Project Management and Learning Environments: a Case Study

Andrea Molinari

University of Trento, Dept. Of Industrial Engineering (ITALY)

Lappeenranta University of Technology, School of Industrial Engineering and Management (Finland)

andrea.molinari@unitn.it

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ABSTRACT

The paper analyses the addition of project management features of an LMS, a topic that LMSs and collaboration platforms have entirely ignored. Many project management-like platforms are available today, especially riding the media wave of agile methodologies. The question is not surprising in itself, as managing time, costs, and resources linked to the discipline of Project Management, is historically a problematic issue for the IT world from a cultural, technical, and organizational point of view. The problem becomes even more complex if applied to the management of learning projects, where we have time, constraints, deadlines, costs, resources like in any other project. LMSs and, in general, collaboration platforms do not include these features, forcing users to link external platforms or adapt existing features (like simple to-do lists) to more complex Project Management tasks. In this work, we will present the tests conducted in a collaborative platform based on the metaphor of virtual learning communities. These tests were on a component developed explicitly for managing projects, activities, and resources, integrated inside the LMS with all the other services (blog, forum, file sharing, calendar, reminders, etc.). The introduction of this new component within the system addresses the need to manage collaborative activities between learners, providing a tool for managing and controlling the progress of the activities assigned to the various community members.

1 INTRODUCTION

This paper presents some services provided inside a virtual community platform as extensions towards managing the users' time, specifically teachers, students, and administrative personnel involved in educational tasks. These services are rarely available (if any) inside Learning Management Systems (LMS) or are simple tasks lists, to-do lists, or academic tasks scheduled in some workflow systems. Functionalities that provide support to (education) projects are something significantly different. Project Management is a well-established discipline, where we can find additional standards, guidelines, and certification processes provided by worldwide organizations. The advent of web platforms claiming to provide Project Management services has changed the scenario, with a lot of competition in 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 author's opinion, 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 oriented explicitly towards the Project Management concepts and methodological tool and added them to a virtual community platform (with all essential collaboration, social media-oriented services). From providing

traditional collaboration, education-oriented services, the platform has been extended to 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. 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 known in the technological solutions that support our daily educational tasks is integrating 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. Implementing Project Management suggestions inside educational processes forces teachers or students to exit from the learning environment (for example, Moodle, Forma.LMS or Sakai LMSs), and use an external platform. This implementation, 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 the aforementioned trivial problem of document sharing, but we extend the analysis to other typical Project Management tasks (like checking deadlines), the situation is again complex: the educational platform and the Project Management platform are entirely disconnected.

We can mainly find inside LMS under the label "project" or "Project Management" is a sort of task-list or to-do list service that the user must manage directly. In a few other cases, the idea of managing projects is implemented with a set of steps of a predefined workflow, in some way linked to each other, but this is very limited even concerning elementary Project Management tools. Let's 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'. Still, strangely software platforms that are so useful for educational purposes are not providing adequate support for this. We have decided to add a set of Project Management functionalities to our "Online Communities" system. "Online Communities" is a software platform created from scratch by our team, constantly updated with new services that our research group considers engaging in educational and, more generally, in collaborative contexts. The organization of the paper is the following: in Chapter 2, we will analyze the idea of projects in educational contexts, presenting how and where education and project management disciplines could intersect. Chapter 3 will briefly introduce "Online Communities", the collaboration platform where we added the services to support project management activities in educational contexts. In Chapter 4, an overview of the different services for project managers will be presented. Finally, Chapter 5 will explain a qualitative analysis with six experienced project managers who used our platform's various

features and compared them with top project management software.

2. PROJECTS IN EDUCATIONAL CONTEXTS

The de-facto standard in the Project Management discipline [3] identifies what a "project" is: "a temporary endeavor undertaken to create a unique product, service, or result" [3], The discipline of Project Management [4] applies a set of different tools and techniques taken from different disciplines (CPM, breakdown structures, network techniques etc) to improve the use of various resources toward the accomplishment of a unique, complex, unique task, taking into consideration 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. Here the focus is mainly on extended functionalities of Agile and in general collaboration services, rather than focusing first on core services like critical path method (CPM), Critical Chain Method (CCM), PERT, etc. The perspective of using a collaborative platform as a Project Management tool is fascinating, but this should happen without compromises concerning what Project Management methods provide to millions of skilled project managers around the globe, thus limiting the power of Project Management concepts. Deadlines, cost management, task duration, resources, and many others are problems that everyone involved in project-related activities faces.

