Flexible Processes in Project-Centred Learning

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Abstract. Project-centred learning is increasingly used both in academia and in companies; universities train students to master complex tasks, often suggested by real-life situations, while companies train users to learn about new products, methods, technologies. This paper introduces a model-driven, extensible environ-ent, delivered on the Web, which is able to support long-distance collaboration of teams working on complex projects. The main merit of this proposal is the ability to self-organize processes, by using a simple Web interface and a library of activities and templates which cover most of the needs of this well-defined class of applications. This paradigm for dynamic workflow management is very general and can be applied to other application contexts, after understanding and modelling the relevant collaboration activities and templates.

Keywords: Flexible Processes, E-learning, Web Application Design.

1 Introduction

Project-centred learning provides environments where learners' teams cooperate on complex projects, collaborating by means of computer-mediated services. Increasingly, such environments are adopted in the context of workplace learning, to support scientific and technical studies, where teams work on a given project, and where teachers' support is substituted by interaction with a small group of advisors and tutors.

In this context, learning environments are organized so that to enhance team collaboration. Team members therefore can i) act individually, by producing separate results later combined to achieve a group result; ii) cooperate, by sharing and discuss ideas; iii) jointly collaborate, following planned procedures to reach a team result.

Collaboration requires some form of coordination ([4][6]), which often relies on the definition of processes guiding the learners' activities. Process-oriented collaboration is an important challenge today. Workflow management systems might appear suitable for modelling collaboration processes. However, while workflow-based applications are characterized by well-defined, predictable and repetitive

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procedures, collaboration processes are difficult to plan completely in advance. Such processes indeed need the consensus of the involved actors. Also, they are *flexible* [4], since they might need to be adapted, even during their execution, to the preferences of team members, as well as to the team members' evolution of background knowledge and competencies due to learning.

So far, several frameworks and tools have been developed to support e-learning teamwork activities (see for example the IMS-LD Design initiative, and also tools like IBM LearningSpace, WebCT, Blackboard, etc.). Such proposals offer facilities for resource sharing, synchronous and asynchronous communication, course planning and help desk. However, they are still "task-oriented", not "process-oriented" [5]. Very often they are designed to support individual activities, while they do not sustain the schedule and organization of collaborative processes. Some recent proposals also address the management of dynamic and flexible processes in teamwork collaboration ([4][5][6][7]), and introduce environments where team collaboration is driven by flexible, yet controlled, means of progressing through processes ([5][6][7]). Based on workflow technologies, on one hand such approaches ensure flexibility; however, on the other hand they often require users to learn concepts and primitives related to process design.

Our approach tries to overcome the limitations exposed by the previous approaches, and introduces an environment, delivered on the Web, which is able to support collaboration in virtual teams. A salient goal of our research is to propose a reference model for teamwork collaboration processes, enabling the management of *flexible* processes that can be defined and modified by end-users at runtime to accommodate their collaboration needs. As described in this paper, the model has guided the development of a Web-based platform, supporting flexible learning processes with pedagogical scenarios and tools enabling cooperation [1].

The paper is organized as follows: Sections 2 and 3 illustrate the main ingredients of our approach, namely a library of collaboration activities, and a Web-based interface for flexible process composition and modification. Section 4 then gives an overview of the architecture of our collaborative platform. Section 5 finally draws our conclusion.

2 Collaboration Activity Libraries

The most salient feature of our collaborative environment is that it allows team members working on a project to:

- *Dynamically define collaborative processes*, to organize and structure collaboration, on the basis of the team's preferred procedures.
- *Easily modify the planned processes*, to cope with the evolution of individuals as well as of the whole team.

Giving the end-users the possibility to define and modify their processes requires the system to offer easy-to-use definition interfaces, based on mechanisms that can guide the team members in the composition of processes, without requiring any specific knowledge and expertise on process design. Guiding inexperienced users requires that the system be "aware" of the semantics of the domain where processes must be executed. Such awareness can be achieved by means of libraries of pre-defined activity types, able to reflect the semantics of the possible tasks that users might need to coordinate and execute in a given context. Starting from this library, the system then guides the composition of “well-structured” processes [2].

Our framework is therefore based on the notion of *atomic activities*, i.e. small pieces of processes that are regularly performed by users to collaborate, and that therefore can be used for the definition of collaborative processes. Due to their fine granularity, they are reusable in several process definitions.

