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Adopting Collaborative Business Processes to Prevent the Loss of Information in Public Administration Organisations

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***Abstract*—**Recently, the use of web 2.0 tools has increased in companies and public administration organisations. This phenomenon, known as "Enterprise 2.0", has, *de facto*, modified common organisational and operative practices. This has led "knowledge workers" to change their working practices through the use of Web 2.0 communication tools. Unfortunately, these tools have not been integrated with existing enterprise information systems, a situation that could potentially lead to a loss of information. This is an important problem in an organisational context, because knowledge of information exchanged within the organisation is needed to increase the efficiency and competitiveness of the organisation. In this article we demonstrate that it is possible to capture this knowledge using collaboration processes, which are processes of abstraction created in accordance with design patterns and applied to new organisational operative practices.

***Keywords*—**Business Practices, Business Process Patterns, Collaboration Tools, Enterprise 2.0, Knowledge Workers.

I. Introduction

IN recent years, as a consequence of emerging communication tools that have gradually become widespread, including within business contexts, the term "Enterprise 2.0" has been introduced. Enterprise 2.0 encompasses the use of social networking tools within companies, or between companies and their partners or customers; it helps people to connect or collaborate through computer-mediated communication, creating online communities [1]. Enterprise 2.0 stimulates collaboration and knowledge sharing, not only in companies, but also in other organisations, including those dedicated to public administration.

Therefore, new operative practices that accompany and complete existing ones have been introduced. As a consequence, in addition to the traditional business processes that define the working practices of a company, it is possible to identify several collaboration processes; these are defined by Nial Cook [2].

Public administration organisations are not companies, but are organisations of workers and, from the point of view of collaboration processes, may be regarded as such.

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Collaboration processes are characterised by strong and non-predefined collaboration among employees, for the purpose of achieving common goals. This collaboration is carried out through a combination of traditional communication tools (e-mail, telephone, direct conversation) and web 2.0 facilities (chat, social networks, blogs, wikis, etc.). The public employees involved in a collaboration process are free to choose their favorite collaboration tool.

Therefore, there is no predefined workbench within the organisation: each individual employee is the only one who knows and understands his needs, such that he can build and modify his own workbench. With Enterprise 2.0, employees are now becoming knowledge workers [3]; they are the ones best equipped to understand customers and organisational processes [4]. This statement is true especially for workers in public administration.

The use of Enterprise 2.0 tools allows people to be significantly more productive, but they need to be trained or receive facilitative support [5]. It is very important that this aid come from the information systems and IT infrastructure.

The real problem is the discrepancy between knowledge workers' social needs and experience [6] and the information systems in use [7]. Very often, the information system is not ready to support the execution of collaboration processes, so knowledge workers use their own collaboration tools outside of the system, with a consequence of a loss of information that is useful for the organisation.

These collaboration processes require new functionalities, different from those of traditional information systems, such as facilities for communication, file sharing, knowledge networking, calendaring, scheduling [8], and so on.

In order to align information systems with new user needs, we exploit the traditional approach of BPM (Business Process Management): outline the business process flow, articulate the targeted process, and have a clear agenda for deployment strategies [9]. In other words, it is important, first, to describe the flow of the business process, using graphical notation, and next to identify some best practices in order to apply them to the specific context. The visualisation of business processes in the form of process models has increased in popularity and importance [10]. The real challenge is in deriving process models efficiently (i.e., consuming fewer resources and less time) and effectively (i.e., meeting high quality standards in order to meet specific needs). As a consequence, the problem becomes the identification and design of collaboration processes such that they can be integrated with the information

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system. In order to solve this problem, it is necessary to understand the current process (in our case, the collaboration process), and to aim towards the design of a better process (in our case, one that would support the knowledge worker experience). To do so, the best practices in the sector must be analysed and the current business processes must be re-designed.

A pattern-based approach can be useful in redesigning processes [3]. In fact, the concept of making use of patterns has been effective in practical contexts and will therefore probably be suitable in other contexts as well [11]. The pattern-based approach has been inherited from the traditional approach to the design of business processes (www.workflowpatterns.org), and from the software engineering sector [12]. Several research studies propose the use of workflow patterns as a means of categorising recurring problems and solutions when modelling business processes [13]. The basic benefit of using such patterns is that the fundamental elements can be reused and, hence, better knowledge management, efficiency, and effectiveness can be attained when the patterns are applied within projects. Therefore, patterns can be considered as building blocks which allow designers to compose solutions, so as to obtain meaningful artifacts with minimal effort. In the context of Enterprise 2.0, very few research efforts have been made, probably, in our opinion, because it is very complex work to design business processes that do not follow a well-defined flow. Collaboration processes can be designed using design patterns of BPMN notation [14].