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 academic tasks that are part of a "project" in the plain sense of the definition, enriched with many other aspects 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 efficiently and profitably managed as projects. Moreover, using Project Management concepts and tools for students of any course would be a real 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 Nevertheless, the application of this complex discipline has not been so widespread and is undoubtedly not applied extensively in education. According to several studies [5], even today, we have a wide range of tools and techniques available, projects are frequently out of time and out of budget [6]. The poor results shown by these (and other) researches in terms of success are subject to different interpretations. Among them, we can mention "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. In contrast, Project Management software has reached a solid maturity level. The Work Breakdown Structure (WBS) has been adopted as a (graphical) tool to define the project's scope and delimit what should be done in the project, separating them by unwanted or unpaid requests. WBS is the hierarchical decomposition of the work to be executed by the project team to fulfill the project's objectives and make deliverables. It organizes and evaluates the overall scope of the project. Information for a WBS is taken from project objective statements, 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 it 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. The project is led and developed by the whole team, and each member has complete information about the project, with all the related documents. The 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 effort into project vision and choose the direction for the project development. The authors of [7] discuss methods and tools for collaborative Project Management; if these elements are coped 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 profitably use the pillars of the discipline. Following this idea, we have integrated into 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 live in demonstrates that it is very important to provide a precise work plan for students who are not allowed to follow physical lectures. Our "Virtual communities" platform provides affiliated users a set of features strictly related to 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 adequately 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 for traditional educational activities and more collaboration and cooperation-oriented tasks. The problem we see in today's collaboration platforms that claim to be Project Management-enabled platforms is precisely 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 colored sticky notes attached on a Kanban board. The world of education is impoverished in terms of Project Management tools and techniques. The proposed one could be an excellent way to improve the awareness of educational actors about how to manage their interaction with the institution. We use words like "educational projects", "educational tasks", "learning milestone", "educational deliverable" very frequently in our focused discussions. On the contrary, even inside modern LMSs, there are no accurate, 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. Together with file sharing (documents, reports, agendas, comments, etc. all these tools represent an apparent stimulus to consider an e-learning platform as a possible provider of support and services to PM. These services, like many others, are widespread 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 an actual 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 the 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
- we can certainly consider as a project the massive open online course (MOOC) initiative, with all tasks related to various phases of creation, marketing deployment, execution, support, and final certification. Both the institution that delivers the MOOC and the participant that has to perform tasks, in any case, must pay attention to milestones to respect deadlines.

The possibilities of using these tools and services inside LMSs is even stronger if we imagine using a Virtual Communities system not only for managing educational "communities", but also in larger collaboration contexts. Examples of this can be a research group, a recreation organization, a secretariat, a board of directors, a club, a sports team, etc. All these "communities" need services 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.. Still, the role of software platforms like Moodle™, Docebo™, Dokeus™, Sakay™, Webct™ is central. These platforms have proven to be effective in contexts not necessarily connected to academic education, posing the issue of the evolution of software platforms towards services that are not necessarily related to traditional academic tasks. Last but not 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". The meaning of this choice is that the primary 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 emerged in past studies [9] and from our preliminary experiments is a need for a different funding paradigm for software platforms: 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 the scope using virtual spaces on the Web. The application's core comprises some abstract entities, i.e., virtual communities as an aggregation of people to which some communication services are available to obtain specific 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. This approach could 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 the following:

- 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 synchronously and asynchronously, to publish contents, exchange files, coordinate events, etc.;
- a manager of the community activates the potential services of a community according to the needs, and the users of a community can use them with different rights and duties;
- communities can be aggregated into larger communities with hierarchic mechanisms and infinite nesting levels;
- the communities can be aggregated arbitrarily 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 several undergraduates involved in the long task of drawing up their thesis. The individual, the professor, or those 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:

- do not integrate platforms
- on average, they are complex
- they are much more appropriate for people with specific expertise in the complex and multifaceted discipline of Project Management

The approach we have followed in the elicitation of requirements wanted to incorporate functional needs very different from one another so that you can create many services with them, most of the time very similar but individually functional on their own for the end-user:

