Project Planning Add-In based on Knowledge Reuse with Product Patterns

Fuensanta Medina-Dominguez, Maria-Isabel Sanchez-Segura, Arturo Mora-Soto, Antonio de Amescua Seco
Computer Science Department
Carlos III University
Leganes, Madrid, Spain
{fmedina, misanche, jmora, amescua}@inf.uc3m.es

***Abstract*—This work presents an approach that incorporates knowledge reuse to the planning process. Project managers can reuse knowledge using product patterns to learn project management techniques. In addition, they can use the add-in support tool proposed in this work to link information to the Gantt chart; therefore, people assigned to each activity in the Gantt chart can reuse existing product patterns that help develop the assigned activity. The authors have corroborated that the proposed solution improves the satisfaction of the people involved in the development of a software project that has been planned using the proposed solution.**

Keywords-Knowledge Management; Project Management; Software Aplication Component; Product Patterns.

I. INTRODUCTION

Project planning has been recognized by the European Commission as essential for a project's success and, as such, is often considered the most important phase in project management [1]. An immense benefit to planning is that, in case a problem arises during the project development, it functions as an alarm mechanism. Also, project planning is a widely explained process in standards like PMBOK [2] and is supported by a wide variety of software tools (analyzed later, in Section II). Nevertheless, there is an aspect of project planning performance that has not been addressed properly, namely, how to incorporate software reuse while project planning is being developed?

Software reuse is the area that studies how to use a thousand times the same piece of software always in a different way. Software reuse is being applied for products developed in different phases of the software development lifecycle by the use of analysis patterns [3], design patterns [4], requirements patterns [5], etc., but in project planning phase, software reuse has not already been incorporated.

It would be very useful to plan the activities to be performed in a software project and, at the same time, plan the potential pieces of software that could be reused on each activity, or even the potential knowledge that could be reused to develop an assigned activity. So, the authors believe that there are at least two scenarios where reuse can be very interesting while planning. One scenario that can occur is when a project manager faces the challenge to develop a project planning; he or she could reuse the knowledge about project planning from experts in the field. Another scenario could be when the project manager is planning the project activities and would like to provide more information regarding the activities the human resources are assigned to. This information can include examples of this activity developed in other projects, lessons learned while developing this activity previously, or references where the person assigned to the activity can learn more about how to develop the activity assigned. The project manager has to always bear in mind the context, the problem, and the forces of the project under development.

Existing project planning tools do not cover these two potential scenarios. This is why the authors propose the use of reuse artifacts, called *Product Patterns* [6] and the use of a software module that has been developed as a Microsoft Project Add-in, which allows the management of product patterns while developing project planning in the previously described scenarios.

The reminder of this paper is structured as follows: Section II describes an analysis of the most remarkable software tools for project management. Section III presents the solution, an add-in support tool based on knowledge reuse with product patterns; this section describes the product pattern, product patterns in project planning and the add-in support tool architecture. Section IV presents the description of the experiment and analysis of the results. Finally, in Section V, the authors present their conclusions and future works.

II. ANALYSIS OF THE MOST REMARKABLE SOFTWARE TOOLS FOR PROJECT MANAGEMENT

When a project manager wants to plan a project, there is no doubt that the most common technique is the Gantt Chart [7], which is typically drawn using a software application. Among the wide variety of project management software tools, according to International Data Corporation (IDC), one of the most notable global providers of market intelligence and analysis [8] is Microsoft Project (MS Project), as can be seen below in Figure 1. MS Project is the most used project manager software tool worldwide [9] and by this fact alone, MS Project could be selected as the best tool to use since it seems that it is the most popular and trustworthy application. However, before choosing a software to implement the authors' knowledge of reuse solution for project planning, an analysis of the most important tools available in the market will be presented in this section, emphasizing whether or not these tools support knowledge reuse to back up project tasks execution.

