Business Process Design Meets Business Practices Through Enterprise Patterns: A Case Study

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ABSTRACT

Every day companies deal with internal problems in order to manage human resources during the execution of business processes. The ability to quickly identify and rapidly apply effective business practices to recurring problems becomes crucial in order to improve the efficiency of the organization. To seize the opportunity of adapting their business practices to emerging organizational forms (Extended Enterprise, Virtual Enterprise) and to reuse the expertise of knowledge workers – who are central to an organization's success – companies are required to face several challenges. This paper presents a set of business patterns useful in resolving emerging organizational issues to support the activities of knowledge workers, increase their productivity and their ability to find the information they need, and enable collaboration with colleagues without changing their habits. Also it describes a real case study and a software system that allows companies to introduce these business patterns in the workplace, adopting an Enterprise 2.0 approach.

Keywords: *Business Practices, Business Process Patterns, Collaboration, Coordination, Enterprise 2.0, Knowledge Workers*

INTRODUCTION

Companies base their success on the use of established business practices to ensure efficiency and effectiveness in the activities related to their core business (Gebauer & Lee, 2008). The introduction of efficient business practices can help resolve recurring problems through proven solutions coming from past experiences (Dietz, 2006). Traditionally, this is achieved through the leadership's ability to empower the workers' productivity in a company, but in reality businesses can benefit from systematic, structured

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investment in the tools and methods supporting collaboration (Kristensen & Kijl, 20102010).

In the past 50 years, a new form of worker – the 'knowledge worker' (Davenport, 2005) – has become more and more important for companies. The knowledge worker is "one who works primarily with information or one who develops and uses knowledge in the workplace". Typically, knowledge workers operate multiple tasks at the same time. They have different working contexts and different channels to deliver information. (Baars & Kemper, 2008) They are involved in many parallel 'knowledge processes' (Simperl et al., 2010) that are often not codified in formal procedures but are unstructured or semi-structured, collaborative and continuously changing. The advent of Web 2.0 has also amplified the presence of knowledge processes not coded in formal structures because knowledge workers have many basic collaboration tools at work but are not checked by traditional information systems. In this context it is essential to keep coherent knowledge processes (unstructured) and business processes (structured), moving from tacit to explicit knowledge (Alderete, 2012; Jashapara, 2007) and involved in shaping a new kind of information system known as Enterprise 2.0 (Maule & Gallup, 2010).

Researchers have pointed out that process modelling and design practices can represent a way to respond to this new situation. If the Enterprise 2.0 tools can be adapted to Extended Enterprise and Virtual Enterprise organization, they can give flexible support to networked human processes. Moreover, network systems based on technologies and architectures of participation offer a new model for online knowledge sharing, cooperation, and collaboration that is different from the traditional institutional framework (Blau, 2011).

In a networked context, the management of informal processes/activities is a challenging problem. Such activities are often collaborative and, typically, they are not codified or elicited as business practices. Informal processes limit the growth of a company because they are highly dependent on the ability of the knowledge worker to correctly and promptly manage activities and generate the information overload. As Lundqvist, Sandkuhl, and Seigerroth (2011) observe, new organizational and technological approaches are needed to prevent knowledge workers' information overload, by proposing methods of achieving a more pertinent and accurate information supply. A formal definition of business practice contributes to capturing and understand the information demand and roles in organizations. Researchers such as Henkel, Johannesson, and Perjons (2011) suggest that enterprise models and business models as being adequate tools for design and maintenance of processes, which require collaboration in agile and flexible networks.

In trying to address the modelling issues involved in business practices, we have explored the traditional Business Process Management (BPM) approach. In particular, we have attempted to formally describe the collaboration and coordination processes in which knowledge workers in a real Small-Medium Networked ICT Enterprise were involved, integrating them into the information system in order to derive process models efficiently (i.e. consuming less resources and time) and effectively (i.e. at a high quality to meet specific needs). However, the unstructured, adaptable and changing nature of knowledge processes soon became an obstacle to the formalization of large-scale business practices. So we decided to project a smaller impact on the overall organization, modelling only recurring business practice atoms, i.e. patterns. A pattern-based approach can be useful to re-design processes (Drucker, 1959) but also in the design of information systems from scratch. In fact, the concept of pattern has been effective in practical contexts and will probably be suitable in others (Fowler, 1997). The approach has been inherited from the traditional business processes design method (Van Der Aalst, Ter Hofstede, Kiepuszewski, & Barros, 2003) and from the software engineering field (Fowler, 1997). Several studies propose the use of workflow patterns as a means to categorize recurring problems and solutions in modelling business processes (Russell, ter Hofstede,

van der Aalst, & Mulyar, 2006), and also to organize collaborative work (Winograd, 1986).

In this paper, we apply a pattern-based approach to knowledge processes as a key factor in quickly identifying and rapidly applying effective business practices to support the activities of knowledge workers, increasing their productivity in the networked workplace without changing their habits. The paper presents a case study highlighting the issues related to the modelling of knowledge processes, demonstrating the difficulty of managing tacit knowledge. To address these issues, we present a set of business patterns which can be useful in modelling collaborative and cooperative activities within business practices. In addition, we propose a software system that allows companies to introduce business patterns in the workplace, and to track tacit knowledge, improving knowledge management and promoting collaboration.

The paper is structured as follows: the next section (Related Work) reports on key related works in the area of analysis, description, identification and application of business practices, mainly to address knowledge workers' emerging needs. The section 'Business Patterns for Modelling the Project Proposal Drafting Process' provides readers with an overview of our pattern-based approach. Each business pattern is identified as a solution to a recurring problem. The section 'KPeople Software System' describes the evaluation of the software system we deployed to apply the patterns, using them to manage typical business practices within real organizations. The numerical details we obtained using a technique based on the living laboratory approach are shown and the results of a usability test we performed during the experimental phase are reported. Finally, the section on 'Conclusions' summarizes our key messages and sketches future research directions.

