Abstract: Companies oriented to project development need tools for efficient project planning, controlling and tracking. The article presents design principles and functionalities of the Web Project Tracker (WebPT) application, which provides project managers and customers with means for easy control over development process and progress tracking. WebPT provides companies with advanced features as roles of assignment, price rate defined for each role, work hours approval, and period activities reports and. Thanks to common J2EE technology merits and its sophisticated architectural design, the system is on open, portable and scalable solution appealing for small and medium enterprises.

Key words: project tracking, project management, tasks, activities, task assignment, task roles

INTRODUCTION

In recent years, we witness a fast evolution of software development in our country. The conditions of strong competition caused firms to increase their range of products and to decrease the time for issuing new releases at the market. In these circumstances, regular usage of systems for project management and progress tracking drops off the cost of production and increases the competitiveness of the company worldwide.

Nowadays, there are a plenty of tools for project management and progress tracking available at the market, suited for both Internet and intranet [1-4]. While desktop products such as Microsoft Project™ offer functionalities for project planning, reporting and static management (only by data introduced by project managers), progress tracking systems implies input of all the actors involved in a project. They are supposed to report their daily/weekly contributions according task assignment planned by the project manager, and these reports should be approved, corrected or annulated by the manager. Dynamic maintenance of work reports for each actor (worker) across a task plan allows building of progress reports showing the real status of project development. Moreover, some systems for project tracking offer assignment of actor roles for participation in each task. However, because of the cost of ownership of these project tracking applications and the additional efforts to adapt them to particular work demands, such products are not widespread in the small businesses.

Our goal is to describe the main requirements and problems in this area and to propose a system solving them, as well as to introduce some innovative concepts that make it applicable for the widest possible range of small and medium software companies.

METHODS FOR PROGRESS TRACKING

The work that has to be done during the life cycle of a software product covers the processes from the clients’ demands specification to the deployment of the finished product. First of all, of tasks and subtasks should be specified and, next, the dependences between them and the sequence in which they should be done. If one or some of them were technically infeasible then the work should no be started at all. Finally, tasks should be assigned to workers (developers, testers, technical writers, etc.) regarding their skills and availability.

In most cases there are several ways to fulfill some of the tasks. There are activities that could be done at the same time and others that need some preconditions to be started. We have to analyze all alternatives and choose the one that best suites the aims of the project. Our choice depends on some of the following criteria: time for development, cost of development, resource usage and so on. It should also fit into the limitations of the project, such as available resources, budget, deadline and so on.
**Milestones**

Above we mentioned that we should break the work in subtasks, assess the available resources and come up with the global scheme which satisfies the aims and limitations of our project. In the sequence of subtasks we also distinguish effort units separated by milestones. If there are \( N \) milestones in the project and we define \( m_i \) as 1 if milestone \( i \) has been reached, and otherwise 0, then the progress \( (P) \) can be written as:

\[
P = \frac{\sum_{i=1}^{N} m_i}{N} \times 100
\]

The main idea behind the milestones method is the same effort needed to reach each of the milestones. If we need more efforts to reach some of the milestones the above formulae will no be true. These cases require other work tracking methods.

**Earned value**

The earned value method we assign a relative value to each subtask. This relative value is added to the total value of progress only if the subtask is finished. The method provides us with a common measure for all tasks independent of the type of work. The sum of all relative values must be equal 100. We can calculate the progress \( P \) using the following equation:

\[
P = \sum_{i=1}^{N} \text{relative value}_i \times \text{milestone}_i
\]

where \( \text{milestone}_i \) is defined as 1 if \( \text{milestone}_i \) has been reached, and 0 otherwise. And

\[
\text{relative value}_i = \frac{\text{effort for milestone}_i}{\text{total effort}} \times 100
\]

If all milestones delimit equal effort tasks progress will remain linear in time as in the milestones method. However, the earned value method compensates for both cases in which effort is not balanced in the project and the resulting graph is linear in time as well.

**EXISTING APPLICATIONS IN THE AREA AND PROBLEMS ENCOUNTERED**

There are lots of Web based applications for software development tracking and management. Just a few of the companies that have developed such systems offer on-line demo versions, usually with less functionality (typically, it does not include the administration module), but it gives us a general idea about how the product works. This makes the client choice more difficult because it should be made considering only the description of the vendors without having the opportunity for real testing of product features.

Other companies prefer to offer on-line presentations of their products, which can be viewed directly or downloaded by the customers. Often the only way to get information about the product is to register and wait for the vendor’s answer. This probably helps the companies to analyze the market but repels a lot of customers because of the demand of too much personal information.