Nowadays, the most remarkable project management tools available are cloud-based applications or services [10]. In addition, there are software desktop applications that could offer a sort of web synchronization service or feature [9], [11] that include not only project management features, but also, project portfolio features as well as collaboration

 ISBN: 978-1-61208-276-9

tools. Since the authors' proposal is focused only to back up a project manager in project planning, the authors only analyzed those tools whose main purpose is project planning. They also analyzed those that are mentioned as relevant by IDC in [9] and by Gartner in its MarketScope for Project and Portfolio Management Software Applications [11] and its Magic Quadrant for Cloud-Based Project and Portfolio Management Services [10]. The tools selected for this analysis were the following:

- *Microsoft Project Professional 2010* [12]. This is the most popular project management software, it is developed and sold by Microsoft [13] and is designed to assist a project manager in developing a plan, assigning resources to tasks, tracking progress, managing the budget, and analyzing workloads.
- *Augeo6* [14]. This is a software solution that organizes and automates all activities related to the life cycle of projects, from the initial evaluation of the project proposal until the completion of the project.
- *Genius Project* [15]. This is a web-based tool that delivers a highly flexible and configurable portfolio and project management software allowing for tailored feature sets for a wide array of project teams and project types.
- Planisware 5 [16]. This is a web-based application that supports the end-to-end governance of company portfolios; it offers a complete project management capability with features such as project and resource scheduling, portfolio reporting, simulation, comprehensive project reporting/cost control, and collaboration tools.
- *Planview Enterprise* [17]. Among its capabilities, this tool delivers visibility into and control of project portfolios, allowing to efficiently prioritize work and make better decisions around request management, planning, and resource capacity.
- *Project.net* [18]. This is a web-based tool aimed to maximize the performance of any organization tracking a single project or a portfolio of projects.
- *Sciforma 5* [19]. This is project and portfolio management software aimed to help project managers to administer all aspects of project, resource, risk, and change management.
- *AtTask* [20]. This is a web-based tool that features task, management, issue tracking, document management, time tracking and portfolio management.

Table I shows the criteria defined to assess the knowledge reuse capabilities. Each criteria is defined by: the criteria, the description and the phase of the knowledge lifecycle supported. To analyze if a tool fulfills a criterion or not, every tool was used to plan a simple software project, looking if the capabilities depicted in the criteria were present or not. The presence of a criterion was rated with the following scale: (0) meant that the criterion was not present; (1) meant that the criterion was partially present; (2) meant that the criterion was completely present; the objective is that the ideal tool could reach a rating of 10, meaning that it has all the criteria completely present. The final results of the analysis are shown in Table II, as can be seen MS Project, Project.net, and AtTask obtained the best ratings. However it is important to highlight that none of the tools analyzed offered any formal knowledge representation mechanism, such as the *Product Pattern* defined by the authors; all of them only offered basic knowledge representation mechanisms such as notes, document attachments, blogs, or wiki. This is an important contribution; nevertheless it is not formal enough to accomplish the goals proposed by the authors, especially to foster an accurate knowledge reuse in project planning.

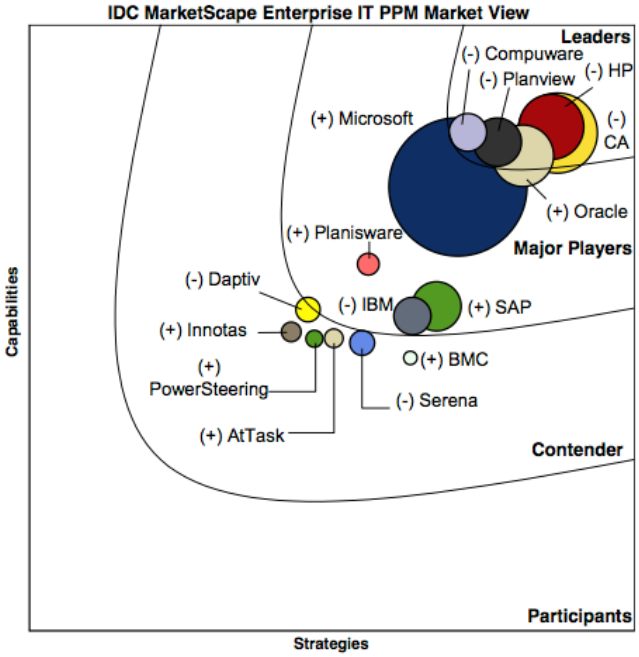

Figure 1 Marker share of project management tools according to IDC

This fact encourages authors to try to improve one of the existing project management software tools, and implement a mechanism to support *Product Patterns* to help project managers improve their project planning activities.

After this analysis, and considering the results offered by Gartner [10], [11] and IDC [9], the authors decided to choose MS Project as the tool to be extended for incorporating a new functionality to link *Product Patterns* and project plan tasks. This decision was made due to Ms Project's wide adoption in the market, a key factor to spreading the use of the solution presented by the authors in this paper, as well as to the large amount of existing documentation to develop new functionalities for this program using the programming languages provided by Microsoft.