Related Work

This section analyzes existing works on explicit modelling of business practices to support collaborative and cooperative semi-structured processes. Business practices are often associated with best practices that companies adopt to manage their internal processes. Therefore, the ability to identify best practices is essential to apply efficient and effective business practices, and to enable the reusing of knowledge and expertise. (Remus, 2012) Companies need to find methods to provide the necessary level of abstraction while modelling daily practices. At the same time, companies must manage and preserve social capital through knowledge workers (Hall & Goody, 2007).

Bhandar, Pan, and Tan (2007) made an interesting study of the importance of 'social capital' is highlighted during the various phases of the development of an information system involving multiple organizations. In doing so, the study suggests innovation through two new perspectives (knowledge integration and inter-organizational relationships) and by leveraging the social capital, a resource based on social relationships that inherently emerges in a collaborative project thanks to the ability of integrating the knowledge bases and knowledge processes of the participating organizations.

The concept of social capital is central. The literature proposes many definitions of social capital and one of them is related to the assets that reside in social relationships (Walker, Kogut, & Shan, 1997) and that emerges or exists in social structures (like projects, hierarchies) through interaction between members (Adler & Kwon, 2002). So, as the authors say "the formation of social capital is supported by the use of social networks" (Burke & Calton, 2009). Conflicts between collaborating organizations, and/or between members of the same organization, can be solved using social capital and can enhance the knowledge integration process by developing cohesion within the structure, aligning stakeholders to the collective goal and reducing the time and the effort related by reaching an agreement within the network of knowledge workers (Briggs, 2003).

A knowledge worker may be categorized by what he/she does with regard to the work processes he or she is involved in Davenport

(2005). Knowledge workers are involved on a daily basis in many unstructured activities that are information intensive but not adequately supported by technology. This rapidly leads to an information overload that negatively affects performance. Until now, there have been relatively few studies related to this topic. Andriole attempts to demonstrate how, if properly deployed, new technologies enable companies to cost-effectively increase their productivity and their competitive advantage (Andriole, 2010). To raise their productivity, companies could integrate emerging technologies (mainly coming from Web 2.0) in traditional business processes (McAfee, 2006). In this way, the information system can allow the knowledge worker to use the right information, in the right format, at the right time but it is essential to understand that processes are made up of people, and that people will use the technology to improve their work. To achieve this goal, knowledge workers should be provided with an integrated space where they can retrieve all the information and tools they need.

Some researches in this area have been carried out. Jennings & Finkelstein (2010) authors propose to analyze specific lightweight ad hoc processes, known as 'micro workflows'; which can occur within a company. Using gestural analysis of human agents within such flexible micro workflows, in combination with social analysis techniques, a new flexibility in business processes can be identified. Thus, the authors provide a helpful way to define how people work in companies and how they can integrate Web 2.0 tools into their daily activities. Stephenson and Bandara (2007) present business process patterns in order to enhance the design of the public health care business process.

The introduction of micro workflows and social software affects Enterprise 2.0 (McAfee, 2006). In this context, the main technological areas through which the Enterprise 2.0 are carried out are the social network/community, unified communication/collaboration and enterprise content management. These areas are particularly important because they show how new trends stimulate collaboration and knowledge sharing. Along with the emergence and the use of Web 2.0 tools, not only in large companies but also in the small and medium enterprises, new operating practices have been introduced to complete the existing ones.

Cook introduces the concept of collaboration process in addition to traditional business processes that define the way a company works (Cook, 2008). Collaboration processes are characterized by a strong and unpredictable collaboration among the participating stakeholders in order to achieve a common goal. This collaboration takes place through the combination of communication tools, both traditional (e-mail, telephone, direct conversation) and Web 2.0 oriented (Sari, Loeh, & Katzy, 2010).

Harrison-Broninski (2005), argue that it is necessary to amplify human-driven processes in order to understand how to formally describe such work, then to capture this knowledge in a software tool. This requires changes in both business process modelling and information systems. The author examines the true nature of work and shows how it can be supported by the next generation of information systems. In order to formally describe human work and the interaction between humans and technology, the identification of patterns can be a useful approach allowing for fine-grained modelling support, as Gschwind, Koehler, and Wong (2008) point out. However, the modelling tools currently available do not fully support the application of patterns, although, as these authors demonstrate it is possible to use an approach through which business users receive help in understanding the context through design patterns.

The concept of pattern (Fowler, 1997) has been useful in a practical contexts and will probably be useful in others. A pattern-based approach has been exploited for many years in the software engineering field but, over the last decade, the concept has been inherited in the business processes area (Desai, Chopra, & Singh, 2009). Mitra and Gupta (2005) point out that most of the analysts who have actually worked on simplifying business process have focused on reusing or identifying some process elements that can be re-applied from one process

to another, or at least when similar processes are encountered. This solution, which comes from the methodology of business process patterns, is very helpful in the information system field and is an important step towards creating a structured and systematic way to manage business practices both in real (Barchetti, Capodieci, Guido, & Mainetti, 2012a) and in virtual environments (Di Blas, Bucciero, Mainetti, & Paolini, 2012). The next section addresses this issue by presenting a set of process patterns which can model collaborative and cooperative activities as business practice atoms.

Business Patterns Modelling the "Project Proposal Drafting" Process

In this section, we present a set of business patterns we have identified in a specific case study, namely the 'project proposal drafting' process. The identified business patterns can be used in a other case studies. The case study identification has been carried out in collaboration with 'Webscience S.r.l.' (referred to here as Webscience), an Italian networked company that operates in the ICT field. Webscience is the leading partner of the KPeople research project, which was founded by the Apulia Region and the European Community. The company has 140 employees, who operate in five business units spread around three continents. Ten focus groups have been carried out, involving the top management and the business unit directors. They indicated that the 'project proposal drafting' process would be an interesting testing ground. Indeed, offering a project proposal to the customer is the first step in starting a business. In addition, according to the opinions of the focus group participants, project proposal drafting is a key process for enhancing the efficiency of the company, because it involves aspects of collaboration and coordination activities with high margins of improvement.

The process of drafting a project proposal is made up of two sub-processes: 'proposal writing' and 'budget creation'. The first of these aims to formalise appealing project ideas that may be submitted to potential customers. The second is required to define economic resources in terms of humans, infrastructures, suppliers and external advisors, training and logistics.