- Personal To-Do List: in this case, the list of tasks of the project is not shared with other users, but is personal reminders of the activities to be carried out in a given period. Tasks can include everything, from social activities to complex projects.
- Brainstorming: here, we can use the list of tasks for brainstorming with people who do not have the chance to meet either physically or through video conferencing. Indeed, given the opportunity to participate in forums, contribute to wikis and glossaries, write a FAQ, attach files, etc., users can add their opinion in various ways to the single tasks, simply reusing the mentioned services that are already available inside the platform. This integration with many services already available is not completed for all services. It will be developed within the service task list/project management evolution roadmap in the following months. We implemented the integration with file management services, which is a crucial service transversal to everything inside the platform. We will provide some examples of this integration in the following pages.
- Organization of meeting: planning a meeting, sending invitations to participants, defining the date, assigning documents to the meeting, all this can be easily implemented inside "Online Communities) via the use of one task named, for example, "Meeting". Subsequently, participants can attach their feedback or materials to this. Then, another simple integration is the "online presence" service, to see in the moment of the conference call, if the person is available or not.
- Bulletin-board system: the services related to task management can be used as a simple bulletin-board system, also shared by multiple users. You can share files and exchange messages with the planning of tasks. In the bulletin boards, tasks can be set by the task leader, updated by the users that have the proper permissions
- Project planning, execution, and monitoring: this is a full-fledged service where you can create and redefine the structure of the task gradually. The inspiration of this service is the category of software devoted explicitly to implementing PM tools and techniques like WBS, Gantt, PERT, CPM, milestones, constraints, deliverables, etc. With this service, it is possible to assign responsibilities to users, and then associate them with each task. During the project's execution, the resource's contribution is updated with a % of completion. This indicates whether the job is completed or not and to what extend. Aggregating all this information, the project manager can check the degree of progress of each activity under the project. For every task of the project, there is the possibility of attaching files

The shortlist just given is not intended to analyze all the possible scenarios of use of the PM services but can show only some examples. As can be seen from the list, the proposed uses have entirely different nature and are not targeted to manage activities with a rigid structure defined as "a-priori". We can even note how the examples discussed above can be transformed with

extreme simplicity from case to case. For example, a To-Do List can change very simply into brainstorming or even into more sophisticated projects. Everything happens through the simple assignment of some users to a given Task and the addition of some files.

4. IMPLEMENTING PROJECT MANAGEMENT SERVICES INSIDE AN LMS

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

One of the implementation choices was how to consider the project and its component activities. A project is created as a tree of tasks with arbitrary depth, whose nodes and leaves represent tasks, milestones, or deliverables. To manage the structure mentioned above, we decided to implement a Work Breakdown Structure (WBS), the standard project management tool used for the analytical breakdown of a project at different levels of detail. Each activity has a numerical index that determines the level, composition, or membership hierarchy.

The Project Management services contain some sophisticated features typical of top software solutions, strictly related to the critical path method (CPM) and its calculation mechanisms. These options have been added in the recent version on the platform as a substantial improvement requested specifically by skilled users complaining about the lack of these options. These options (fig.1) allow us to obtain the same results we can get, in terms of calculation of time, start, finish, etc., with Project Management professional tools.

The options are:

- defining a project calendar with working and non-working days
- specifying 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 you 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 that have a duration equal to zero days and represent crucial moments in the project to be highlighted to stakeholders.
- Project visibility: this option sets the project visibility

for the involved resources. It can be limited only to the assigned tasks to those resources or when tasks are complete.

- Task completion: this option sets the possibility for the created project to have task completion confirmed by a manager. Therefore, a task will be completed when all its resources set completion to 100%, or when verification by a manager is required.
- Summary task: this allows the project to have the robust 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 a simplification compared to full-fledged software, as these platforms implement the CPM also for the summary tasks. In this situation, the calculus is more complicated for the calculation engine, and we have decided to skip this version.
- Estimated duration: this is instead an exciting niche feature available only in the most advanced software, but we consider it very important. This option allows to set 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. For example, a task with a duration "6?d", is a task with 6 days estimated duration.

Another professional feature of the PM service is the possibility of setting, on each task or project, constraints and deadlines. A task has the following features:

- Status: The status indicates at what stage of development the project is. Son provided the states active (the task is in progress), inactive (the task is still in progress), pending, and completed.
- Priority: can be low, standard, and high. It is an indicator of the urgency of the execution of a task.
- Temporal constraints: An activity has three dates that mark its production cycle: start date (the start of the task), end date, deadline (maximum limit for completing the task). To allow the creation of milestones (used to indicate the achievement of the objectives set at the design stage) we let the three abovementioned dates to coincide.
- Percentage of completion;
    - Category: allow a subdivision of projects according to the subject
    - Description;
    - Attachment: you can attach any file that is available inside the file repository of the community.

Tasks and users can also be shared among different communities with the exact inheritance mechanism. On the one hand, users have an institutional role inside the organization and one or more functional roles in each community in which they participate. Examples of institutional roles are those of the classic academic institution (student, teacher, etc.) As examples of functional roles, we have a community administrator, participant, moderator, blogger, secretary, member, dean, writer, etc. Administrators can create roles freely,

assign users with individual permissions to each service available in the platform and PM services.