 ISBN: 978-1-61208-276-9

TABLE I. CRITERIA DEFINED TO ASSES THE KNOWLEDGE REUSE CAPABILITIES OF PROJECT MANAGEMENT SOFTWARE TOOLS

Criteria	Description	Phase of the Knowledge Lifecycle supported
C1: Basic knowledge assets representation mechanism.	This criterion is intended to identify if the tool offers an integrated mechanism to represent *basic knowledge assets* related to project plan tasks. This kind of asset is any piece of knowledge (an idea, a comment, best practices, or thoughts) that is explicitly represented in natural language, which in turn can be stored in some way that could be shared or used by any person (e.g. document attaching, document sharing, notes, embedded documentation, etc.)	Create
C2: Formal knowledge assets representation mechanism.	This criterion is intended to identify if the tool offers and integrates mechanism to represent *formal knowledge assets* related with project plan tasks. This kind of asset is a piece of knowledge that is represented using a formal or standard notation, such as a metamodel, a pattern language, or a graphical notation (like UML or BPMN).	Create, Codify
C3: Knowledge-tasks linking protocol.	This criterion is intended to identify if the tool offers rules to link the tasks of a project plan with existing knowledge assets that could be helpful to perform them. Knowledge assets could be basic or formal as described above in criteria C1 and C2.	Embed, Diffuse
C4: Knowledge improvement mechanism.	If the tool offers some of the characteristics depicted in criteria C1, C2 and C3, this criterion is intended to identify if the tool offers a mechanism to improve existing knowledge assets that were linked to project plan tasks, for example, by adding new information that could complement the existing one.	Create, Codify, Embed, Diffuse
C5: Tool extension capabilities.	This is not a criterion related to knowledge reuse, but due to the authors' desire to extend the capabilities of the software tool, this criterion is intended to identify if the tool's features can be extended using a programing language.	This criterion does not apply.

TABLE II. RESULTS OF THE PROJECT MANAGEMENT SOFTWARE TOOLS ANALYSIS

Criteria	MS Project Professional 2010	Augeo6	Genius Project	Planisware 5	Planview Enterprise	Project.net	Sciforma 5	AtTask
C1	2	2	2	1	2	2	2	2
C2	0	0	0	0	0	0	0	0
C3	1	1	1	1	1	1	1	1
C4	1	1	1	1	1	1	1	2
C5	2	0	0	0	1	2	0	1
Rating	**6**	**4**	**4**	**3**	**5**	**6**	**4**	**6**

III. SOLUTION

This section describes the solution developed to reuse knowledge with product patterns in project planning, therefore describing the product pattern concept, product patterns in project planning and the add-in support tool architecture.

A. *Product Pattern*

Product Patterns are reusable artifacts that store the experts' knowledge and best practices to develop a product [6]. Although product patterns can be used in different fields, in this paper they have been applied in the software engineering field, where the authors are experts.

For the authors, a software product is any product obtained along the activities of the software project life cycle (for example, requirement specification, data base, planning, etc). Product patterns have been formalized in a wiki, which is available at [21]

The Gantt Chart Product Pattern [22] is an example of product patterns to perform project planning.

B. *Product Patterns in Project Planning*

When a project manager has to perform a project planning, he or she must think about the next question: Do I have the needed knowledge to develop a project planning based on the software engineering best practices?

Figure 2 illustrates the way authors propose to use product patterns in projects planning. There are two possibilities, that the project manager does not know how to perform a project planning (which is illustrated in Block 1 in Figure 2), or the project manager knows how to develop a project planning and wants to perform it (which is illustrated in Block 2, Figure 2).

 ISBN: 978-1-61208-276-9

Project planning learning process (Block 1 description): If the project manager does not know how to develop a project planning, he or she can learn the software engineering best practices and the experience of other project managers. The project manager has to follow the next two steps: STEP 1: Access to the product pattern wiki, available at [21]. STEP 2: Look for the Gantt Chart Product Pattern and learn its content. In the product pattern wiki, the project manager should look for the "Project Planning Product pattern". With this product pattern, the project manager will learn step by step how to perform a project planning. Lessons learned, information resources, knowledge and skills to perform project planning are also available.