The actors involved in both sub-processes are the Managing Director (MD), the Client Manager (CM), the Project Manager (PM), the Head of Human Resources (HR) and the Business Unit Manager (BM). These actors deal with any aspect of the business, from proposal writing to negotiation with the customer to costs approval and resources management.

From the analysis of the data collected during the focus groups, it emerged that the most relevant problem of the considered process is the loss of information exchanged by knowledge workers due to an uncontrolled use of Web 2.0 tools. To provide readers with evidence of the number of collaborative activities and information exchange characterized by a massive use of Web 2.0 tools, in Table 1 we report the data collected about the budget creation sub-process. Data were collected through interviews and focus groups with the Webscience workers and by analyzing the intranet repository used by the company to manage the budget's lifecycle.

Table 1 shows a large information loss (from the point of view of the company knowledge base) during the execution of the budget creation sub-process and a lack of formalization in repetitive and very similar activities. Business practices are left to the ability and the accuracy of knowledge workers. This leads to a decrease in efficiency for the company.

We have decomposed this general problem in three main aspects related to Collaboration, Coordination and Know-how Elicitation. In the following, each of these is analyzed. Business patterns are proposed which aim to overcome difficulties by modelling the involved actors, their collaboration and communication and the activities they perform.

Collaboration

This aspect tackles problems related to the design of the collaboration among people who operate within the company to achieve a

Table 1. Numerical details of the budget creation sub-process

	N.	Source
Collaborative activities	5	Interviews, focus groups
Employees involved in process execution	40	Interviews, focus groups
Budgets / year	350	Intranet repository analysis
Collaborative activities / year	1,750	(N. of collaborative activities) × (N. of budgets/year)
Categories of Web 2.0	3	Interviews, focus groups
Web 2.0 tool uses in the process	100	Analysis of a sample of process activities
Web 2.0 tool uses/year in the process	35,000	(N. of Budgets / year) × (N. of Web 2.0 tool uses in the process)

specific goal. Even if we pointed out that there is a strong interaction between knowledge workers in the company, current practices lack any of the specific flows that are typical of business process design.

A knowledge worker in the company (CM or PM) can execute the task independently or he/she may decide to ask for a contribution from other knowledge workers. There is not a default number of workers from which the CM or the PM can ask for help, and the number of interactions between the CM or the PM and other employees can be defined on the fly using different communication tools. For example, the CM can ask about the economics of the proposal using an instant message for the first request, then he/she can use e-mail to exchange documents, and subsequently use instant messages to exchange other information about the quotation. Knowledge workers choose the communication tool autonomously, so there is a risk of losing the information exchanged between employees, which could be valuable for other knowledge workers in the company.

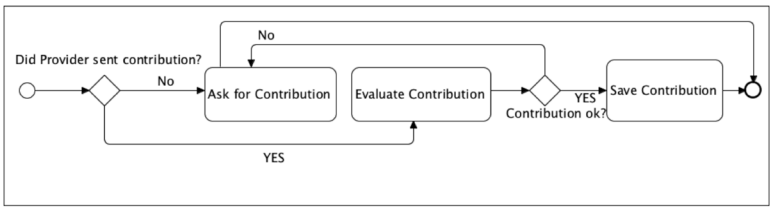
The **Collaborative Decision Making Pattern** models a collaborative activity where the goal is to take a decision about certain topics which involves a number of responsibilities. The pattern allows the identification and the codification of the collaboration data stream in the company information system. In this scenario, a moderator is in charge of preparing a proposal draft for discussion and/or to modification. After the discussion, the moderator has the task of preparing an artifact that represents the result of decisions made during the collaborative activity. There are two types of decision makers: the Main Decision Maker, involved in the collaboration activity, and Decision Maker(s) (It is possible involve one or more decision makers) that may contribute to the discussion of a topic (He/she is not forced to participate in the discussion). This pattern is explained in detail by Barchetti, Capodieci, Guido, and Mainetti (2011) who present it in the context of the 'budget creation' process. Readers should refer to the cited paper for details.

Coordination

This aspect tackles problems related to the task of making cooperation possible among several people who have different roles within the company and who work in remote places. The activities regarding people with specific roles, and who can cooperate with each other, are often not structured in terms of traditional information systems, although it is useful to keep track of data exchanged among employees during cooperative activities in order to avoid losing information.

During the drafting of the project proposal, the interaction, e.g. mail exchange, between the PM and other knowledge workers is often frenetic. This may be a problem when the people in charge of writing the proposal are too busy with other activities.

Figure 1. The coordinate contribution pattern



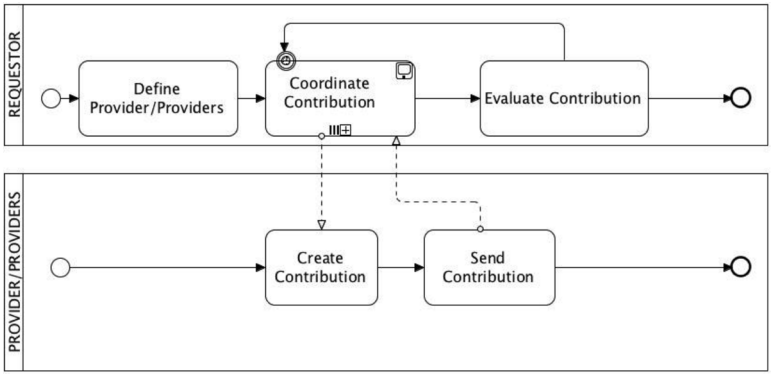
The role of the PM is to make cooperation possible among colleagues in order to write the proposal and to ensure the quality of the result. However, there are several situations to consider, which recur many times and are often very chaotic. Such situations are modelled by the 'Coordinate Contribution Pattern' and the 'Retrieve Contribution Pattern' described in what follows.