In this article, a methodology involving the use and identification of patterns to prevent loss of information is described. The preserved information in this way becomes part of the organisation's total information assets. This methodology was developed and applied for the first time in ICT. Here, it will be expanded and applied to the field of public administration.

The paper is structured as follows: the next section, "Related Work", reports on the most important related works that focus on design patterns and their application to business process design. The section titled "Methodology Used" provides readers with an overview of the methodological approach we used to identify and put into practice collaborative processes. The section titled "Description of a Use Case: A New Municipal Act" describes a use case in the public administration industry and how it has been modelled using a pattern-based approach. Finally, the section titled "Evaluation, Conclusion, and Future Works" summarises our key messages and sketches future research directions.

II. Related Work

In this section, we study the explicit modelling of business practices, to try to give support to the concepts of collaborative and cooperative semi-structured processes. Business practices are the most useful practices for organising internal company processes. Therefore, in order to identify better practices, it is really important to create efficient and effective business practices, but it is also important to create opportunities to reuse knowledge and expertise [15]. Each company should find methods for providing the necessary level of abstraction while modelling daily practices. However, at the same time, companies must manage and preserve social capital through their knowledge workers [16].

Knowledge workers can be divided among different categories, reflecting what each individual does in the work process in which he or she is involved [17]. Every day, each knowledge worker is involved in different unstructured activities, which are information intensive but lack technology support. For this reason, there is a rapid overload of information that has a negative impact on the worker's performance. To date, we do not have a lot of studies on this topic. Andriole attempts to demonstrate how new technologies enable companies to cost-effectively increase their productivity and their competitive advantage, if they are properly deployed [18]. If a company wants to increase its productivity, it must integrate emerging technologies (most importantly, those that comprise Web 2.0) with traditional business processes [19]. In this way, the information system supports the knowledge worker in using the right information, in the right format, at the right time. Nevertheless, we must 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 research in this area has been carried out. Authors Jennings and Finkelstein [20] have proposed an analysis of some specific lightweight ad hoc processes known as "micro workflows". Using gestural analysis of human agents within these flexible micro workflows in combination with social analysis techniques allows new flexibilities within business processes to be identified. The authors have two purposes: to give a better definition of how people work in companies and determine how, the people, can use Web 2.0 tools in their daily activities in order to obtain better results. Stephenson and Bandara [21] present business process patterns that enhance the design of the public health care business process.

In this context, the main technological areas through which Enterprise 2.0 is carried out are: social networks and communities, unified communication/collaboration, and enterprise content management.

Cook introduces the concept of the collaboration process as an addition to traditional business processes. It is the way in which a company organises its work [22]. Collaboration processes have the characteristic of collaboration among the participating stakeholders, in order to achieve a common goal. This collaboration takes place through a combination of communication tools, both traditional (e-mail, telephone, direct conversation) and Web 2.0-oriented [23].

Harrison [24] argues that it is necessary to amplify human-driven processes in order to understand how to formally describe such work and then capture this knowledge in a software tool. This requires a change in both business process modelling and information systems. The author analyses the nature of work and explains how information systems can

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support it in the future. In describing human work and interactions between humans and technology, the identification of patterns can be a useful approach, allowing for fine-grained modelling support, as Gschwind, Koehler, and Wong point out [25]. 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 whereby business users receive help in understanding the context of their work with the aid of design patterns.

The concept of pattern [11] has been useful in 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 passed down to the business processes arena. References [13], [26]-[31] point out that most analysts who have worked on simplifying business processes have focused on reusing some process elements or identifying those that can be reapplied from one process to another, or at least applied in situations in which similar processes are encountered. This solution, which comes from the methodology of business process patterns, is very helpful in the information systems field, and is an important step towards creating a structured and systematic way to manage business practices in both real [30], [31] and virtual environments [32].

III. Methodology Used

In this section, the methodological approach used to identify collaborative processes is described. As was written in the introduction, the adaptive and unstructured nature of knowledge generation processes could become an obstacle to the formalisation of business practices on a large scale.