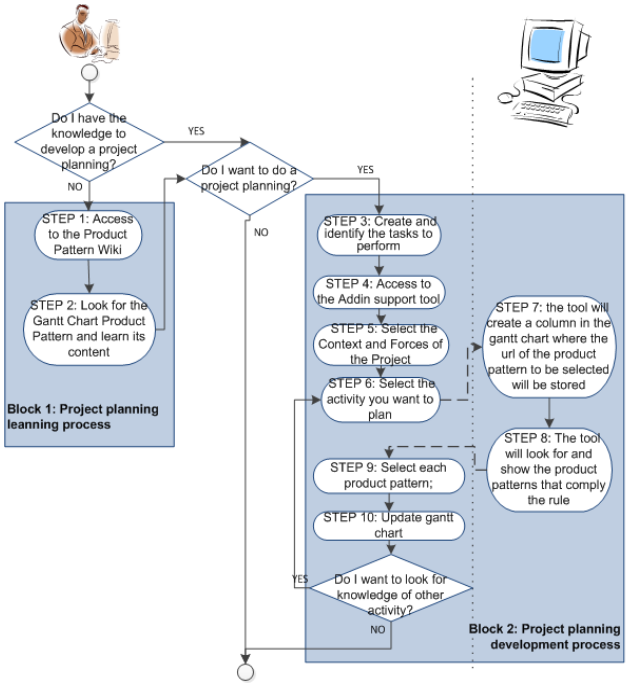

Figure 2 Product Patterns in Project Planning

In this way, product patterns will be useful to the project manager to learn the needed knowledge to perform project planning, using the best practices of software engineering and the experience of software managers who have used and given feedback about the product patterns with the knowledge of using the Gantt Chart product pattern in different projects.

Project planning development process (Block 2 description): If the project manager knows how to perform the project planning and he or she wants to develop a Gantt Chart, the project manager must follow the next steps: STEP 3: Create and identify the tasks to be performed during the software project. STEP 4: Access the add-in support tool developed by the authors. STEP 5: Select the context and the forces of the project; the project manager will have to select the context where the project will be developed and the generic and specific forces that affect the project planning under development, such as the kind of organization, team experience, etc. Figure 3 shows the screenshot where project manager has to select the context and forces. STEP 6: Select the activity you want to plan. As can be seen see in Figure 4, once the context and the force are selected, the project manager will have to select the activity to be planned. STEP 7: The add-in suport tool will create a column in the Gantt Chart where the selected product patterns url will be stored (it can be seen in Figure 5).