Some atomic activities have a general nature (e.g., those related to the management of documents), and can therefore be adopted in several domains where collaborative processes are required. Some other activities may however be particular for specific contexts and their identification requires an investigation of the addressed domain. In the context of the Cooper EU project [1], we have investigated *virtual company* scenarios [8], which situate learning in a virtual business environment, enabling learning-while-working. We have also analysed the domain of project-based education at two academic institutions (ALaRI[1], and ASP[2]), and project-based training at the CoWare company[3]. As a consequence, we developed a library that includes some forty atomic activities, classified according to the main cooperation goals they are related to:

– *Teamwork planning activities* support the scheduling of the team activities, such as the assignment of roles and tasks, the definition of milestones, etc.
– *Resource management activities* refer to the publication, access and also recommendation of resources (i.e., documents, forum messages, wikies, etc.).
– *Communication activities* enable the invocation of synchronous communication services (e.g., video conferences), and asynchronous communication tools (e.g., forum).
– *Reviewing and assessing activities* refer to the review of artefacts produced by the team, and to the assessment of team members, both individually and in the context of the team.

In our framework, which aims to deliver cooperative processes on the Web, atomic activities are realized as Web pages, expressing the interface through which users can execute them. A particular feature is that such pages are developed by means of a conceptual modelling approach, based on the WebML visual model [3]. The model-driven approach facilitates the extension of the library with new atomic activities, which just requires modelling new pages at a high level of abstraction.

Atomic activities constitute basic pieces of processes. Besides them, our framework also provides *templates*, i.e., pre-defined process models that can be the basis for the definition of new processes. Templates generally correspond to typical “patterns of collaboration”. In some cases, they can be pre-defined by the institution where teams operate, and are therefore used to suggest teams some “certified procedures”. Examples of built-in templates are: “Team Formation”, “Voting”, or “Delivery of Project Results”. Team members are also allowed to create their own templates and build a personal library, to be used for process composition.

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3 Web-Based Definition and Execution of Processes

Our collaborative platform is deployed on the Web, and makes use of standard Web technologies and of a hypertext-based interface to provide users with easy-to-use interfaces for the definition and execution of their collaboration processes. Process definition by end users requires the selection of atomic activities and/or templates from the library, and the definition of some constraints controlling the activity assignment to users and resources and the activity transition during process execution.

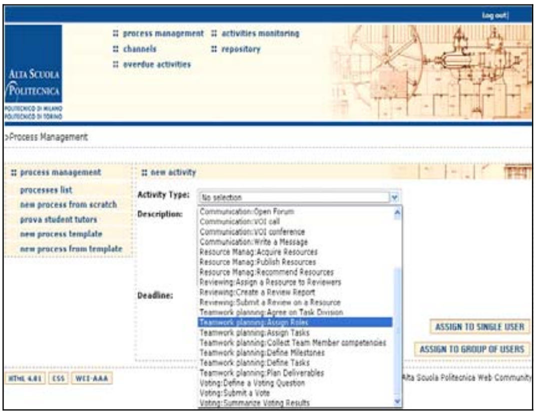

Fig. 1. A web page for activity selection

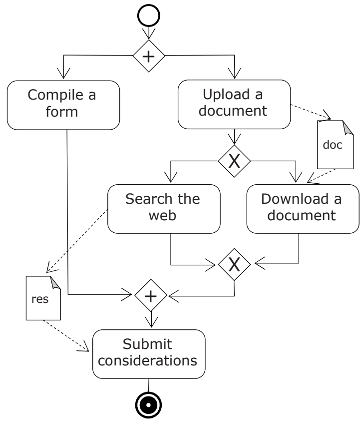

Fig. 2. Example of structured process

An example of Web page for process definition is shown in Fig. 1: the user selects the type of activity (e.g., “Assign Roles”) from the library, and enters a short activity description. S/He is then required to assign the activity to one or more members of her/his team. In case of multiple actors executing an activity, the user also needs to indicate the kind of parallelism governing the activity execution. Depending on the type of activity, the user might also associate the activity to some resources to manage possible documental flows. By means of a guided visit to subsequent form-based pages, users are allowed to compose processes and templates of any kind of complexity (as the one in Fig. 2), selecting and configuring one activity at a time. (Nested) blocks of parallel activities are created by means of a depth-first composition of each parallel branch. Users can also modify the definition of existing processes and templates at run-time.

Once the process has been defined, its execution consists in providing the users with the Web pages associated to the process activities. Process execution therefore implies guiding the users through the “right” sequence of Web pages, in accordance with the defined activity flow.