We, therefore, decided to add an extra feature that takes advantage of the possibilities of the creation of a project inside a virtual community: a member of the virtual community can be a resource of the project (fig.3). In educational communities, this is the case very frequently, where the community itself exists because of the need to manage 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 illustrated feature. We can also add external users, so avoiding limiting 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 to validate the users' actions inside the different parts of the portal. In this perspective, external users typically have minimal actions to perform inside the platform. At the same time, in educational projects, they can act as an essential stakeholder and thus need different permissions on the project. For example, imagine an enterprise tutor following a workgroup to support her ideas. S/he can be an external person, with supervisory tasks to perform on what the workgroup is doing. Still, at the same time, her high-level permission on that specific workgroup should be isolated from the rest of the portal.

The Project Management service provides the user a general activity for the project at level zero of the WBS, thus providing a consistent approach to creating both complex projects and simple reminder/to-do lists and following standard planning procedures commonly available in scheduling software. This particular task indicates the project's root, distinguishing it from the others only by the absence of a parent.

Starting from this summary task, the user can manage the rest of the WBS, together with the rest of the inputs (duration and predecessors) for the CPM engine (Fig. 4). This feature implies a set of best practices in planning a project, starting from a) the definition of a calendar, b) the start date of the project c) the tasks and their dependencies. With these inputs, our system can 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 we expect in a Project Management context is not so "normal" in educational contexts. For example, forcing thesis students to think about their thesis as a "project" with tasks, deadlines, constraints, etc. has dramatically improved both students' and supervisors' daily work.

As a 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).

From a security and protection perspective, the community where the project is created/managed guarantees a "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 (Fig.5). The roles that we have decided to support are:

- Owner of the project: role assigned when creating the project. The owner is the user with total control over the project and has no limit in respect to assignment of roles, cancellation of tasks, attachment, etc.
- Manager: this role will have the same potential as the project owner, with some restrictions on the tasks created by other managers. A manager may appoint other managers or simple resources, and this appointment can be made only on tasks whose owner is the creator of the task itself. The same goes for the cancellation and modification of activities. Note how the role of the project owner is separated from the others because of the control on every part of the task list regardless of the assignments. The task manager and the owner will also be asked to indicate the status of a task or project, thus introducing control over the work of other users.
- Resources or executors of the project: these users will have a limited subset of actions since their primary purpose is to perform the task and inform the manager through a report.
- Guest: this role is for those users who want to enable you to view a project without, however, afford to interact with it in any way.

You can create three different types of projects or task lists on the platform depending on confidentiality and the context required. You can create personal and public projects within a community or personal projects at the 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. However, a public project 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 a portal task list, conceptually associated with a super-community, where all subscribers to the portal (here we are at the highest level of the communities' hierarchy) are considered within the same context. We, therefore, can potentially engage all people registered with the platform in a single project, regardless of the inclusion in any community.

Another example of beneficial integration of Project Management services into a collaboration platform is attachments' management. Every task of a project can have some interesting documents attached with it to explain/clarify/deepen what the task has to do. In educational projects, this feature can be even more important if not indispensable, for example, if we consider a task as educational homework and the attachment as the instructions and content of the task to be performed. So in educational usage of project management tasks, attachments should be almost considered as a requirement rather than simply a desired feature. The interesting thing is that this feature, considering the concept of community that protects the visibility of documents and limits access to the members with appropriate authorizations, is substantially already available. In an educational project, we can add documents to the file repository of the community, then create the tasks list, and finally attach the appropriate documents to the relative tasks. The cost of implementing this feature has been minimal compared to the benefits brought to the Project Management service. (Fig.6)

Budgeting is another relevant feature, even if in educational contexts it is not so common. The implementation has been oriented to the maximum easiness because we knew that a certain level of complexity and project management knowledge is needed when dealing with the budget. The feature allows classifying resources in work or material resources. According to how the relative fees will be charged on the project, it assigns them an hourly or quantity cost. Users can then allocate resources to tasks, and the engine will calculate the budget for the different tasks using a sort of OLAP cube (Fig.7). Availability for every resource, of the day-by-day assignment plan on each task of the project is a direct consequence of the assignments. This availability, in turn, provides allocation charts, resources' overloading information, and other double-checking tools commonly available in full-fledged software tools.