- **Coordinate Contribution Pattern:** During the definition of the project proposal, the PM is in charge of coordinating the contributions of several knowledge workers. He/she periodically reviews the contributions and, if correct, registers them. They can be reused later, when all the contributions will be put together. These activities are modelled by using the Coordinate Contribution Pattern. As shown in Figure 1, the pattern aims to verify and evaluate the received contribution. It allows for coordinating the contributions of other actors. First of all, the system checks whether a Provider has delivered the contribution assigned to him/her. If the contribution has not been received, the system requests the contribution to the Provider. Otherwise, the received contribution is evaluated. It is then registered if it matches quality attributes or, if it does not meet requirements, the system asks the Provider for a new version.
- **Retrieve Contribution Pattern:** Another critical situation occurs when the PM has to ask some knowledge workers to write some parts of the documents, depending on their specific expertise. The PM decides a priori who are the involved knowledge workers and sets a deadline to provide the contributions. When the deadline expires, the PM needs to put together all the received documents. These activities are modelled by the Retrieve Contribution pattern. This pattern, as shown in Figure 2, aims to solve the problem of retrieving contributions produced by knowledge workers. It takes into account the need to collect the contributions by a predefined date in order to have time to elaborate them. This pattern aims also to manage situations in which it is necessary to collect contributions before the scheduled deadline. The Retrieve Contribution Pattern foresees the involvement of a Requestor and one or more Providers. The Requestor identifies the resources that will have to provide the contributions, while the Providers produce and send the required contributions. The process is activated by the Requestor who has to identify the involved knowledge workers. Then the Requestor starts the Coordinate Contribution task, modelled by the previous pattern, which can end for two reasons: (i) the time has expired or, (ii), all the Providers have sent their contributions. Finally, the Requestor evaluates the contributions obtained from the Providers.

Know-How Elicitation

This aspect tackles problems related to practices that are repeated many times and where there is a risk of losing information useful for the company. In the specific case of project proposal drafting, many critical collaborative activities can be performed without an adequate control.

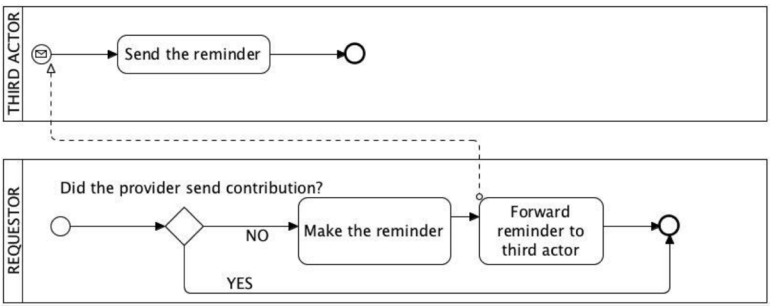
Figure 2. The retrieve contribution pattern



Such activities are modelled by the 'Escalation Patterns' and 'Deadline Agreement Patterns' described in what follows.

- **Escalation Pattern:** A typical situation modelled by this pattern happens when the PM has not received the requested contribution from a knowledge worker. Thus, the PM asks his/her own immediate manager to solicit the defaulting knowledge worker to produce the contribution and to send it to the PM. The 'Escalation Pattern' represented in Figure 3 aims at delegating to a manager the responsibility to remind a negligent colleague of the need to obtain more effective and immediate results. The pattern involves the Requestor who requested the contribution, a Provider from whom a contribution has been requested, and a third actor who, given his authority, may be more masterful in requesting the contribution through a reminder. The Requestor can activate the process if the provider does not send the requested contribution by the agreed date and if the Provider continues to not send the required contributions after he/she receives the Requestor's reminder. Then the Requestor prepares a reminder and forwards it to the third actor who, in turn, sends it to the negligent Provider.
- **Deadline Agreement Pattern:** During the project proposal drafting process, there is a delicate issue to be addressed concerning the definition of the deadline for completing a specific task and the job to be assigned to each worker. Work assignation is a crucial activity for the success of projects. This activity can often be affected by factors

Figure 3. The escalation pattern

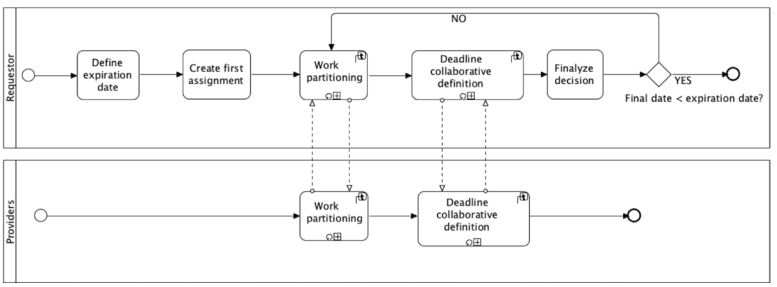


such as the technical expertise, writing and organizational capability of the people involved. So, in this context, it is important to properly define the work assignation and to adequately agree on the internal release date of contributions. The PM can decide to agree on these aspects with the knowledge workers. The Deadline Agreement pattern, shown in Figure 4, aims to support the activities related to work planning, work assignation and decisions about the internal release dates for contributions. This pattern aims to create a model according to which the deadline agreement activity can be performed efficiently, taking into account the different needs of the people involved. Two classes of actor characterize the pattern: the Requestor, who is responsible for the whole activity completion, and one or more Providers, who must provide the required contributions. To agree on the work assignation and the internal release date, the Requestor, first of all, defines the date by which any contribution must be provided. Then he/she carries out an initial work assignation of activities. So two collaborative activities ('Work Partitioning' and 'Deadline Collaborative Definition') will begin. Each of them involves a Requestor and the Providers. These collaborative activities deal with assigning the work ('Work Definition' task) and agreeing the internal release dates for each Provider ('Deadline Collaboration Definition' task) Respectively. The two tasks are sub-processes modelled through the Collaborative Editing pattern. A Decision Team is made up of the Requestor and the Providers who, using collaborative tools, agree on the work assignation and the internal deadline definition. When the Work Partitioning and the Deadline Collaborative Definition are finished, the Requestor, through the 'Finalize decision' task, formalizes the decisions made and he/she defines the latest date against the dates agreed with the Providers as the deadline for the conclusion of their activities. If these deadlines exceed the date defined initially by the Requestor, a new iteration of the two collaborative activities can be carried out.

