

Towards a Project Management-enabled learning environmentS: a case study

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Abstract—The paper addresses the issue of managing activities within virtual learning communities, a topic virtually ignored by LMS platforms and systems that offer collaboration services, not least social networks. The question is not surprising in itself, as the issue of managing time, costs and resources, linked to the discipline of Project Management, is historically a difficult issue for the IT world, from a cultural, technical and organizational point of view. The issue becomes even more complex if applied to the management of learning processes, where in any case we have times, deadlines, associated costs, resources that work there etc. In this work we will present a component for the management of projects, activities and resources within a collaborative platform used mainly in e-learning contexts, based on the metaphor of virtual learning communities. The introduction of this new component within the system wants to respond to the need to manage collaborative activities between learners, providing a tool for managing and controlling the progress of the activities assigned to the various members of the community

Keywords-component: Project Management, virtual communities, social network

I. INTRODUCTION

In this paper, we present some services provided inside a virtual community platform as extensions towards managing time of the users, specifically teachers, students and administrative personnel involved in educational tasks. These services are rarely available (if any) inside Learning Management Systems (LMS), or have the form of simple tasks lists, to-do list or educational tasks scheduled in some workflow systems. Functionalities that provide support to (educational) projects are something significantly different. Project Management is a well-established discipline, where we can find different standards, guidelines and certification processes provided by world-wide organizations. The advent of web platforms that are claiming to provide Project Management services has changed the scenario, with a lot of competition in the market of Project Management services. If we aim to provide a Project Management approach to the conduction of educational activities, we find different solutions: a) “traditional” Project Management platforms, fully equipped with standardized services for scope, time, cost and resource management, but with a lack of support to collaboration and social processes inside project teams b) a lot of web platforms that support collaboration processes [1] and claim to support Project Management processes but that are not very efficient in this sense, lacking basic mechanisms like critical path method (CPM), timesheet cost and resource management, milestones, constraints, deadlines etc. [2]

This paper explores what should be needed, in the opinion of the author, inside a Learning Management System and inside educational contexts to support the many activities that fall into the definition of “project” [3]. We designed and realized a set of services specifically oriented towards the Project Management concepts and methodological tool and added them to a virtual community platform (with all basic collaboration, social media-oriented services). The platform, from providing traditional collaboration, education-oriented services, has been extended with a fully-fledged set of tools compatible with the most used Project Management standards, including task planning, costs, and resource management functionalities.

Since the advent of open source LMSs, Technology-Enhanced Learning (TEL) is a consolidated research topic, and a lot of tools and techniques are available for creating, delivering and managing online educational paths with plenty of solutions for every educational institution. What is less available inside the technological solutions that support our daily educational tasks is the integration with Project Management tools and techniques to manage tasks, resources, and costs within educational settings.

We can find a plethora of platforms and cloud services available today, even for free, that support at different level activities related to a project, but in order to implement Project Management discipline suggestions inside educational processes, a teacher (or a student) is forced to exit from his learning environment (for example, Moodle, Forma.LMS or Sakai LMSs), and use an external platform to manage project. This, in turn, could be problematic as most of the items that are the subject of the educational project are inside the LMS, so the user is forced to duplicate the material. Then, if we consider not only the trivial aforementioned problem of document sharing, but we extend the analysis to other typical Project Management tasks (like for example checking deadlines), the situation is again complex: the educational platform and the Project Management platform are completely disconnected.

What we can mostly find inside LMS under the label “project” or “Project Management” is a sort of task-list or to-do list service, that must be managed directly by the user. In few other cases, the idea of managing projects is simply implemented with a set of steps of a predefined workflow, in some way linked each other, but this is clearly very limited even respect to elementary Project Management tools.

If we consider the world of education in its full complexity and what educators do every day, we can find plenty of activities that can be fully defined as a “project”, but strangely software

platforms that are so useful for educational purposes are not providing adequate support to this.

II. PROJECTS IN EDUCATIONAL CONTEXTS

The de-facto standard in the Project Management discipline [3] clearly identifies what a “project” is: “a temporary endeavour undertaken to create a unique product, service, or result” [3]. The discipline of Project Management [4] is the application of a collection of tools and techniques (such as the CPM and matrix organization) to direct the use of diverse resources toward the accomplishment of a unique, complex, one-time task within time, cost and quality constraints.