Finally, to summarize the most important features of this new service, we have to mention the reporting facilities provided to selected users. This service "simply" presents all data deriving from the previous planning activities, providing some primary reporting mechanism. In the current version of the platform, this feature is still in its preliminary steps, not because of lack of data, but mainly because of three different reasons: a) need to implement core features before this; b) test the feature extensively to ask users which kind of reports, among the many possible, they would like to have, also considering the possible crossing with data not necessarily related to project management but rather, with educational aspects of the community; c) the possibility of exporting data and creating reporting with external BI/reporting tools, rather than implement them internally.

Figure 8 shows an example of reporting obtained from a project planned inside a community. We can see details about the WBS with its tasks, completion level, and associated costs to any single task.

5. DISCUSSION AND RESULTS

To test the above-presented services, we asked the collaboration of six project managers with a tested

experience in the educational field, asking them to plan their project using our platform's contemporarily Microsoft Project and services. The projects were of different sizes, different complexity, and a different number of involved resources, so they were not perfectly comparable. Our interest was to test the functionalities of the services created inside "Online Communities", and especially have feedback from those users, particularly experts in Microsoft Project. This constructive input was helpful to understand if our services could be a valuable contribution to what they were usually doing with their favorite software.

It is not easy to compete with an established software since the 80s like Microsoft Project, with millions of users and a development team that can extend the platform towards the desired features. Our aim was mainly to understand the appreciation for what we included, especially the advantages of being integrated with a web platform that provides different services concerning pure project management services.

We asked our testers to implement their educational projects using both the services presented in this paper and Microsoft Project. The PMs involved in the experimentation have a medium to a high level of experience in using MS Project, so their judgment could have been very severe concerning our platform. The educational projects were different but substantially falling into these macro-categories: bachelor/master theses, long-term assignments, planning new Master's and bachelor degrees, educational materials, software development. Each Project Manager plans over three months from 3 to 5 projects in both versions, replicating the same tasks, duration, predecessors, and the rest of the requirements of the critical path method. We then collected their quantitative feedback about some analytical dimensions. The dimensions of analysis have the following characteristics and features offered by the two platforms:

- Project settings Definition
- Calendar exceptions management
- Work breakdown structure creation
- Predecessors, Leads, and lags
- Milestones
- Constraints
- Assigning resources to tasks
- Attachments
- Reporting functions

For each of these investigation areas and for each of the above-listed features of the platforms, subjects have expressed an appreciation score, an overall judgment on the production of a project plan, and the user experience with them. Finally, we asked to give a qualitative suggestion for our platform in a final "desired area of improvements" answer. As a qualitative integration, a forum for general discussion has been created and made available to the community participants where the test took place. The final results also consider the valuable comments for the final analysis, so we excluded all the requests of clarification and bugs notification. We kept

the judgments useful for our research. Here follows a summary of the questions and the quantitative results expressed on a Likert scale of 1 to 5, with 5 being an excellent evaluation. (Fig.9).

From the results emerges a strong appreciation of the MS Project features (as primarily expected), but some exceptions are notable and can be an interesting field of improvements and promotion for the use of our platform. The first notable exception regards the assignment of resources to tasks. This task is notoriously uncomfortable in any project management software. Still, from qualitative comments, we have noticed that the evident appreciation in favor of "Online Communities" derives from the availability of resources from the community members. This availability lets the project manager understand the project team, assign it to the various tasks, control them in the sense of "members of a community", not unknown resources listed in the software.

The second feature that received higher appreciation compared to MS Project has been attachment management. This result is another expected one, both because of the lack of web availability for the Microsoft solution and for the beneficial idea of having a file repository, organized in folders and protected with authentication/authorization mechanisms, from where to pick up the file that I want to attach to that specific task. All comments from our users converged on this helpful feature, paradoxically a feature recommended for MS Project. Finally, the overall judgments on the user experience and the applicability of the project management tool in educational contexts. Here the comments have been richer of comments and appreciation, even if we must consider that MS Project is a desktop application, full of functionalities that most users don't know. That creates a sometimes clumsy and poorly efficient user experience. More important for us is the positive results compared to the usability and usefulness of project management tools, which confirms our initial research question about the needs of these services for whoever is involved in educational processes.