KPeople Software System

A software demonstrator of the KPeople (Barchetti, Capodieci, Guido, & Mainetti, 2012b) system has been deployed. This focuses on unstructured and complex processes within a networked enterprise environment (such as decisional, collaborative, and creative contexts) in order to improve the management of information and communication, and to optimize the workspace, recovering the time spent in low-value activities, in particular to find relevant information, execute knowledge tasks, and integrate collaborative workspaces with individual productivity tools (office automation, e-mail, etc.). According to the goals of the project, the KPeople system enables organizations to configure a set of business patterns (those described in the case study) and support the automatic enactment of their workflows. The

Figure 4. The deadline agreement pattern



system exploits collaborative Web 2.0 tools, dynamic process composition methods, and semantic engines to implement the business patterns identified in the case study. In the next subsections, we describe the architecture of the KPeople demonstrator, the Human-Centred approach adopted to design and develop it and the empirical test carried out by adopting the Living Laboratory approach.

Architecture

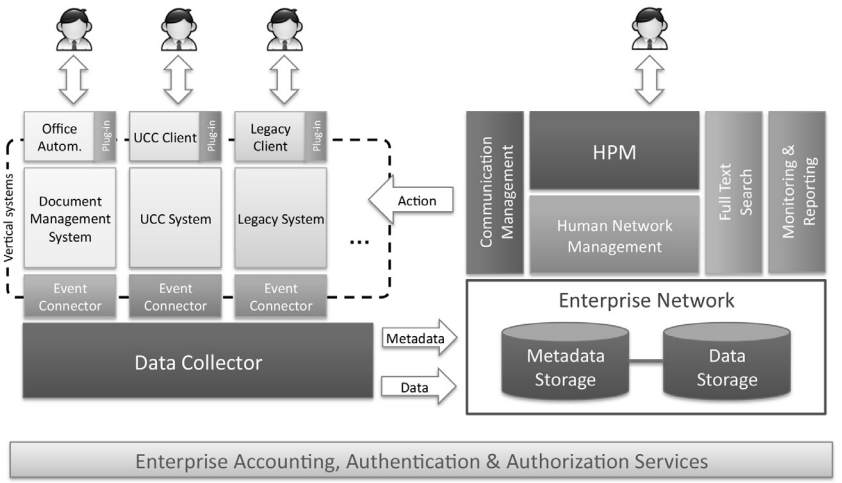
The KPeople software demonstrator was built upon an event-driven architecture, which – thanks to custom adapters – is able to trace and store events generated by traditional enterprise information systems (CMS, BI, CRM, ERP, etc.), communication tools (e-mail), unified communications & collaboration tools (UCC) and Web 2.0 facilities.

Figure 5 shows the KPeople system architecture. Knowledge workers can collaborate with colleagues by exchanging information, files and tasks through the HPM (Human Process Management) tool that allows users to apply patterns and examine the progress of the processes, the activities to be completed, the flow of communication, exchanged documents and e-mails, and to examine a set of indicators useful to evaluate performances and to identify bottlenecks. All data, information and documents are collected in a common database (Data Storage) enabling easy data retrieval (through Metadata) for knowledge workers and improving their efficiency. Events are tagged and clustered using a domain ontology. Event streams may be analyzed by social networks analysis tools. For example, during the field studies, the Cytoscape open source platform for complex network analysis and visualization has been exploited.

Human-Centred Design

The software demonstrator of the KPeople system has been designed and developed by adopting an approach based on the Human-Centred Design (HCD) methodology (ISO/IEC 9241-210, 2010). The basic principles of HCD are: 1) to analyze users and task; 2) to design and implement the system iteratively through prototypes of increasing complexity; and 3) to evaluate design choices and prototypes with users. The HCD approach requires that the system be designed by iterating a design-implementation-evaluation cycle. According to Participatory Design, domain experts, representative of end users, and end users themselves

Figure 5. KPeople system architecture



have an active role in the whole process (Schuler & Namioka, 1993). They are involved, also, in the requirement analysis. They participate in the evaluation of early paper prototypes and provide feedback. They test the successive system prototypes in the laboratory and then in field settings.

The team created for designing the software demonstrator of the KPeople system was multidisciplinary. It was composed of experts in Human-Computer Interaction, software engineers, and representatives of end users, i.e. a Managing Director, a Client Manager, a Project Manager, a Business Unit Manager and a Head of Human Resources. These end users' representatives were chosen from the personnel of the business unit of the IT company in Southern Italy which is a partner in the project.

In the early stages of analysis, user profiles were created through meetings, brainstorming sessions, on-site visits for observing users at their workplaces and interviews. The tasks to be performed through the system were analyzed and typical usage scenarios were developed (Rogers, Sharp, & Preece, 2011). Design solutions, consisting of navigation models and schemes were then shaped. Low-fidelity paper prototypes of the main screens of the software demonstrator were sketched and discussed with the whole design team. These were not the same people who participated in the definition of the business patterns.

Later, the system was iteratively designed and developed through the use of prototypes of increasing complexity. Such prototypes were evaluated through user testing and heuristic evaluation, as described in Nielsen and Mack (1994). The prototypes of the KPeople software demonstrator were inspected by five experts in Human-Computer Interaction to assess its compliance with respect to learnability, efficiency, memorability, low error rate, and user satisfaction. The inspectors carried out heuristic evaluations individually and recorded the problems they identified in their own inspection reports. Depending on its seriousness, a rate was assigned to each problem, on a range from 1 (purely aesthetic) to 4 (catastrophic). The inspectors then met together to discuss and aggregate their findings in a final report. The multidisciplinary team received the report, made the corrections to the prototype and released a new version of the KPeople software demonstrator. The iterative process of designing a prototype and its assessment using either heuristic evaluation and user testing with a couple of users (7 users, aged 21-40 years old, were chosen from the outside of the project team) has continued until a prototype, which met the identified requirements, was obtained. This iterative process was not particularly expensive because the interface prototypes used in the evaluations were created easily and evaluated by using methods that required few resources. Table 2 summarizes the types of prototypes employed in the user tests, the tasks executed and the goals.