In order to identify and apply the patterns of collaborative processes, you have to adopt an approach that considers the needs of the organisation as well as the best currently available practices for the identification and application of model patterns.

The approach to be followed in identifying and applying the patterns of collaborative business processes is divided into six phases:

1) The first phase is characterised by the analysis of the business environment, with a lot of attention given to the identification of some of the processes and areas which are characterised by both intense collaborative activities among the workers and the need to use Web 2.0 tools. One of the first steps in this preliminary stage is identifying the competence areas of the company and the ways in which its employees are involved in various projects. In this phase, you can see that the workers are used to working and collaborating with each other. Interactions among them are not very often defined in advance; some activities are done by hand while many others are carried out through the use of unstructured communication tools (chat or email), so it is important to identify all the different professionals who collaborate with each other to achieve common goals. In this stage, we have to identify the various study cases, using:
   - "Focus groups" with business leaders and heads of business units;
   - A questionnaire.
2) The work continues in the second phase, where we model the business processes that were detectable within the study cases selected in the previous step, through the use of BPMN. You need to study a number of processes, being careful to analyse both the business practices that are codified and all the activities that occur every day that are not already encoded or predetermined. In other words: first of all, all of the collaborative practices should be highlighted and modelled.
3) In the third step, you engage in the study and comparison of the BPMN diagrams of all the modelled processes; to identify new patterns, it is necessary to focus all repetitive common and atomic "segments" derived from the modelling performed in the previous phase. Particular attention should be paid to collaborative and cooperative activities, where we found a number of practices that incorporate considerable repetition. Each pattern identified must be a shaper of typical situations of Enterprise 2.0 and, if properly applied, able to provide concrete support to the actors involved in such situations. Typical situations that occur within organisations are characterised by a strong collaboration among the actors, who all contribute to the performance of a particular task, as well as an intensive use of Web 2.0 tools (such as wikis, blogs, chat, etc.) to assist the progress of the activity. So, the identified patterns will respond to two fundamental needs: on the one hand, they help manage collaboration among different actors that are called on to accomplish a given task that lacks a pre-defined and pre-structured sequence, and on the other hand, they allow the best use of the Web 2.0 tools that are typically employed within the enterprise. In conclusion, the approach to be used for the identification of design patterns requires the modelling of processes that are related to three types of activities:
   - Activities related to cooperation among workers for the purpose of achieving a specific goal (collaboration activity);
   - Activities that require the cooperation of different people with different roles, that are not encoded within traditional information systems, and for which it is useful to keep track of the messages exchanged in order not to lose information (coordination activity);
   - Activities that are repeated many times and for which there is a risk of losing information that would be useful for the enterprise (know-how elicitation activity).
4) Some of the patterns detected in the previous step may already be known; thus, at this stage, it is necessary to identify those patterns that are similar or identical to patterns that have previously been identified. In these cases, it is better to apply already-known solutions which have been previously applied and validated in different contexts.

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5) During the fifth phase, you start to apply the design patterns identified in the third step to the modelling and realisation of a prototype of a collaborative information system. The purpose of this step is to verify the validity of the approach that was adopted to identify the patterns, and to apply these patterns to the realisation of a collaborative information system. The identified patterns should be used both in the design of the platform's conceptual model and in its implementation, in order to achieve a development framework that will allow us to:

- Manage both structured and unstructured information flows;
- Incorporate a portfolio of solutions to support unstructured business processes;
- Create a workspace focused and customised to the needs of individual workers.

6) Following prototype creation, in order to verify the usefulness of this application of patterns in the context of a collaborative information system, you need to collect trial data (sixth phase, "Evaluation of Design Patterns"). This evaluation of activities must be conducted by administering questionnaires to the knowledge workers, who will gauge the functioning of the system. The testing must be preceded by a training session aimed at users involved in the identified processes, with the goal of explaining the project and demonstrating the main functions of the system and how it may be used. Once the trial is ended, you need to meet with the users again, in order to receive feedback on the potential of the tool and the benefits associated with its use in the following areas:

- Level of usability;
- Areas of possible intervention for the purpose of subsequent improvements;
- Possible extensions of its features.

The system should be subsequently reworked in light of the evaluation data.

IV. Description of a Use Case: A New Municipal Act

A. Description of the Use Case

A Municipal Act is a single judge administrative act that manifests the will of the service manager of an institution, according to the rules of organisation of the offices, services, and executive management plan of the municipality.