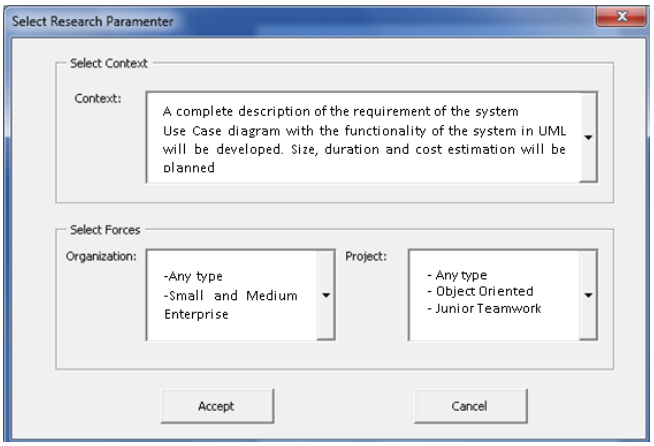

Figure 3. Context and forces selection

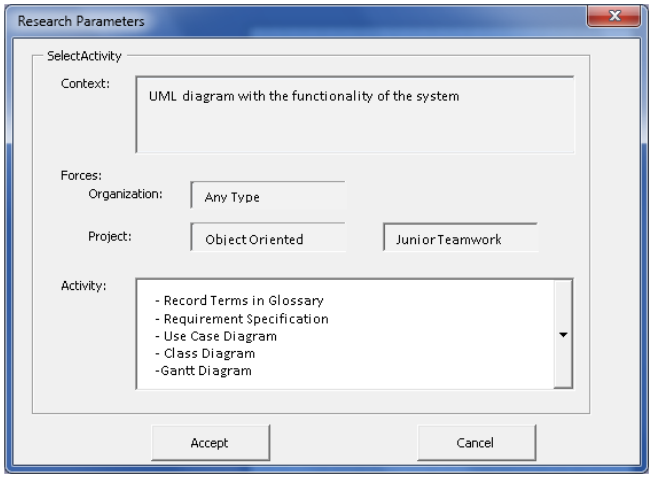

Figure 4. Activities selection

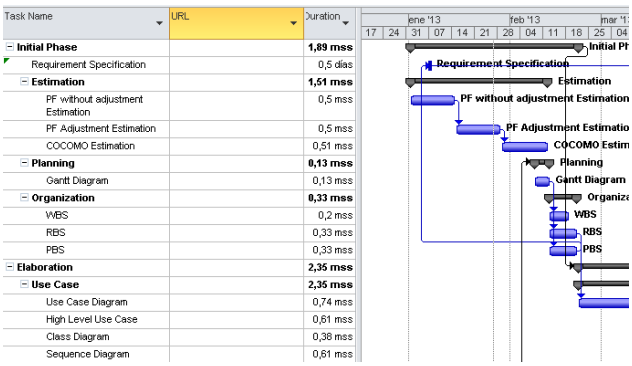

Figure 5. Create URL Column

STEP 8: The add-in support tool will look for the product patterns which comply with the context, forces and the activity (problem) that the project manager wants to plan; so the tool will execute the next rule:

If you find yourself in this **context**
(and) with this **problem**
(and) entailing these **forces**
then
map a product pattern in your project
(and) look for more product patterns

The product patterns that comply the rule will be shown in the tool, this can be seen in Figure 6. STEP 9: The project manager can select each product pattern and the add-in support tool will show the description and the url of the product pattern where the project manager will have access to the best practices and the experiences of other software engineers related to the activity being planned (time, resources, lessons learned, etc).

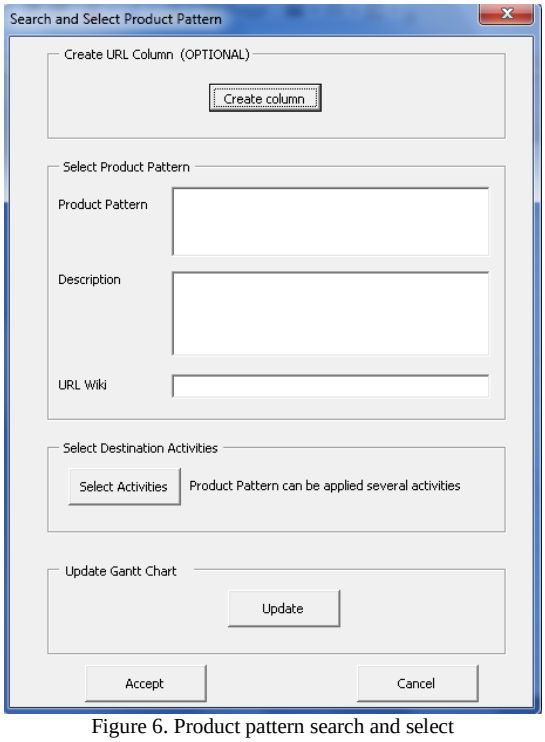

Figure 6. Product pattern search and select

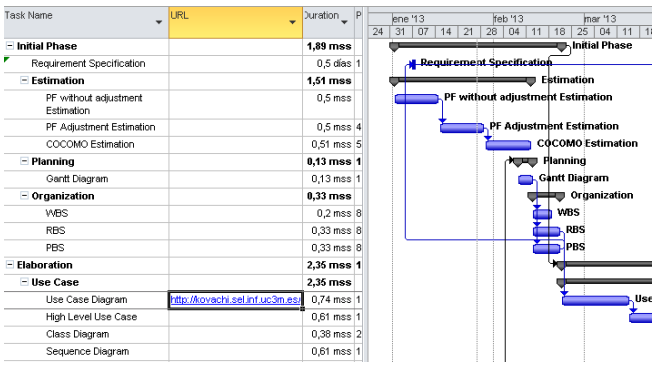

Figure 7. Update Gantt Chart

At this point, the project manager will have to select the product pattern that best fits with the activity which is being planned. STEP 10: Update Gantt Chart: the add-in suport tool will update the Gantt Chart with the url of the selected product pattern, this can be seen in Figure 7. STEP 11: Save the changes. The add-in suport tool will save the updated project planning.