The final prototype was evaluated through user testing. Ten knowledge workers of the IT company in Southern Italy, aged 21-40 years old, were involved. They were observed in individual sessions. Each user performed seven tasks, which required exploiting several of the business patterns and, consequently, of the KPeople system functionalities implementing them (see 'Interactive prototypes' section in Table 2). To avoid a learning effect, the order of task execution was counterbalanced among users. The test demonstrated that the knowledge workers were able to successfully use the system and to detect and correct the few mistakes occurred during the interaction by themselves. The usability problems that emerged during the user test were fixed and the final system was released.

Figure 6 shows a screenshot of one of the KPeople user interfaces. In particular, it implements the Retrieve Contribution pattern. The system is available at http://kpeople.webscience.it.

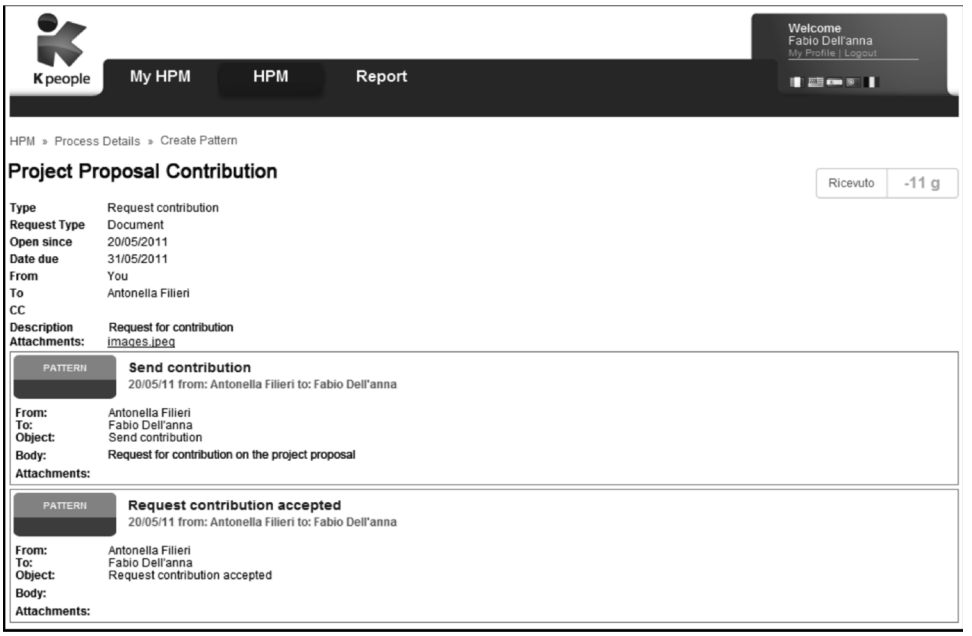
Field Studies

We introduced the KPeople system in six real organizations: 1) the Italian IT company Webscience; 2) the Italian Association for

Table 2. Prototypes employed in the user tests, tasks executed and goals

Section	Task	Goal
Paper prototypes	• Indicate which processes are assigned to you • Indicate which activities are assigned to you • Indicate which activities you assigned to other workers • Indicate which processes are out of the schedule • Indicate all the open processes • Indicate who are the handlers of the action Z • Search the process X by means of the advanced search form • Show how to create a new process • Show how to add a new activity	• Evaluate learnability, efficiency, and low error rate of early prototypes of the KPeople system demonstrator. In order to map users' mental models and processes, stressing the critical ones, they have to 'think aloud' while executing the assigned task through 10 screenshots provided by the demonstrator.
Interactive prototypes	• Create the new process X • Ask a colleague for a contribution • Check process deadlines • Find processes in charge of Mr./Ms. Y that are not yet completed • Find all events and processes related to Mr./Ms. Y • Download the document X • Verify for pending activities	• Evaluate learnability, efficiency, and low error rate of interactive prototypes of the system demonstrator. Users have to 'think aloud' while executing 7 concrete tasks to be done using interactive prototypes of the KPeople system demonstrator.

Figure 6. A screenshot of the KPeople system



Computing (AICA); 2) an Italian large-scale public hospital to manage the deployment life-cycle of internal IT products; 3) a Brazilian IT company (Elogroup) specializing in BPM tools; 4) a Hungarian company (John Von Neumann Computer Society) and 5) a Korean company (KPC) that works in the field of computer driving licensing.

Participants

Twenty knowledge workers, characterized by different profiles, were recruited from six companies: 2 MDs, 2 BMs, 4 HRs, 3 PMs, 3 CMs, and 6 developers.

Procedure

The KPeople system was made available to the companies by hosting it on a WebScience server. Minimal modifications were required to customize the application portfolio of each company according to the KPeople system requirements were introduced by means of specific plug-ins. For example, the plug-in for the Microsoft Outlook mail client allows the KPeople system to automatically trace mail exchanges among the people involved in a particular process. This solution also limited the impact of the introduction of a new system in the usual practice of the companies. The trials focused on the planning, development and management of IT applications that support the core business of the companies. In the companies being considered, the realization of these applications is largely outsourced, thus the supervision of the related processes is particularly complex and critical, due to the possible geographical distribution of the actors and to business realities which are extremely different from each other. Thus, the processes considered in the trials were:

- Preparation of the budget dedicated to the development of information technology products and additions / changes to existing products.
- Testing of the applications developed by external suppliers; management of product approvals; management of changes if the products are not approved.
- Management of extra features not planned in the original budget.
- Sharing of reports related to the use of the applications and to the interactions with the help desk.

The trials were conducted over a period of about 3 weeks and involved several users. Within this period, they were enabled to use all the features provided by the prototype simply accessing the system via a web browser. They also installed the plug-in for Outlook.

Data Collection

At the end of the trial, users met again to gather feedback on the3 potential benefits of the tool and its use, its level of usability, areas required for improvement, and implementation of other features. Data collection was performed by means of a questionnaire designed to collect qualitative information concerning the unstructured or semi-structured collaborative activities performed during the trial.

Results

The participants' answers were analyzed according to the following criteria: *Relevance to business goals* was assessed by using a semantic differential scale that required users to judge the KPeople on 12 items. The participants could modulate their evaluation on a (1 = very negative ÷ 7 = very positive). A user-perceived relevance for business goals index was computed as the mean value of the score across all the 12 items: mean = 5.2, mean S.E. = 0.94, reliability α□= 0.75.