Other comments on the forum that could be relevant for the research follow:

- web-based features of "Online Communities" have been very appreciated compared to MS Project: a web-based software tool, even if not very equipped with lots of functionalities, is much more helpful for today's project managers than a desktop, Windows-only tools, especially in an educational context where limited budget and low expertise on project management create an entry-barrier to the usage of these services;
- a particularly appreciated feature is the community-based management of resources, which certainly need many improvements (like some cost features, profile management internal to the platform, skills portfolio management, etc.), but even in the current

version could be very useful. Consider again that other services of the platform, apparently disconnected from Project Management services and not created for that purpose, have revealed their utility when the project management services have been added to the platform. A typical example is the "Curriculum" service, implemented for teachers to know the CV of the community members. In a Project Management context, this could be used by the project manager to understand skills and competencies of the project's resources;

- The forum has been helpful for users to communicate some minor bugs related to screen refresh and CPM incoherences
- All the users have reported the lack of some functionalities that available in MS Project, mainly advanced features not related to the CPM implementation (custom fields, total slack, recurring tasks, timesheet management): excellent suggestions for future improvements;
- Few user-experience suggestions were related to the assignment of resources and management of the CPM. All the users, being project managers with long experience, were aware of the many improvements on one side and the complexity of the needs in Project Management. Not everything in Project Management is simple or can be simplified.
- A few comments were about several features of "Online Communities" that have been considered even better than stand-alone MS Project. These comments are not surprising, and it's not a significant element of proudness because it is straightforward to propose something better when somebody else already opened the path. What we consider instead a valid argument is the availability of non-predictive project management features inside e-learning contexts.

6. CONCLUSIONS

In this paper, we presented a new set of features of our LMS called "Online Communities" that extend the platform's services towards the use of Project Management tools and techniques inside educational and collaborative contexts. These tools and techniques, made available for any user inside the platform, allowed to implement the idea of managing a project inside a collaborative and educational environment. 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, the integration with other already-available services, and their availability to community members. A qualitative investigation has

been performed using professional Project Managers and comparing their user experience in planning (educational) projects with a top-ranked project management software and with the services provided by "Online Communities". Results are surprisingly encouraging, paradoxically because "Online Communities" has not implemented many services mostly considered "not very useful" or "rarely used" by project managers.

On the contrary, complete and up-to-date services of Project Management integrated into a collaborative platform seem to help users in daily operations, with a higher level of usefulness compared to trivial to-do lists or simple task managers. Results can not be interpreted as extensive research, but due to the experience and professional quality of the involved project managers both from the project and educational side, we consider these results very interesting. They validate our original hypothesis substantially, even if not numerically. Educational world and LMSs in particular, need to incapsulate project management services into the offered services. The next evolutionary steps are the completion of some project management services with specific features (overallocation management, budgeting details, cost-type resources, charting, and reporting) and greater integration with the other services provided by "Online Communities", like calendar management, resource booking, grade assignments to assigned tasks, etc.

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FIGURES

Fig.1 – Options for advanced settings of an educational project	*Fig.2 Structuring a WBS with child tasks and predecessors*