The conditions of enforceability and effectiveness of the Municipal Act are regulated by law, by statute, and by local regulations. Depending on the type of Municipal Act, there are different enforceability conditions:

- Without expenditure commitment: made enforceable following the subscription of the manager who adopted it;
- With expenditure commitment: made enforceable following the signature of the Municipal Accountant;
- Of clearance: made executive by the endorsement of the head of the financial department, referred to in art. 184, paragraph 4, of Legislative Decree no. 267/2000, and in subsequent amendments.

The process leading to the creation of a new Municipal Act includes the following main phases:

- Evidentiary;
- Manager checking;
- Accountant checking;
- Secretary checking;
- Publication.

This process involves several actors including:

- Instructor (Evidentiary phase);
- Manager (Manager checking phase);
- Accountant (Accountant checking phase);
- Secretary (Secretary checking phase);
- Editor (Publication phase);
- Publication Responsible (Publication phase).

All of these figures are strictly necessary in order to ensure that every aspect concerning the definition, approval, and publication of the Municipal Act will be taken care of.

The processes that will be presented were used to design an information system for the public services of a medium-sized municipality in southern Italy. The employees of this town have a strong need to collaborate with each other through the use of Web 2.0 tools that are completely untied from the official information system.

B. Modelling of the Use Case (TO-BE)

After a preliminary phase of analysis of the use case, we proceeded to the modelling of the same, using BPMN notation. This activity led to the definition of the process called "New Municipal Act".

Fig. 1 shows the design of the BPMN process "New Municipal Act". We can observe that the actor who starts the process is the Manager. The Manager initiates the creation of a new act by passing the assignment to one or more Instructors. Once the assignment is received, the various instructors proceed to the definition, creation and transmission of the various contributions. Once a draft of the act has been obtained, the Manager has the power to:

- Accept it and sign it without modification;
- Reject it and send it back to the Evidentiary phase;
- Modify it, accept it, and sign it.

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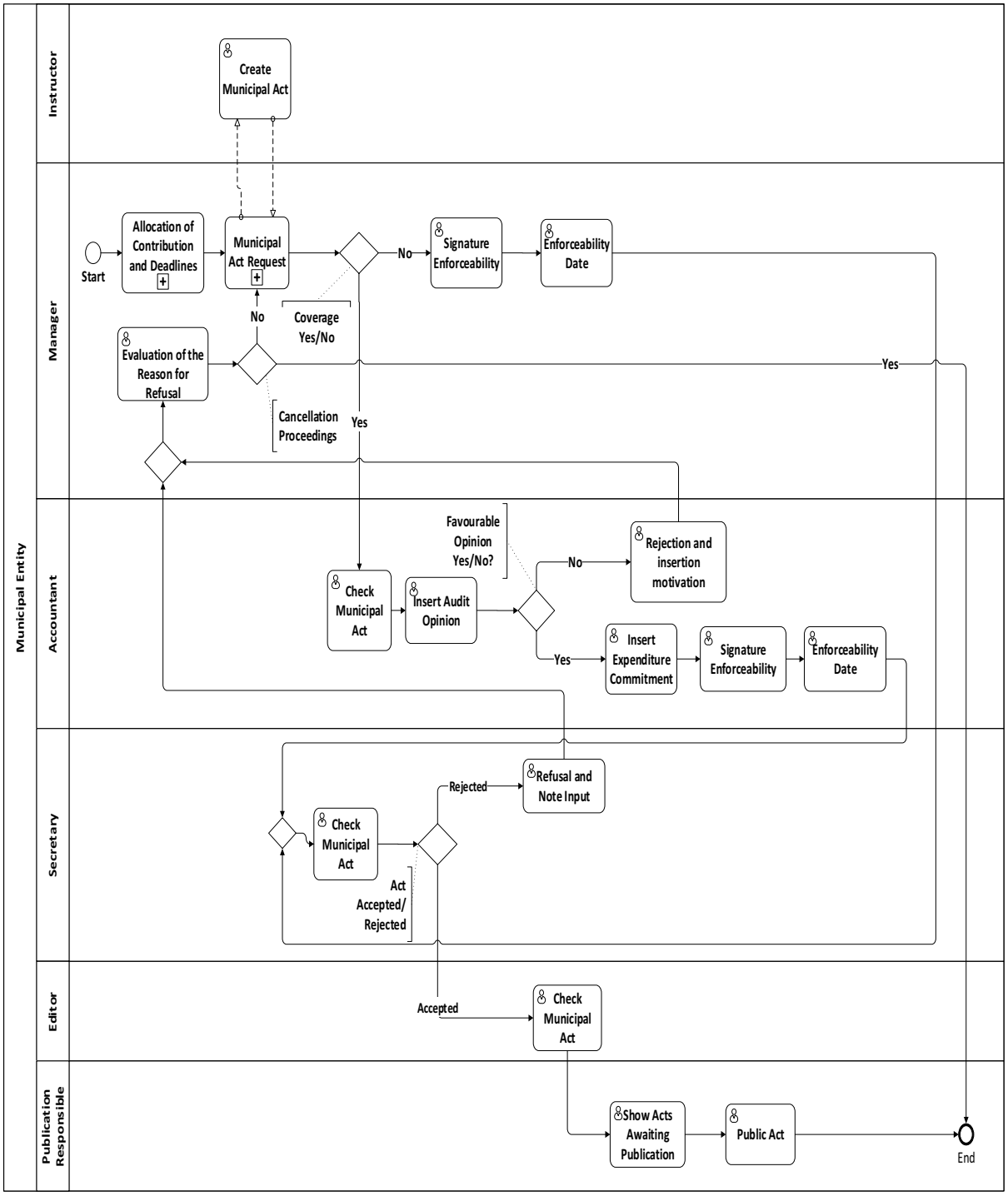