Degree of utility was measured by the data collected through four questions, asking the participants to judge whether they found KPeople's features for daily work useful and whether they were supported by the implemented business partner. The participants also scored the general degree of utility of the system on a 7-point Likert-scale (1 = very negative ÷ 7 = very positive). On average, they had a mark

of 5.6 (min = 4.1, max = 6.9, reliability α□= 0.83). A question also asked the participants to globally score the *Perceived degree of efficiency of processes with KPeople* on a 10-point scale (1 = very negative ÷ 10 = very positive). The global satisfaction was high (mean = 7.7, mean S.E. = 0.7). The last two questions then asked so the participants could judge their performance as knowledge workers with and without the KPeople system. In particular, they had to indicate the percentage of the processes over which they felt they had adequate control, based on a retrospective analysis of the processes execution. This can be considered as a proxy of confidence (Hornbæk, 2006). On average, the participants stated that they were able to completely control the 94% of the processes executed during the trial (min = 70%, max = 100%, mean S.E. = 10.7%). They also felt very satisfied about their performance (mean = 3.2, mean S.E. = 0.6; on a 4-point scale 1 = very negative ÷ 4 = very positive).

CONCLUSION

Knowledge workers are becoming more and more important for companies, especially for networked organizations. In such a context, knowledge workers operate multiple tasks at the same time, in different working environments involving many parallel knowledge processes that, very often, are not codified in formal procedures and are unstructured, collaborative and continuously changing. Organizations base their success on the quality of the management of informal processes/activities that are not elicited as business practices. Informal processes limit the growth of organizations because they are highly dependent on the ability of the knowledge worker to perform the tasks correctly and promptly. In this paper, in order to meet the challenge of providing a conceptual tool to organize knowledge activities and integrate them within business processes, we presented a pattern-based approach to (re-)design business practices, which involve knowledge-intensive activities. We originally exploited the method of workflow patterns to knowledge processes as a key factor to quickly identify and rapidly apply effective business practices to support the activities of knowledge workers. By using a real case study, we presented a set of design patterns able to model collaborative activities – Collaborative Decision Making and other patterns that readers can find in Barchetti et al. (2011) – and cooperative activities (Coordinate Contribution, Retrieve Contribution, Escalation, and Deadline Agreement patterns) that represent recurring situations for knowledge workers.

To experiment with and evaluate the usefulness of the identified business patterns in real situations, we developed the KPeople software prototype. According to the Human-Centred Design approach, the system was designed and evaluated involving many stakeholders. Heuristic evaluations and user testing were carried out in order to improve the system usability. The KPeople system was then made available in six different companies spread around the world and twenty knowledge workers, with different roles in their company and who were in the process of project proposal drafting, were involved. The analysis of the data collected through a questionnaire showed that they perceived improved efficiency of the processes carried out with the support of the KPeople system. They felt a reassuring sense of control of the different sub processes, and also rated the system as being highly useful and relevant to the company's business goals.

The proposed approach allows companies to identify and to design collaboration activities recurring in the enterprise practices. The collaboration patterns can coexist with the traditional business process. Compared with the state of the art (Stephenson & Bandara, 2007) our approach is not focused on a specific application domain but can be used in several situations where the problem of managing the collaboration arises. While the state of the art deals mainly with the sociological aspects of collaboration (Briggs, 2003), we identified new collaboration patterns and presented an example of their representation using BPMN.

Future research will concern the collection of new patterns and the comparison of these patterns (derived from an in-field observations of knowledge workers) with those of the social network analysis tool of the KPeople system, which will be automatically gathered through process mining techniques.

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REFERENCES

Adler, P. S., & Kwon, S.-W. (2002). Social capital: Prospects for a new concept. *Academy of Management Review*, *27*(1), 17–40. doi: doi:10.2307/4134367

Alderete, M. V. (2012). SME e-cooperation: A theoretical team contract analysis under hidden information. [IJeC]. *International Journal of e-Collaboration*, *8*(1), 53–64. doi:10.4018/jec.2012010104

Andriole, S. J. (2010). Business impact of Web 2.0 technologies. *Communications of the ACM*, *53*(12), 67–79. doi:10.1145/1859204.1859225

Baars, H., & Kemper, H.-G. (2008). Management support with structured and unstructured data—an integrated business intelligence framework. *Information Systems Management*, *25*(2), 132–148. doi:10.1080/10580530801941058

Barchetti, U., Capodieci, A., Guido, A. L., & Mainetti, L. (2011). Modelling collaboration processes through design patterns. *Computing and Informatics*, *30*(1), 113–135.

Barchetti, U., Capodieci, A., Guido, A. L., & Mainetti, L. (2012a). Collaborative process management for the networked enterprise: A case study. In *Proceedings of the 26th International Conference on Advanced Information Networking and Applications Workshops (WAINA '12)*.

Barchetti, U., Capodieci, A., Guido, A. L., & Mainetti, L. (2012b). Information systems for knowledge workers: The Kpeople enterprise 2.0 tool. In X. S. Wang, I. Cruz, A. Delis & G. Huang (Eds.), *Proceedings of the Web Information Systems Engineering (WISE 2012)* (Vol. LNCS 7651, pp. 804-807). Berlin Heidelberg, Germany: Springer.

Bhandar, M., Pan, S.-L., & Tan, B. C. Y. (2007). Towards understanding the roles of social capital in knowledge integration: A case study of a collaborative information systems project. *Journal of the American Society for Information Science and Technology*, *58*(2), 263–274. doi:10.1002/asi.20493

Blau, I. (2011). e-Collaboration within, between, and without institutions: Towards better functioning of online groups through networks. [IJeC]. *International Journal of e-Collaboration*, *7*(4), 22–36. doi:10.4018/jec.2011100102

Briggs, R. O. (2003). Collaboration engineering with ThinkLets to pursue sustained success with group support systems. *Journal of Management Information Systems*, *4*, 31–64.