After many years of mostly being ignored by the software industry (with some notable exceptions), nowadays we can find on the market, many different tools that project managers can choose to plan and manage their projects. Nevertheless, the application of tools and techniques derived from the standards is rare inside these platforms, where the focus is mainly on extended functionalities for Agile and in general collaboration services, rather than focusing first on core services like critical path method (CPM), Critical Chain Method (CCM), PERT, etc.

On one side, the perspective of using a collaborative platform as a Project Management tool is very interesting and fascinating, but this should happen without compromises respect to what Project Management methods provided to millions of skilled project managers around the globe, thus limiting the power of Project Management concepts. Deadlines, cost management, task duration, resources, these and many others are problems that everyone involved in any kind of project-related activities are forced to face.

The next consideration relates to the presence of these tools inside another kind of collaboration software, i.e., LMS. If we look at educational contexts, there are plenty of educational tasks that are part of a “projects” in the plain sense of the definition, enriched with many other aspects that are typically managed in project contexts. The many relations among students, between students and teachers, between students and the educational institution or external organizations (like stages) can be very easily and profitably managed as projects. Moreover, using Project Management concepts and tools for students of any course would be a fundamental growth in any direction their future professions will lead them.

Everybody talks about team working, tasks, milestones, deliverables, scope, risks, i.e., uses the typical jargon of Project Management, but the application of this complex discipline has not been so widespread, and surely not applied extensively in education. According to several studies [5], even today that we have a wide range of tools and techniques available, projects are frequently out of time and/or out of budget [6]. The poor results shown by these (and other) researches in terms of successful performance are subject to different interpretations, the most common being “Project Management continues to fail because included in the definition are a limited set of criteria for measuring success, cost, time and quality, which even if these criteria are achieved simply demonstrate the chance of matching two best guesses and a phenomenon correctly” [6].

Project Managers, today, can choose among many techniques and software to plan and manage their projects. The widespread usage of network approaches, like Gantt charts, critical path method (CPM), etc. have simplified the planning and controlling steps, while Project Management software has reached a solid maturity level. In order to define the scope of the project, the Work Breakdown Structure has been adopted as a (graphical) tool to delimit the things that should be done in the project, separating them by unwanted and/or unpaid requests. WBS is the hierarchical decomposition of the work to be executed by the project team to fulfill the objectives of the project and make deliverables. It organizes and evaluates the overall scope of the project. Information for a WBS is basically taken from project objective statement, historical files of previous projects and project performance reports. An appropriate WBS encourages a systematic planning process, reduces the possibility of omission of key project elements and simplifies the project by dividing into manageable units.

Another area heavily interlaced with Project Management and relevant for our argumentation is collaboration. Collaborative spaces are available within the project team to contribute to the success of the project's objectives. New generation tools of Project Management enable this functionality. Project is led and developed by the whole team, and each member has complete information about the project, with all the related documents. Project's progress is visible to everyone anytime, according to permissions granted to the subject.

When the project manager is free from the routine tasks; s/he can put more efforts into project vision and choose the direction for the project development. The authors of [7] discuss methods and tools for collaborative Project Management; if we cope this element with the widely recognized collaborative nature of educational processes, we should expect a convergence of these two disciplines and the relative tools.

On the contrary, the only field where we have found the application of Project Management tools and techniques inside educational contexts is the production of learning objects [8]. Here the concept of Project Management is not focused on providing tools inside the LMS for the management of activities as a project, but rather on managing the creation of learning objects with the typical five phases of the lifecycle of a project (initiation, planning, executing, monitoring and controlling, closing). This means treating the production of learning objects using the project's lifecycle as stated in [3], but the LMS remains in the background with the traditional set of functionalities not equipped with Project Management functionalities.