Fig. 1 BPMN process design "New Municipal Act"

The act, once approved by the Manager, is sent to the Accountant's office to be validated if it requires an expenditure commitment; otherwise it goes directly to the Secretary's office. The accountant in charge examines the act and can either accept it or reject it. In the case of refusal, he inserts the reasons and sends the act back to the Executive phase. In the case of a favourable opinion, he specifies his audit opinion and affixes his "enforceability signature". Upon the approval of the Accountant (Act with expenditure commitment) or of the Executive (Act without expenditure commitment), the Act passes into the hands of the Secretary, who may either reject it and close the process (inserting the reasons) or accept it. The last phase in the process is the publication of the final Act in the online Praetorian register. This operation is performed by the Editor and by the in-charge Publication Responsible.

The modelling of this process was accomplished by taking into consideration the methodology presented in the previous

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section. After analysing and modelling the use case, we proceeded with the identification of possible collaborative sub-processes. The collaborative sub-processes identified in this process are:

- Assigning of contributions and deadlines;
- New Municipal Act Request.

These sub-processes involve known collaborative behaviours which have been modelled through the use of patterns in previous works [29], [30]. This specific instance did not reveal any collaborative behaviours that allowed for the identification of new patterns. The following paragraphs will explain the details of these two sub-processes.

1) Secondary Process: Assigning of Contributions and Deadlines

Fig. 2 shows a drawing of the BPMN sub-process "Allocation of contributions and deadlines". The sub-process is started by the Manager, who coordinates the contributions and the deadlines of the individual instructors who will take part in the drafting of the new Municipal Act. This sub-process was modelled using the pattern "Deadline Agreement", already published in [30].