Burke, K., & Calton, J. M. (2009). A framework describing the relationships among social technologies and social capital formation in electronic entrepreneurial networking. In N. Kock (Ed.), *e-Collaboration technologies and organizational performance: Current and future trends* (pp. 25–38). IGI Global. doi:10.4018/978-1-60566-984-7.ch038

Cook, N. (2008). *Enterprise 2.0: How social software will change the future of work*. Ashgate Publishing Company.

Davenport, T. H. (2005). *Thinking for a living: How to get better performances and results from knowledge workers*. Harvard Business Press.

Desai, N., Chopra, A. K., & Singh, M. P. (2009). Amoeba: A methodology for modeling and evolving cross-organizational business processes. [TOSEM]. *ACM Transactions on Software Engineering and Methodology*, *19*(2), 1–45. doi:10.1145/1571629.1571632

Di Blas, N., Bucciero, A., Mainetti, L., & Paolini, P. (2012). Multi-user virtual environments for learning: Experience and technology design. *IEEE Transactions on Learning Technologies*, *5*(4), 349–365. doi:10.1109/TLT.2012.16

Dietz, J. L. G. (2006). *Enterprise ontology: Theory and methodology*. Berlin Heidelberg, Germany: Springer. doi:10.1007/3-540-33149-2

Drucker, P. F. (1959). *Landmarks of tomorrow*. New York, NY: Harper.

Fowler, M. (1997). *Analysis patterns: Reusable object models*. Addison-Wesley.

Gebauer, J., & Lee, F. (2008). Enterprise system flexibility and implementation strategies: Aligning theory with evidence from a case study. *Information Systems Management*, *25*(1), 71–82. doi:10.1080/10580530701777198

Gschwind, T., Koehler, J., & Wong, J. (2008). Applying patterns during business process modeling. In M. Dumas, M. Reichert, & M.-C. Shan (Eds.), *Business process management* (Vol. 5240, pp. 4–19). Springer Berlin Heidelberg. doi:10.1007/978-3-540-85758-7_4

Hall, H., & Goody, M. (2007). KM, culture and compromise: Interventions to promote knowledge sharing supported by technology in corporate environments. *Journal of Information Science*, *33*(2), 181–188. doi:10.1177/0165551506070708

Harrison-Broninski, K. (2005). *Human interactions: The heart and soul of business process management*. Meghan Kiffer Pr.

Henkel, M., Johannesson, P., & Perjons, E. (2011). An approach for e-service design using enterprise models. *International Journal of Information System Modeling and Design*, *2*(1), 1–23. doi:10.4018/jismd.2011010101

Hornbæk, K. (2006). Current practice in measuring usability: Challenges to usability studies and research. *International Journal of Human-Computer Studies, 64*(2), 79-102. doi: http://dx.doi.org/10.1016/j.ijhcs.2005.06.002 ISO/IEC 9241-210. (2010). *Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems.*

Jashapara, A. (2007). Moving beyond tacit and explicit distinctions: A realist theory of organizational knowledge. *Journal of Information Science*, *33*(6), 752–766. doi:10.1177/0165551506078404

Kristensen, K., & Kijl, B. (2010). Collaborative performance: Addressing the ROI of collaboration. [IJeC]. *International Journal of e-Collaboration*, *6*(1), 53–69. doi:10.4018/jec.2010091104

Lundqvist, M., Sandkuhl, K., & Seigerroth, U. (2011). Modelling information demand in an enterprise Context: Method, notation, and lessons learned. *International Journal of Information System Modeling and Design*, *2*(3), 75–95. doi:10.4018/jismd.2011070104

Maule, R. W., & Gallup, S. (2010). Enterprise 2.0 collaboration for collective knowledge and intelligence applications. In T. Sobh (Ed.), *Innovations and advances in computer sciences and engineering* (pp. 567–572). Springer Netherlands. doi:10.1007/978-90-481-3658-2_99

McAfee, A. P. (2006). Enterprise 2.0: The dawn of emergent collaboration. *Management of Technology and Innovation*, *47*(3), 21–28.

Mitra, A., & Gupta, A. (2005). *Agile systems with reusable patterns of business knowledge: A component-based approach*. Artech House, Inc.

Nielsen, J., & Mack, R. L. (1994). *Usability inspection methods*. New York, NY: John Wiley & Sons, Inc.

Remus, U. (2012). Exploring the dynamics behind knowledge management challenges—An enterprise resource planning case study. *Information Systems Management*, *29*(3), 188–200. doi:10.1080/10580530.2012.687309

Rogers, Y., Sharp, H., & Preece, J. (2011). *Interaction design: Beyond human - computer interaction* (3rd ed.). Wiley.

Russell, N., ter Hofstede, A., van der Aalst, W., & Mulyar, N. (2006). *Workflow control-flow patterns: A revised view.*

Sari, B., Loeh, H., & Katzy, B. R. (2010). Emerging collaboration routines in knowledge-intensive work processes: Insights from three case studies. [IJeC]. *International Journal of e-Collaboration*, *6*(1), 33–52. doi:10.4018/jec.2010091103

Schuler, D., & Namioka, A. (1993). *Participatory design: Principles and practices*. CRC / Lawrence Erlbaum Associates.

Simperl, E., Thurlow, I., Warren, P., Dengler, F., Davies, J., & Grobelnik, M. et al. (2010). Overcoming information overload in the enterprise: The active approach. *IEEE Internet Computing*, *14*(6), 39–46. doi:10.1109/MIC.2010.146

Stephenson, C., & Bandara, W. (2007). Enhancing best practices in public health: using process patterns for business process management. In *Proceedings of the 15th European Conference on Information Systems.*

Van Der Aalst, W. M. P., Ter Hofstede, A. H. M., Kiepuszewski, B., & Barros, A. P. (2003). Workflow patterns. *Distributed and Parallel Databases*, *14*(1), 5–51. doi:10.1023/A:1022883727209

Walker, G., Kogut, B., & Shan, W. (1997). Social capital, structural holes and the formation of an industry network. *Organization Science*, *8*(2), 109–125. doi:10.1287/orsc.8.2.109

Winograd, T. (1986). A language/action perspective on the design of cooperative work. In *Proceedings of the ACM Conference on Computer-Supported Cooperative Work*, Austin, TX.

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