory vs. optional) of feasible treatments and required resources (e.g. diagnostic equipment, medications) rather than detailed workflows. The documents deliberately abstain from specifying explicit sequences of therapies in a flowchart manner or by applying decision trees as these – in their opinion – hamper physicians in their flexibility and creativity. Deciding on details of an individual treatment is heavily dependent on the individual case and the resources available and thus should remain to the physician on duty.

In contrast, the assistant medical director of the surgery unit advocates flowchart-like process descriptions. From his point of view, the reason for the applicability of such process models in his department is twofold: First, the operating room is an extremely scarce and expensive resource and hence processes have to be optimized with regard to this bottleneck. Second, patients undergoing surgery are under anesthetic and hence more predictable. He noted that after introducing a more process-oriented thinking in his unit the average length of patients' stays has been reduced significantly.

An intermediary approach of handling extremely unstructured and flexible processes was found in the psychiatry unit. Since treatments in psychiatry are complex and heavily dependent on the individual patient, a precise prescription of the processes including sequences of procedures for every imaginable case is not possible. Therefore the team decided to compose the unit's process documentation in a rule-based style. They defined if-then-rules to specify patient paths, e.g. dependent on a patient's condition and current resource availability, or determine responsibilities, e.g. for night shifts, rather than modeling the precise process orchestration for all thinkable cases.

The heads of nursing services from pneumology and internal medicine took in a more practical point of view. To them certain internal procedures, such as the internal procedure for the interaction with dying persons, are extremely helpful. This particular process documentation is characterized by a short, clear, and concise structure, which reveals the relevant information at a glance (inter alia by the use of bullet points). In contrast, they deemed continuous text in process documentations as being cumbersome since it takes too long to identify the relevant information, especially in stressful situations. From their point of view, the same holds for complex diagrams. "To gain acceptance and foster use in practice internal procedures have to be clear and brief."

Furthermore, many interviewees agreed that internal procedures in their current state are filled with details, which are only relevant for certain target-groups or rare exceptions. Thus, most staff members do not read through the whole document – although the process documentations are meant as tools for training of new staff.

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[1] All quotes in this paper are translated from German to English.

Access

A major problem, stated several times during the interviews, is the lack of a single point of access for process documentation. At the moment, there are at least four places where process documentation is kept: an intranet application, directories on the internal file server, directories on local computers, and paper folders. Hence, people often do not know where the latest version of an internal procedure, internal guideline, or imperative statement can be found. Furthermore, in most units only few computers are available so that quick access to the digital process documentations is not always possible.

In addition, not every staff member is used to work with a computer and knows how to find relevant information efficiently. Hence, most people use the – sometimes outdated – hardcopies of process documentation, which are available at nurses' stations. The following quotation of the head of nursing services depicts the overall access problem: "I am faster if I look it up in the printed version of the process documentation."

The psychiatry unit experiences fewer problems regarding information access. All relevant documentations are available via the electronic "psychiatry handbook". This handbook is a simple collection of documents relevant to psychiatry. To efficiently access these documents two indexes, one in form of a spreadsheet file and another in form of a structured list of hyperlinks on an intranet web page, have been set up by an employee of the department. These self-made workarounds work so well that the psychiatry unit does not use hardcopies at all.

Filtering

During the interviews it became apparent that the mere amount of documentation, which came along with the KTQ certification, is creating new problems. The assistant medical director of the internal medicine stated that „the number of instructions and regulations has increased in the course of the KTQ certification. New staff members cannot cope with this documentation flood due to a lack of time." Furthermore, people often do not notice when new documents are available or existing documents are updated that are relevant to them.

Some interviewees expressed the desire for information retrieval and filtering techniques as known from the web. At the moment the intranet search only indexes the documents' names and excludes the actual documents' content. A full-text search would be highly appreciated. Another suggestion was to allow an individual categorization of documentations through tags.

A general problem, which came up in the context of information filtering is the distinction of the different documentation types, i.e. internal procedure, internal guideline, and imperative statement. Some interviewees stated that the segregation is not clear to most of the hospital staff. This increases the problem of acquiring desired information. If a person that has a particular information need is not aware of the difference between internal procedures and internal guidelines, she does not know where to look first.

Suggestions

Category	Suggestion	RQ
Content	_ Define only mandatory activities and restrictions rather than specifying all possible process variants	
	_ Include target-group specific summaries at the top of each documentation	RQ1
	_ Use a small set of structuring items such as bullet points or simple diagrams consistently across all process documentations	
Access	_ Provide single point of access to process documentations	
	_ Design documents to be accessed via different channels (e.g. web, print, mobile devices)	
	_ Allow for audience specific categorization	
Filtering	_ Provide possibilities to subscribe to relevant topics and get notice when new relevant documents appear or existing ones are altered	RQ2
	_ Implement a full-text search among process documentations	
	_ Define clear-cut distinction between types of documentation	

Table 2. Suggestions for future improvements

On the basis of the findings of our descriptive case study we introduce some suggestions on how to improve future settings of the same type (cf. Table 2). They derive from both the implementation of process documentation that we encountered in our

case organization and the shortcomings and potential improvements stated by our interview partners. Along with a classification by the categories of our findings (content, access, filtering) we relate the different suggestions to our research questions.

CONCLUSIONS, LIMITATIONS AND OUTLOOK

The purpose of our research is to gain an understanding of how flexible business processes in dynamic environments can be documented effectively and efficiently for a human audience. We chose clinical processes in the healthcare sector as an exemplary domain for our work. This paper presents first findings from a descriptive case study in a large German hospital that has recently undergone a certification procedure. Process documentation was a major theme in this certification. Over a period of three consecutive days in October 2008 we interviewed seventeen people across a variety of different hospital units and hierarchy levels about their practices and experiences concerning the topic of process documentation. Our interviews were guided by two research questions. First, how can a single flexible business processes be described? Second, how can the documentation of a whole process landscape be managed? In the course of the interviews three categories of aspects (content, access, and filtering) related to process documentation emerged and gave structure to our case study findings.

The primary contribution of this paper is a rich description of practical issues concerning the documentation of flexible processes in dynamic environments. A number of practical suggestions for healthcare organizations in similar contexts are given, e.g., allowing for target-group specific representations and implementing multiple but consistent channels of accessing and filtering process documentation. At this early stage of our research, first findings regarding content suggest that clinical process documentation is supposed to focus on what should be done rather than what can be done. It is more about giving guidance than formally specifying a detailed recipe for action. However, due to the fact that the presented study is only a single-case study within a special context no generalizations can be derived.

Due to limitations in space, this paper merely presents some key findings of our study. A more elaborate description of our research will be subject matter of a future publication. Future work will include further case studies in similar contexts to finally develop a framework for the documentation of flexible business processes.

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