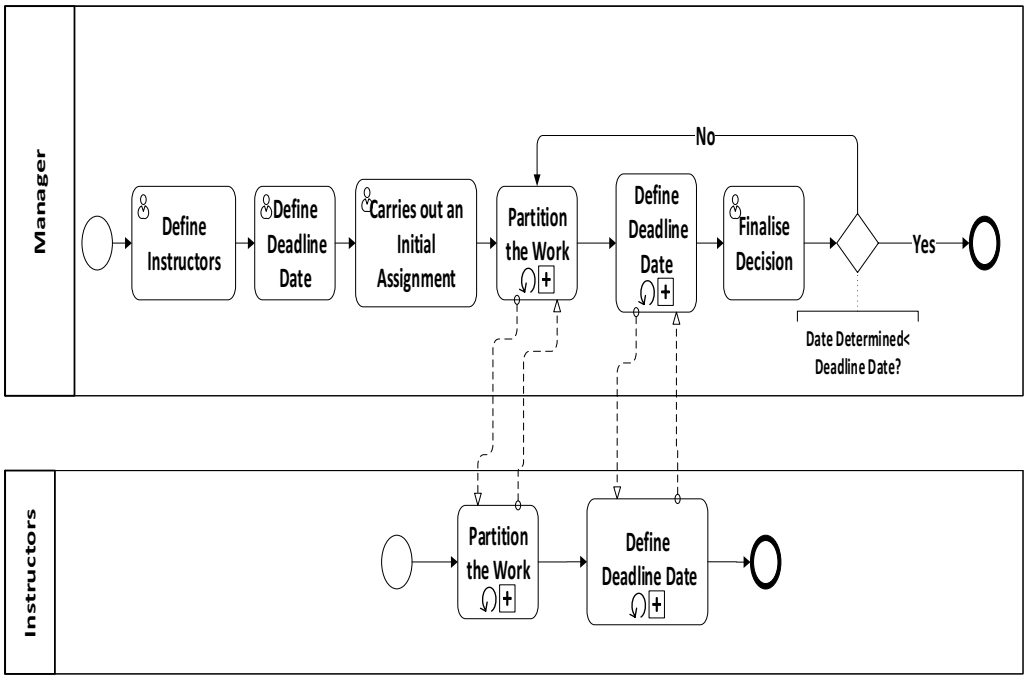

Fig. 2 BPMN sub-process design "Allocation of Contribution and Deadlines"

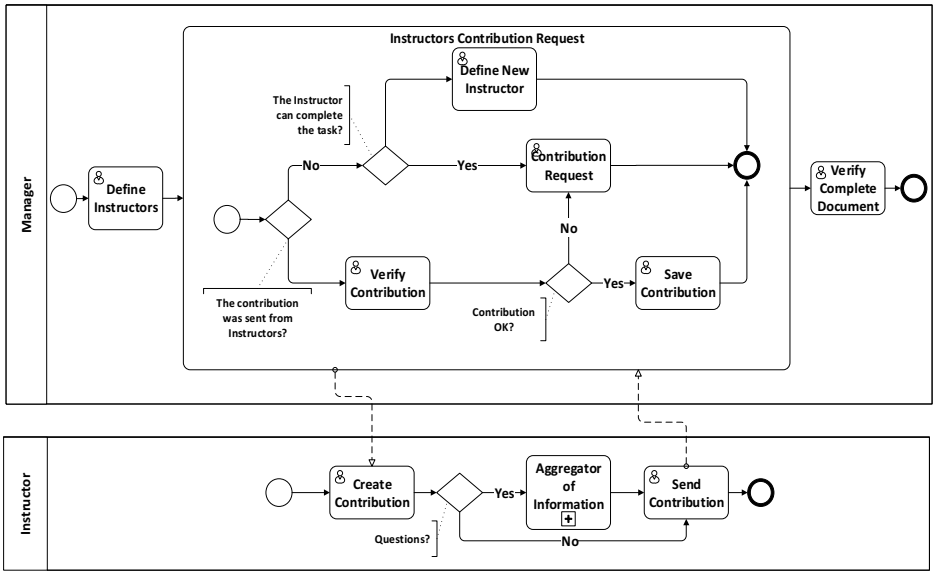

Fig. 3 BPMN sub-process design "New Municipal Act Request"

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This pattern aims to create a model in which deadline agreement activity can be performed efficiently, taking into account the different needs of the people involved. Two classes of actor characterise the pattern: the Requestor, who is responsible for the completion of the whole activity, and one or more Providers, who must provide the required contributions. To create agreement regarding work assignations and internal release dates, the Requestor, first of all, defines the date by which any contribution must be provided. Then he or she carries out an initial assignation of work activities. Two collaborative activities ("Work Partitioning" and "Deadline Collaborative Definition") begin here. Each of them involves a Requestor and the Providers. These collaborative activities deal with, respectively, assigning the work (the "Partition the Work" task) and agreeing on internal release dates for each Provider (the "Define Deadline Date" task). 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 assignations and the internal deadline definitions. When the Work Partitioning and the Collaborative Deadline Definition processes are finished, the Requestor, through the "Finalise Decision" task, formalises the decisions that were made. He or she also compares the latest deadline with the dates agreed on with the Providers as the deadlines for the conclusions of their activities. If these deadlines are later than the date defined initially by the Requestor, a new iteration of the two collaborative activities can be carried out.

2) Secondary Process: New Municipal Act Request

Fig. 3 shows a drawing of the BPMN sub-process "New Municipal Act Request". The sub-process is started by the Manager for the purpose of creating a Municipal Act. The process ends when the various Instructors finish the sending of their contributions.