Fig.3 Managing resources and roles inside the project
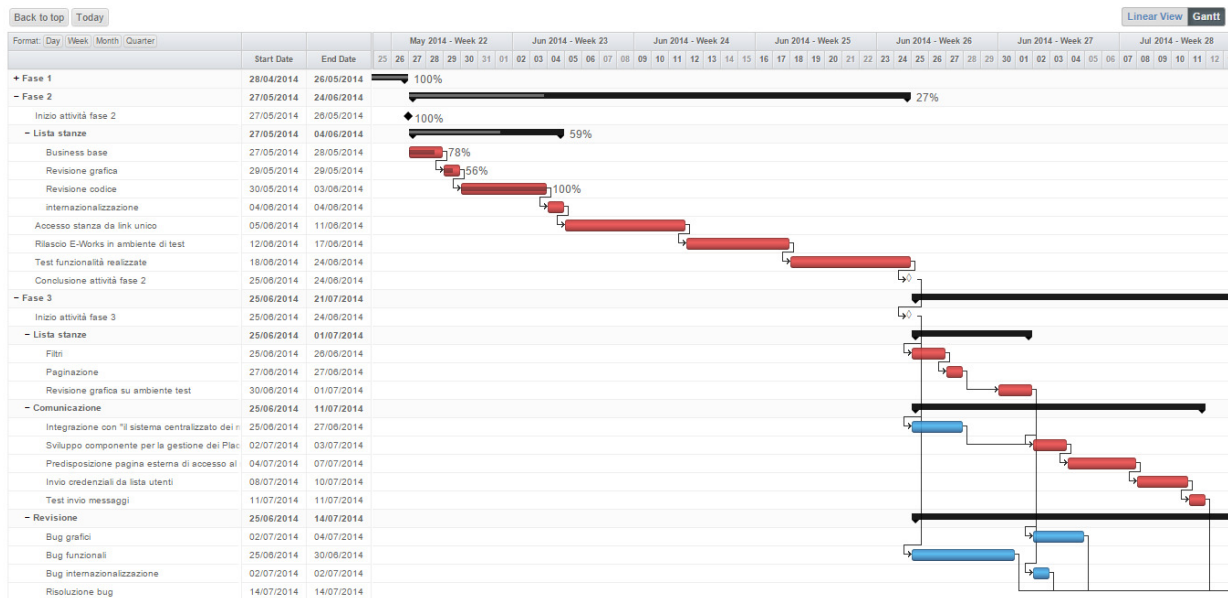
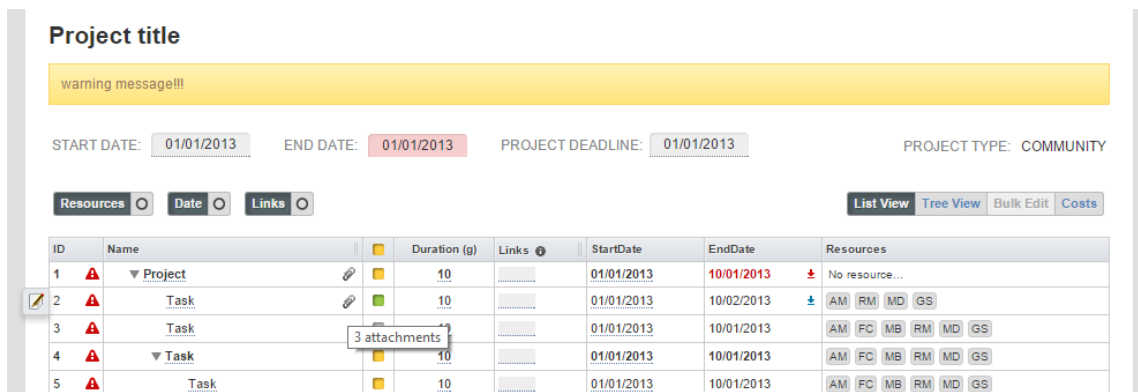*Fig.4: the WBS with critical path, predecessors, and completion percentage*

Fig.5: WBS with assignments of resources taken from the community's users
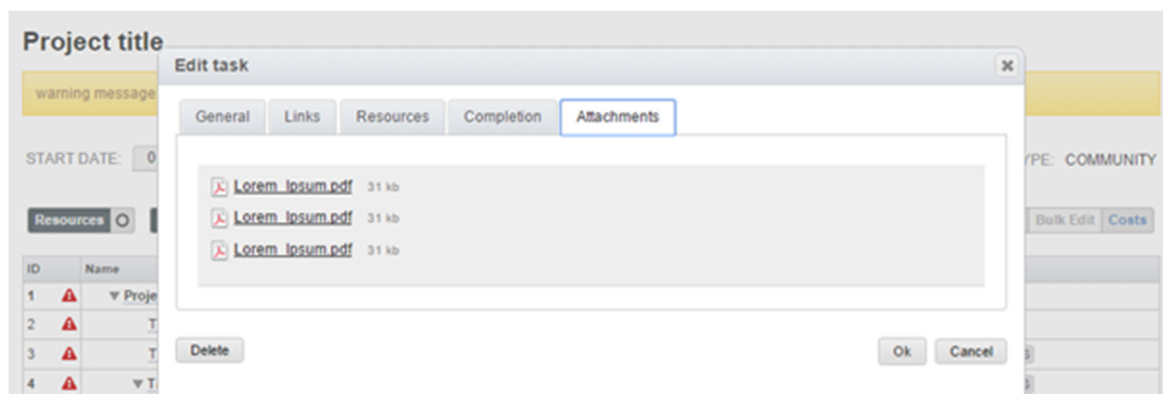