C. *Add-in Support Tool Architecture*

The architecture of the add-in consists of three modules clearly identifiable:

- The client (or component add-in) is embedded within the Microsoft Project program. The add-in is installed on client computers using a simple self-install, slightly configurable, and outside the building application.
- Web service: it works thanks to an application server; both are located in a server computer. The Web Service WSDL descriptor allows that the services can be public and accessible for the customer.
- Database manager: it is located in a server computer. The database query manager handles the queries of the project manager to obtain the knowledge needed to perform the project planning.

IV. EXPERIMENTATION

This section describes the experiment and the analysis of results.

A. *Description of the experiment*

This solution provides an add-in support tool for project planning using product patterns. The authors validated the time spent developing the project planning from the satisfaction of project managers and teamwork involved in the development of each planned project. The experiment was conducted in two phases:

Phase I: Implementation of project planning without using add-in support tool, and development of the projects planned.

Phase II: Implementation of project planning using add-in support tool developed by the authors and development of the projects planned.

The authors believe that although the development time using the add-in support tool will increase, the level of satisfaction achieved will increase as well because it provides the knowledge of the best practices and the experience and knowledge of experts in software engineering.

To validate this goal, six software projects were developed at Carlos III University in Spain. All the project managers who participated in this validation had between 10 – 15 years' experience, and a Bachelor's degree in computer science. Each of the 6 projects that took part in the validation included:

- Two different project managers that participated in the validation, one project manager to develop the planning without using the add-in support tool, and another one using the add-in.

 ISBN: 978-1-61208-276-9

- Two different teams, one team that used the planning made by the project manager without using the add-in support tool, and the other one that used the planning made by the project manager using the add-in support tool.

A survey was performed to value the level of satisfaction of people involved in the experiment.

B. Results Analysis

The data analysis results are shown in Figure 8. The bubble figure shows a comparative: for each project (x-axis) there are two bubbles with the development time (y-axis) and a level of satisfaction (bubble area), within each bubble there are numbers that represent "time; satisfaction".

As can be seen in Figure 8, the development time is greater in phase 2 where the add-in support tool is used. This increase is the result of the project manager learning the knowledge provided by the product patterns to select the ones that best fit with each project activity. Although for each project the time spent in project planning is greater when using the add-in support tool, the bubble area is larger as well because the project planning is done with the knowledge about how each activity affects the project planning. Also, the project manager provides for each activity, using the add-in support tool, a URL to the products patterns wiki, where the person in charge of each activity can access the knowledge on how to perform the assigned activity.

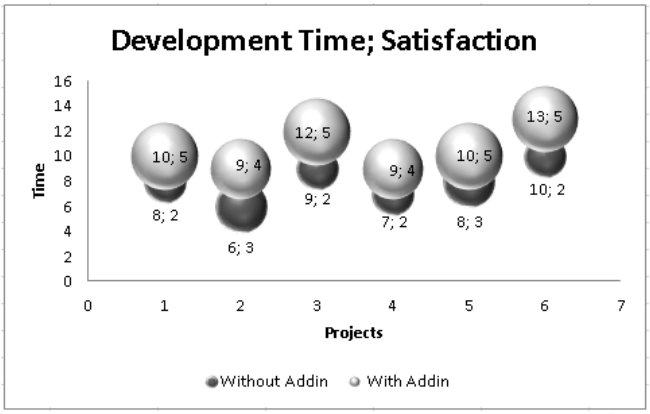

Figure 8. Results Analysis (Phases – Development Time – Level of Satisfaction)

V. CONCLUSIONS AND FUTURE WORKS

The most important mission of this work was to focus on the scarce reuse being done in general in project management and specifically in project planning. The authors proposed an easy way to incorporate into project planning all the necessary information (i.e., activities to be done, product to be obtained, people assigned, time schedule, budget, etc.), but also the know-how the software engineers have on developing software products, which can be reused a thousand times and never in the same way to develop the project activities. This has been done by using product patterns, proposed by the authors as artifacts to gather the know-how on how to develop software products and easily accessed by the wiki [21], and an add-in support tool, that can be easily developed by any project development platform (in this case developed to be added to Microsoft Project). The use of the proposed solution has demonstrated that, although the time spent in the project planning increased, the satisfaction of the teamwork while developing their assigned activities also increased. The authors want to demonstrate as future work that the productivity of the teamwork increases as well.

Using this approach is an interesting way to ensure the company which is developing software projects, that the planning has been done by reusing the know-how of the people working in the company and in this way it is easy to assess how the know-how is giving a return of investment to the company.