The secondary process "New Municipal Act Request" was modelled using the pattern "Retrieve Contributions", already published in [30]. This pattern models situations in which you need to collect contributions provided by multiple actors in order to achieve a common goal. It 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 on them.

The Retrieve Contributions pattern foresees the involvement of a Requestor and one or more Providers. The Requestor identifies the human resources that will have to provide the contributions, while the Providers produce and send the required contributions.

This pattern involves the use of the pattern/sub-process "Coordinates Enhanced Contributions".

This sub-process aims to verify and evaluate the received contributions. It allows for the coordination of the contributions of multiple actors. First of all, the system checks whether a Provider has delivered the contribution that has been assigned to him or her. If the contribution has not been received, the system requests the contribution from the Provider.

Otherwise, the received contribution is evaluated. If it matches quality standards it is then registered or, if it does not meet requirements, the system asks the Provider for a new version.

The sub-process "New Municipal Act Request" has inside of it a further sub-process called "Aggregator of Information", which will be described in the following paragraph.

3) Secondary Process: Aggregator of Information

During the creation of their various contributions, Instructors repeatedly make requests of the Manager regarding uncertainties they have about the proper structuring of their contributions. Very often, such requests are made through Web 2.0 tools, or even by telephone.

The problems involved with exchanging information by phone can be overcome by encouraging employees to use Web 2.0 tools.

To solve the problem of unstructured information obtained through the use of Web 2.0 tools, we have used the pattern "Aggregate Activity Loop", already published in [29].

This pattern allows for the extraction of structured information from interactions that are conducted through Web 2.0 tools which generate unstructured information. The goal of the Aggregate Activity Loop is to store information coming from activities that use Web 2.0 tools.

The pattern starts each time an actor uses one or more communication tools. Within the pattern there is the chance to elaborate and transform unstructured information into structured information. Fig. 4 shows a reference model of the design pattern "Aggregate Activity Loop".

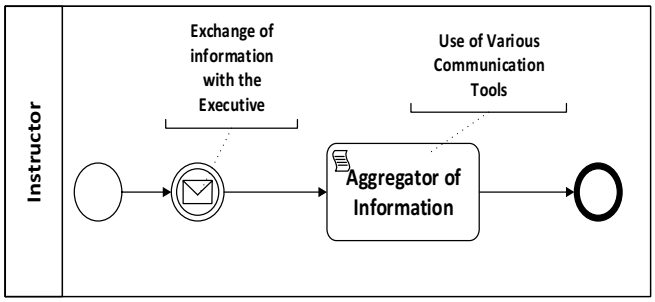

Fig. 4 BPMN Reference Model of "Aggregate Activity Loop"

V. Evaluation, Conclusion, and Future Works

In this paper we presented an application of a set of "Cross-domain" Collaborative Business Patterns to model an Enterprise 2.0 Public Administration Information System, with the purpose of preventing information loss within the system.

We also presented a pattern-based approach to redesigning business practices that involve knowledge-intensive activities, in order to meet the challenge of providing a conceptual tool that can organise knowledge activities and integrate them within business processes. We originally applied the methodology of workflow patterns to knowledge processes, as

a key factor in quickly identifying and rapidly applying effective business practices that support the activities of knowledge workers. Drawing on a real case study done within an ICT company, we were able to present a set of design patterns that could model collaborative activities, which readers can find in [29]-[31].

The aim of using these patterns is the resolution of emerging organisational issues, in order to support the activities of knowledge workers, to increase their productivity and their ability to find the information they need, and to enable their collaboration with colleagues.

The patterns presented in [29] and [30] were extracted from a case study completely different from the one shown here, the subjects of which were the collaborative processes of an ICT company.

The case studies presented in this paper use collaborative business patterns to model collaborative processes in the public administration sector.

The patterns were applied without any modification, and the results are immediately usable to model collaborative processes. In this way it was possible to test the generality of the identified patterns and their ability to be defined across domains.

Moreover, the proposed approach allows companies and organisations in general, to identify and design recurring collaborative activities within "enterprise practices". The collaboration patterns can coexist with traditional business processes.

Compared with the state of the art [21], our approach is not focused on a specific domain of application, but can be used in many situations where the problem of managing collaboration arises.

Future research will concern the application of the patterns to other case studies in various fields and the realisation, using collaborative patterns, of a prototype of an Enterprise 2.0 Information System.

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