In our opinion, educational processes in general (and not only the production of educational material) can be profitably managed using the pillars of the discipline. Following this idea, we have integrated in our self-made LMS an entire set of Project Management functionalities. The management of tasks within an educational environment shows a series of constraints and issues that need to be managed with appropriate tools, like those supplied by Project Management. The pandemic we are living demonstrated that it is very important to provide a precise workplan for students, that are not allowed to follow physical lectures. Our “Virtual communities” platform provides affiliated

users a set of features strictly related with Project Management tools and techniques: a) define and manage projects and their scope b) prepare a fully-functional Work Breakdown Structure with predecessors and constraints c) implement the Critical Path Method in the calculation of start/finished dates and free/total slack d) assign resources to tasks and check their allocation e) assign and control costs associated to a project, with a combination of role-permission to a level that can properly administer the security, confidentiality and privacy of the activities.

The integration of these features inside a Learning Management system guarantees the increase of application fields for these platforms, allowing them to be used not only for traditional educational activities but also for more collaboration and cooperation-oriented tasks. The problem we see in today's collaboration platforms that claim to be Project Management-enabled platform is exactly the approximation and imprecision of implementation of Project Management services.

In our experience, this incompleteness causes users to start using the service and then abandoning it (and the platform consequently), or on the contrary, considering Project Management as the discipline of the coloured sticky notes attached on a Kanban board. Being the world of education very poor in terms of Project Management tools and techniques, this could be a very good way to improve also the awareness of educational actors about how to manage their interaction with the institution. Books and manuals are full of words like "educational projects", "educational tasks", "learning milestone", "educational deliverable", but even inside modern LMSs there's no real, native, theoretically-grounded services that could support educational actors in exerting their tasks under the umbrella of Project Management theories and tools.

3. PROJECT MANAGEMENT FUNCTIONALITIES IN LMS

The typical collaboration services available in enterprise platforms (like wikis, blogs, and collaborative planning tools. All these tools, together with file sharing (documents, reports, agendas, comments...) represent a clear stimulus to consider also an e-learning platform as a possible provider of support and services to PM. These services, like many others, are very common both in collaborative environments and in e-learning platforms, as presented in [9][10]. Likewise, many different situations in educational settings could take advantage of PM services. Some examples can be the following:

- the management of a thesis assigned to a student is a real project with tasks, milestones, deliverables, and costs (even if not directly sustained by somebody);
- a research project led by a teacher or researcher is, by definition, a project, involving again different resources, costs, deliverables, and milestones;
- an educational path and all the tasks that any participant has to manage is another example of a "project"
- a complex training path providing professionals with a certification at the end of the activities, with respective assistance of external resources and tutors, is a project from the perspective of the organizing institution. Here we have a

typical mix of educational needs (the LMS's most traditional services) and PM tasks

- a massive open online course (MOOC) initiative, with all the tasks related to the various phases of creation, marketing deployment, execution, support, and final certification is a project, both for the institution that delivers the MOOC and for the participant that has to perform tasks, to pay attention to milestones, to respect deadlines.

The possibilities of using these tools and services inside LMSs is even bigger, if we imagine to use a Virtual Communities system not only for managing "communities" devoted to educational purposes but also in larger contexts typical of collaboration, like a research group, a recreation organization, a secretariat, a board of directors, a club, a sport team, etc. All these "communities" need services that are available inside LMSs (like document sharing, forums, wikis, FAQ, sync, and async communication, etc.).

E-learning became so popular thanks to many factors, like network availability, multimedia, increased power of client workstations, flexibility, low costs, etc., but the role of software platforms like Moodle™, Docebo™, Dokeus™, Sakay™, Webct™ is clearly a central role. These platforms have proven to be effective in contexts not necessarily connected to academic education, therefore posing the issue of the evolution of software platforms towards services that are not necessarily related to traditional academic tasks. Last but not the least, the integration of e-learning (or collaborative) software platforms with the rest of the information system of the hosting organization represents clear evidence of the role of software platforms today in education.

From a meta-architectural point of view, e-learning platforms have based their pillars on the idea of "course", or "class", meaning that the basic container for relationships among users of the platform is a virtual place that resembles in some way what happens in any educational organization: collecting people in a (virtual) classroom.