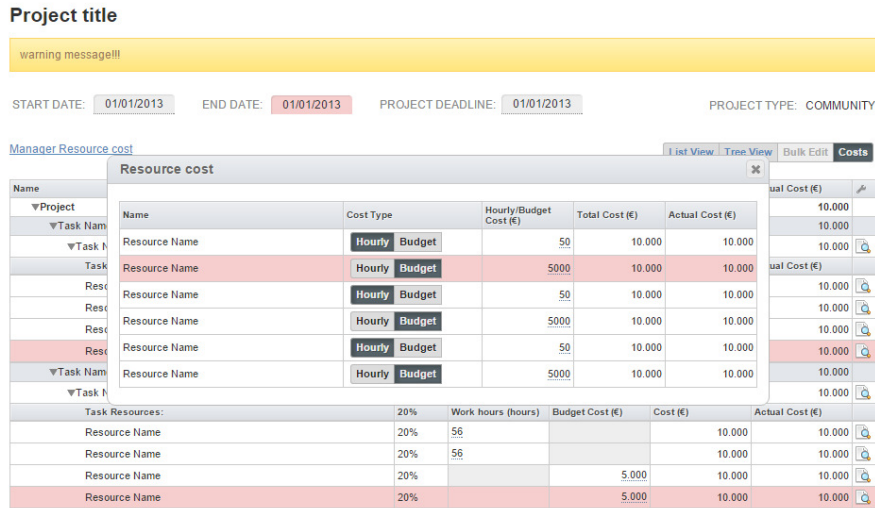*Fig.6: Property of a task with the possibility of attaching files taken from the community's repository*

Fig.7 Resource Management with costs and allocation availability for each resource.
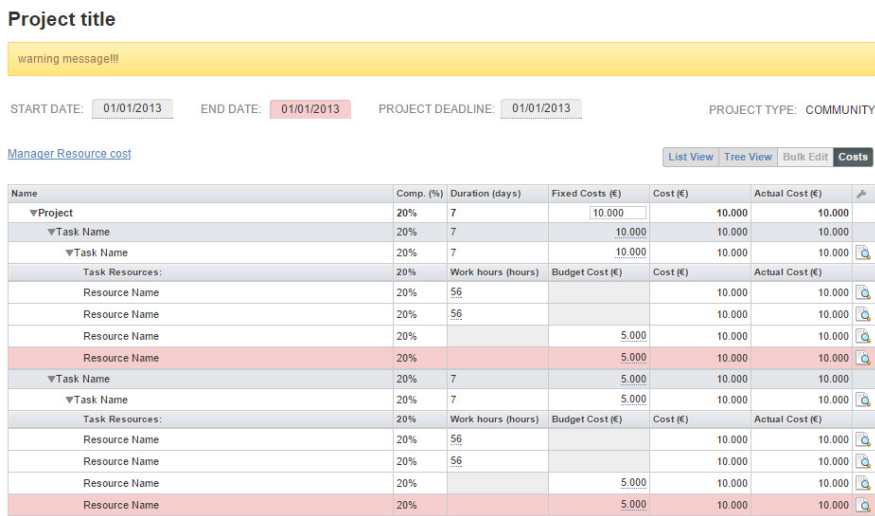
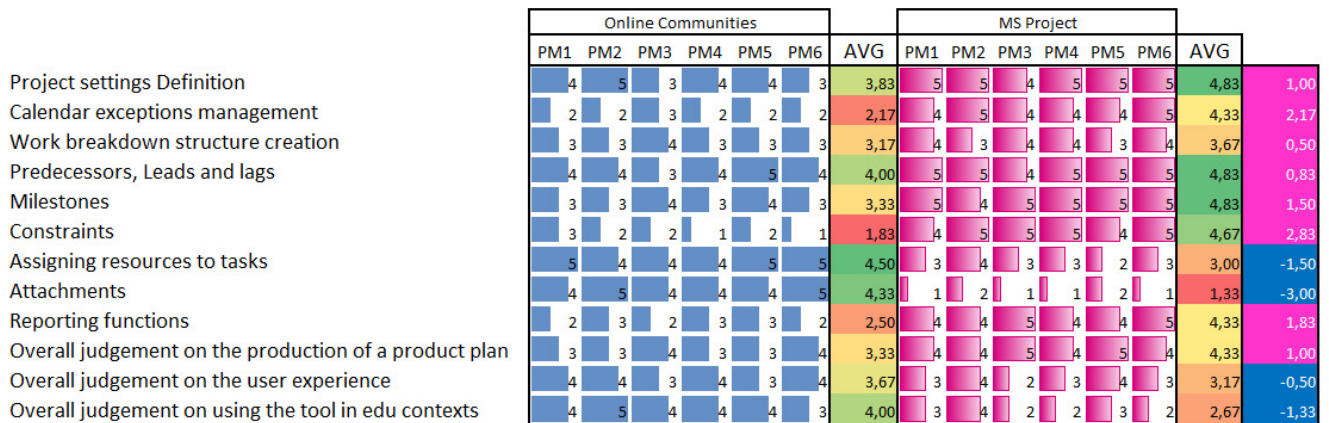Fig.8 WBS, tasks, completion, and associated costs to any single tasks

Fig.9 The results of the experiment of the new PM services on 6 users