4 System Overview

Fig. 3 illustrates the architecture of our framework. Our approach in particular addresses flexible processes delivered on the Web. Therefore, in line with the

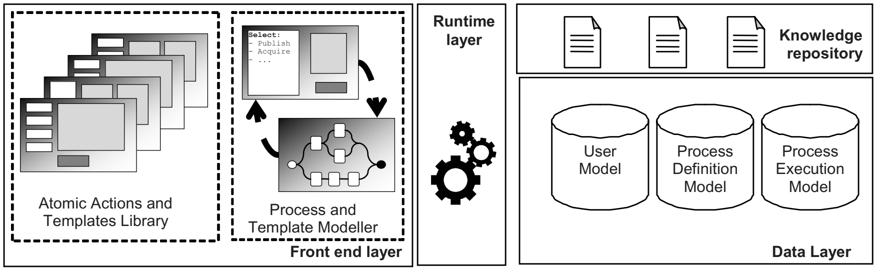

Fig. 3. The architecture of the framework supporting the definition and execution of flexible processes

classical architecture of Web applications, our proposal is characterized by a *data layer*, a *runtime layer* and a *front-end layer*.

The data layer stores some *process metadata*, representing the actors involved into the process (*User Model*), the process model (*Process Definition Model*) as defined by end-users, as well as some process execution data to control the process execution and also monitor users' activities (*Process Execution Model*). The hypertext layer then provides the front-end through which end-users dynamically compose processes and templates and feed the process model metadata (*Process and Template Modeller*). Such layer also includes the pages to execute the process activities (*Atomic Activity Library*). The runtime layer finally offers support for: *i)* computing the hypertext pages through which end-users define processes; *ii)* governing the execution of processes, according to the user-defined process model; *iii)* computing the pages supporting the execution of atomic activities.

In addition to the previous layers, the architecture relies on the availability of a knowledge repository that stores the resources needed by team members for developing projects, and that therefore can be the object of the activities composing a process.

5 Conclusions

In this paper we have presented a solution enabling the run-time user-driven definition of flexible collaborative processes. This solution has been implemented in educational scenarios for academic learning and industrial training, which rely on collaboration in project-based learning. Some first experiments with users in three different institutions have demonstrated the usefulness of the proposed environment in the academic and industrial domains where project-based learning is crucial. We nevertheless believe that the conceived solution and the proposed framework architecture have a general value for the management of dynamic flexible process, and can be replicated as well in other domains requiring process flexibility.

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References

[1] Bongio, A., et al.: Towards a Collaborative Open Environment of Project-Centred Learning. In: Nejdl, W., Tochtermann, K. (eds.) EC-TEL 2006. LNCS, vol. 4227, pp. 561–566. Springer, Heidelberg (2006)

[2] Ceri, S., Daniel, F., Matera, M., Raffio, A.: Providing Flexible Workflow Support to Porject-Centered Learning. Technical Report, DEI-Politecnico di Milano (June 2007)

[3] Ceri, S., Fraternali, P., Bongio, A., Brambilla, M., Comai, S., Matera, M.: Designing Data Intensive Web Applications. Morgan Kaufmann, San Francisco (2002)

[4] Charoy, F., Guabtni, A., Valdes, M.: Faura. A Dynamic Workflow Management System for Coordination of Cooperative Activities. In: Proc. of the First Int. DPM '06 Workshop (2006)

[5] Lin, J., Ho, C., Sadiq, W., Orlowska, M.W.: Using Workflow Technology to Manage Flexible e-Learning Services. Educational Technology & Society 5(4) (2002)

[6] Nodenot, T., Marquesuzaa, C., Laforcade, P., Sallaberry, C.: Model-based Engineering of Learning Situation for Adaptive Web Based Educational Systems. In: Proc. of WWW 2004, pp. 94–103. ACM Press, New York (2004)

[7] Sadiq, S., Sadiq, W., Orlowska, M.: Pockets of Flexibility in Workflow Specifications. In: Kunii, H.S., Jajodia, S., Sølvberg, A. (eds.) ER 2001. LNCS, vol. 2224, pp. 513–526. Springer, Heidelberg (2001)

[8] Westera, W., Sloep, P.B., Gerrissen, J.: The Design of the Virtual Company; Synergism of Learning and Working in a Networked Environment. Innovations in Education and Training International 37(1), 24–33 (2000)