What clearly emerged in past studies [9] and from our preliminary experiments is a need of a different funding paradigm for software platform: the "community", or "virtual community". The virtual community is a container ready for didactic processes, but not only: research teams, recreation groups, friends, secretariats, the board of directors, colleagues, anything that could be an aggregation of people around scope using virtual spaces on the web. The core of the application is composed of some abstract entities, i.e., virtual communities as an aggregation of people to which some communication services are available in order to obtain certain objectives. "Online Communities" [10] is a space on the web devoted to a collaboration objective, populated by people who communicate with each other, using a series of communication systems. With this approach, it could be possible to represent all the hierarchical relationships between different types of communities (such as faculties, didactic paths, master degrees, courses, etc.). The main characteristics of a virtual community could be summed up as follows:

- a community is a composition of services for a virtual space of interaction involving end-users for that community

- the services are general applications that enable the users to communicate in a synchronous and asynchronous way, to publish contents, to exchange files, to coordinate events, etc.
- the potential services of a community are activated by a manager of the community according to the needs, and the users of a community can use them with different rights and duties
- the communities can be aggregated into larger communities with hierarchic mechanisms and infinite nesting levels
- the communities can be aggregated in an arbitrary way into larger communities disregarding the possible position of a hierarchical structure
- all users are recognized.

The addition of Project Management services inside e-learning came mainly from the experience of the team in the techniques of Project Management, on the one hand, but also from everyday tasks: consider, for example, as part of learning community college, the need for a teacher to coordinate a number of undergraduates involved in the long task of drawing up their thesis. The activities of the individual, the professor, or those that are shared between them have often intertwined/associates and impose the need to manage time, deadlines, relationships, and mutual dependencies.

More complicated is the situation on the teacher's side, where s/he could have more thesis to follow, so more projects of this type to manage. We, therefore, believe that the lack of a tool of this kind can be solved naturally with valuable tools for planning and managing existing projects, but these: a) do not integrate platforms b) on average, they are complex c) they are much more appropriate for people with specific expertise in the complex and multifaceted discipline of Project Management.

4. IMPLEMENTING PROJECT MANAGEMENT SERVICES INSIDE AN LMS

The idea of implementing Project Management services inside learning contexts benefitted a lot of the availability of "Online Communities", the virtual spaces dedicated to each community (what we call the virtual community). This collaboration space is equipped with services provided to the users, so it was simply a matter of creating new services related with the Project Management (PM) discipline but aware of all the rest the platform provides, and integrate the PM services with this. Another fundamental factor from the virtual community that we used in assembling the new services was the concepts of "roles", "rights", and "permissions" that are assigned to each user for each separated community. This allows a fine-grained, sophisticated way of managing and controlling who is doing what on a certain task.

The Project Management services contain some sophisticated features that are typical of top software solutions, strictly related with the critical path method (CPM) and its calculation mechanisms. These options have been added in the recent version as a substantial improvement, because some users were complaining about the lack of the following options. These options (fig.1) allow to obtain the same results we can obtain, in

terms of calculation of time, start, finish etc. with Project Management professional tools. These options are:

- defining a project calendar with working and non-working days
- defining the start date of the project from which the CPM will start to calculate all start/finish dates according to the predecessors
- default resources: this allows to set the resources you want to automatically assign when a new task is created
- Milestone: allows the project to use "Milestone", i.e., tasks with a duration equal to zero days

*Start date: 11/05/2021

Deadline:

Calendar: Mon Tue Wed Thu Fri Sat Sun

Owner: Molinari Andrea

Default resources: ☐ set
Set the resources you want to automatically assign when a new task is created.

Milestone: ☒ allow
Allows the use of "Milestone", tasks that have zero as duration

Project visibility: ☒ Completed
Sets the project visibility for the involved resources. It can be limited to the assigned tasks or complete.

Task completion: ☐ confirmed by a manager
Sets if a task is signed as completed when all of its resources set the completion to 100%, or if a verification by a manager is required.

Summary task: ☒ allow
Sets if summary tasks are allowed. If you are using the CPM mode, it will not be possible to create dependencies from and towards summary tasks.

Estimated duration: ☒ allow
Sets if estimated dates are allowed. For example, a task with duration "67d", is a task with 6 days estimated duration.