ACKNOWLEDGMENT

This work has been partially funded by the Spanish Ministry of Science and Technology through the project TIN2011-27244.

REFERENCES

[1] European Commission. Managing projects. Available at: http://ec.europa.eu/eahc/management/Fact_sheet_2010_01.html. [Accessed: 30-Jan-2013].

[2] PMBOK A Guide to the Project Management Body of Knowledge. Fifth Edition. PMI. 2013.

[3] S. Ketabchi, N.K. Sani, and L. Kecheng, ”A Norm-Based Approach towards Requirements Patterns”. Computer Software and Applications Conference (COMPSAC), 1 IEEE 35th Annual Topics: Computing & Processing (Hardware/Software), 2011, pp: 590 – 595, Digital Object Identifier: 10.1109/COMPSAC.2011.82

[4] C. Larman. Applying Uml and Patterns: An Introduction to Object-Oriented Analysis and Design, and the Unified Process. 2002. Prentice Hall

[5] L. Hagge, K. Lappe, and T. Schmidt, “REPARE: The Requirements Engineering Patterns Repository”. 13th IEEE International Conference on Requirements Engineering (RE'05), 2005, pp. 489-490.

[6] M. Sanchez Segura, F. Medina-Dominguez, A. Amescua and A. Mora-Soto. “Improving the Efficiency of Use of Software Engineering Practices Using Product Patterns”. Information Sciences (Impact Factor: 3.291), Vol. 180, Issue 14, July 15, 2010, Pages 2721-2742.

[7] H. Kerzner, Project management: a systems approach to planning, scheduling, and controlling, 10th ed. Hoboken, NJ, USA: Wiley, 2009, p. 1120.

[8] USA IDC Corporate, “International Data Corporation.” [Online]. Available: http://www.idc.com/. [Accessed: 24-Jan-2013].

[9] M. Ballou and J. C. Pucciarelli, “IDC MarketScape Excerpt: IT Project and Portfolio Management 2010 Vendor Analysis. Four Views to Enable Effective Evaluation,” Framingham, MA, 2010.

[10] D. B. Stang and R. A. Handler, “Magic Quadrant for Cloud-Based Project and Portfolio Management Services”, Stamford, CT, USA, 2012.

[11] D. B. Stang and R. A. Handler, “MarketScope for Project and Portfolio Management Software Applications”, Stamford, CT, USA, 2012.

 ISBN: 978-1-61208-276-9

[12] Microsoft Corporation, “Microsoft Project Professional 2010. Product Information.,” 2010. [Online]. Available: http://www.microsoft.com/project/en-us/project-professional-2010.aspx. [Accessed: 26-Jan-2013].

[13] Microsoft Corporation, “About Microsoft,” 2013. [Online]. Available: http://www.microsoft.com/about/en/us/default.aspx. [Accessed: 25-Jan-2013].

[14] Augeo Software SAS, “Augeo6 Product Description,” 2012. [Online]. Available: http://www.augeo.com/page/augeo6. [Accessed: 24-Jan-2013].

[15] Genius Inside, “Genius Project. Product Description.,” 2012. [Online]. Available: http://www.geniusinside.com/software/software. [Accessed: 24-Jan-2013].

[16] Planisware, “Planisware 5 information.,” 2011. [Online]. Available: http://www.planisware.com/main.php?docid=12420. [Accessed: 24-Jan-2013].

[17] Planview Inc., “Planview Enterprise description.,” 2013. [Online]. Available: http://www.planview.com/products/enterprise/. [Accessed: 24-Jan-2013].

[18] Project.net, “Project.net overview.,” 2013. [Online]. Available: http://www.project.net/overview. [Accessed: 24-Jan-2013].

[19] Sciforma Corporation, “Sciforma 5.0 overview.,” 2012. [Online]. Available: http://www.sciforma.com/page?id=927. [Accessed: 24-Jan-2013].

[20] AtTask Inc., “attask product overview.,” 2012. [Online]. Available: http://www.attask.com/product. [Accessed: 24-Jan-2013].

[21] Product Pattern Wiki. Available at: http://kovachi.sel.inf.uc3m.es

[22] Gantt chart Product Pattern. Available at: http://kovachi.sel.inf.uc3m.es/800-spanish/801_libreria_de_patrones_de_producto/Diagrama_de_Gantt

 ISBN: 978-1-61208-276-9