Fig.1 – Options for advanced settings of an educational project

- Project visibility: this option sets the project visibility for the involved resources. It can be limited only to the assigned tasks to that resources, or only when tasks are completed.
- Task completion: this sets the possibility for the created project to have task completion confirmed by a manager. This implies that a task is signed as completed when all of its resources set the completion to 100%, or if a verification by a manager is required.
- Summary task: allows the project to have the powerful feature typical of the WBS, i.e., tasks that summarized all data (start, finish, costs etc.) of the subtasks. If you are using the project in the CPM mode, it will not be possible to create dependencies from and towards summary tasks. This is partly a simplification respect to the full-fledged software where the CPM is implemented also for the summary tasks, but it's clearly more complicated in the calculation engine, and we have decided to skip this part in this version.
- Estimated duration: this is instead a very interesting niche feature available only in the most advanced software, but we consider it very important. This option sets the possibility of setting the duration of tasks in estimated days, i.e., days of duration considering a linear calendar of 365/366 days per year without non-working days. This feature dates are

allowed. For example, a task with duration "6?d" , is a task with 6 days estimated duration.

Tasks and users can also be shared among different communities, with the same inheritance mechanism. Users have on the one hand an institutional role inside the organization, and one or more functional roles in each community to which they participate. Examples of institutional roles are those of the classic academic institution (student teacher etc.) As examples of functional roles, we have the administrator of a community, participant, moderator, blogger, secretary, member, dean, writer, etc. Roles can be freely created, assigned with respective permissions for each service available in the platform, PM services included.

We therefore decided to add an extra feature that takes advantage of the possibilities of creation of a project inside a virtual community: member of the virtual community can be assigned as resources of the project (fig.2). This is very frequent (and logic, so to say) in educational communities, where the community itself exists because of the need of managing a project. A workgroup, for example, created with some students that have to perform a common educational task, with milestones, deadlines and detailed WBS, perfectly fits as an application scenario of the following feature. We can also add external users, so avoiding to limit the management of the project to people enrolled in the community.

This feature, natural as it may seem, has been very complicated to implement because of the need of validation of the users' actions inside the different part of the portal. In this perspective, external users have very limited actions to perform normally inside the platform, while in the case of educational projects, they can act as an important stakeholder thus needed different permissions on the project. For example, imagine an enterprise tutor following the workgroup to support with her ideas the students.

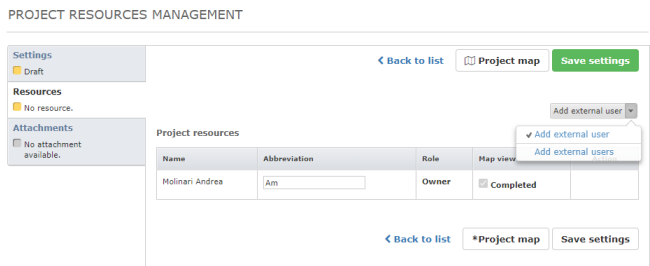


Fig.2 Managing resources and roles inside the project

In order to have a consistent approach to both the creation of complex projects or simple reminder/to-do lists, and to follow standard planning procedures in commonly available scheduling software, the Project Management service provides the user a general activity for the project at level zero, indicating the root of the project, distinguishing from the other only by the absence of a parent. From this point, the rest of the WBS is managed, together with the rest of inputs (duration and predecessors) by the CPM engine that we have implemented, this means that starting from a) the definition of a calendar b) the start date of

the project c) the tasks and their dependencies, our system is able to produce as output a) the start and finish date of all the tasks b) the critical path, i.e., the tasks that have a total float equal to zero c) the finish date of the project.

What is normal in a Project Management context, it's not so "normal" in educational contexts. For example, forcing thesis students to think about their thesis as a "project" (what else?) with tasks, deadlines, constraints, etc. has been a great improvement in both students and supervisor daily work.

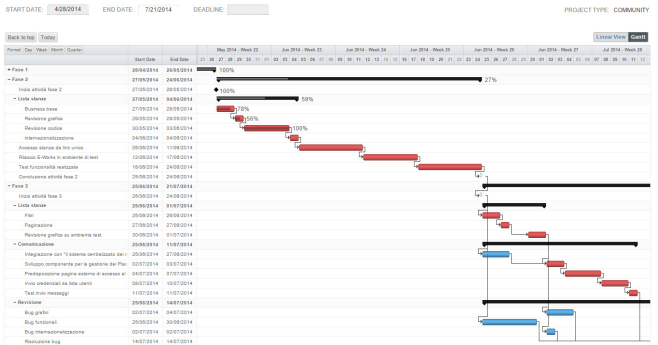


Fig.3: the WBS with critical path, predecessors and completion percentage

As further implementation, we have improved the previous version of our services, adding for each task or project the possibility of adding constraints and deadlines. A task has several other features, like a status (indicates at what stage of development is the project), priority, temporal constraints and the creation of milestones (used to indicate the achievement of the objectives set at the design stage).

On the side of security and protection, the community where the project is created/managed guarantees a sort of "sandbox" for the permissions management. A user holding the appropriate permissions is allowed to create a project with an arbitrary number of sub-tasks, to which different resources can be assigned. The roles that we have decided to support are:

- Owner of the project: role assigned when creating the project. Owner is the user that has total control over the project and has no limit in respect of assignment of roles, cancellation of tasks, attachment, etc.

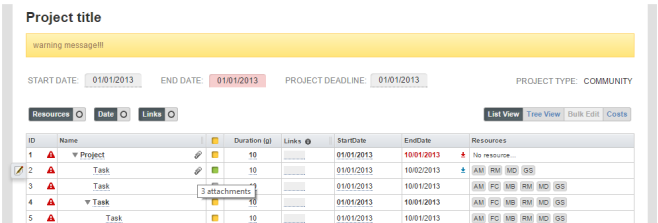


Fig.4: WBS with attachments and assignments of resources taken from the community's users

- Manager: this role will have the same potential of the project owner, with some restrictions on the tasks created by other

managers. A manager may appoint other managers or simple resources. This can be done only on the task of which the manager is the owner (creator). Same goes for the cancellation and modification of activities. Note that the role of the owner of the project is distinguished from all others because of its total control over every single part of the task list regardless of the assignments. Task manager and the owner will also be asked to indicate the status of a task or project, thus introducing the control over the work of other users.

- Resources or executors of the project: these users will have a limited subset of actions since its main purpose is to perform the task and inform the manager through a report.
- Guest: this role is meant for those users who want to enable you to view a project, without, however, afford to interact with it in any way.

In the platform, you can create three different types of projects or task lists depending on confidentiality and context required. You can create personal and public projects within a community or personal projects at portal level, i.e., outside any specific community. A task list is visible only to the creator of the same and to the assigned people.

A public project, however, provides the necessary permissions for users with admin rights within the community to view and interact with all users involved, inviting external people from other communities or even not enrolled in the platform. We get more flexibility in the case of a portal task list, conceptually associated with a super-community, where all subscribers to the platform (here we are at the highest level of the communities' hierarchy) are considered within the same context. This allows us to engage in a project potentially all people registered to the platform, regardless of the inclusion in any community.

5. CONCLUSIONS

In this paper, we present a specific part of our LMS called "Online Communities", a software platform providing collaborative services among members of a (virtual) class, that in the end, we consider as a particular type of a virtual community. In this platform, we have added some Project Management tools that are following the tools and techniques provided by the Project Management discipline. These tools and techniques have been made available for any user inside the platform, in order to implement the idea of project integrated

with a collaborative and educational software platform. This approach revealed two positive aspects: a) the appropriateness of Project Management concepts inside educational contexts, because many of the activities we perform during educational tasks can be seen as part of a project b) the advantage of implementing these services inside a virtual communities' environments, that provides a natural and fertile ground for the development of these services, and their availability to community members. Next steps of this evolution are the completion of project management services respect to some specific features (overallocation management, budgeting work, cost and labour resources, charting and reporting) and become a serious competitor on one side for project management tools, and on the other side for educational environment where these tools and techniques are not implemented, or implemented in very primitive stages.

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