The basic functionality of most of the applications in this area consists of management of user accounts, projects, subtask and daily report information [3,4]. They usually have only two kinds of users – administrators of the system and programmers working with it. Rarely there are systems with more user types.

One of the major problems of most of the applications is that their orientation is towards problem tracking and reporting which arise after the creation of a software product (the so called “bug reports”). In the cases in which development process tracking is
provided there are no roles which the employees to be associated with. Reports generation and managers’ approval schemes are missing, too.

Let us have a more detailed look on the problem areas mentioned above:

- **Roles of association**

  A very important aspect is the explicit specification of the role of each employee in the subtask he/she is taking part. Some of the most often encountered roles are: designer, documentation writer, developer, quality manager and project manager (PM). Each of the roles is fulfilled by a specialist in the given area and assigned by the PM to a worker for given task (fig. 1). The amount of work and the per hour wage are different for the various roles. If the system provides such functionality it will be much easier to distribute and account for the resources. It will be possible to calculate the resources used by different specialists, as well as the work done by each of them.

![Fig. 1: Mapping of roles](image)

- **Reports**

  The availability of various kinds of reports helps the managers and the accountants working with the system. They can easily obtain information about the activities and expenses of each programmer, task or project.

- **Project manager**

  Only a few systems give the opportunity to define a project manager. He/she is an employee who is responsible for the project workflow, the division of the work in subtasks and the assignment of the subtasks to the other workers. For each subtask he/she has to define the deadline, man hours and later to approve the hours of work spent on it.

  A single project has one manager, but one employee could be a manager for several projects. Thus, if the firm has hired one highly qualified manager he/she could take responsibility for all of the projects and will be associated with the role of “Project manager” for all of the projects.

- **Work hours approval**

  This is a genuine feature introduced by WebPT. The concept of “work hours’ approval” is suitable for remote work or when a team is gathered for the completion of a single application. If the manager has the opportunity to edit the workers’ activities he/she would have better control of the project progress. In some circumstances a change of the hours spend on the task could be necessary if the manager does not agree with values reported by the employee and the manager could decrease or increase them.
In the report generated by the system only the approved hours are considered. This guarantees that the statistics is based only on approved by the manager data. The approach is not applicable for companies, which have employees with permanent contracts and the salaries are not based on the current employees' load. They keep track of the subtask activities just to make some project statistics.

- External customers

This is the opportunity the company’s clients to observe the projects’ progresses. They could see the general statistics, on what tasks is the project separated, who works on each task and the week activities report generated from the approved work hours.

- Period activity

Another drawback of most systems is that they require daily reports from the employees. In most cases this is not possible or is impractical. Often the workers forget to fill their reports or system cannot be accessed. It is convenient to have the possibility to fill larger periods of time with a predefined template. If the user decides that for a particular period some of the days do not fit in the template he can change the data just for these days manually.

**WEB PROJECT TRACKER**

The application is built on J2EE technology and is running in JBoss and MySql environment [5]. It has three layers as shown in fig. 2:

- presentation layer

It is responsible for the visualization of the requested information in HTML format, as well as parsing the request of the user which leads to the invocation of particular business components from the business layer. In our case it consists of servlets and JSPs from the ptvw.web package. In practice the user works only with this layer.

- business (EJB) layer

This layer consists of a set of business components working in an EJB container environment [5]. These components can be reused multiple times and are independent of the client logic. Conforming to the ADVANCED ENTERPRISE JAVA BEANS concepts we can easily change the presentation layer without any modifications to the business layer.

In WebPT we have created a container managed persistence entity bean for each table in the database. The EJB container of the server automatically generates all the requests to the database. If you want to migrate to another application server it is only necessary to write the server dependent XML configuration files.

The web components do not interact directly with the entity beans. There is an intermediate layer of session beans (session facade), which is responsible for all operation with entity beans. This is one of the ways to encapsulate the business logic, improve the performance and achieve easily modifiable source.

- database layer

It is the place for the permanent data storage. The databases accumulate all the additional information concerning the application.

There are three main types of users:

- Administrator

The users of this group administer the accounts of the rest of the users. They define and modify the data for the projects, associate roles for the users. They also generate reports for the users’ activities, the other activities on the projects, the amount of money to be paid to the workers and the total cost of the project,

- Worker - the user might be:
  - a common worker such as analyst, interface designer, developer, tester, etc.
  - a manager of single or multiple projects
Depending on the worker’s type, the navigation menu has a different structure. Each user can access the “My assignments” menu, which shows all of the active tasks to which he/she is assigned; “My daily report” menu – the place where the user should report the daily activity; “Period activity” – the place to report period activities; “View all assignments” – where the user can view all assignments; and “View project activity” – project statistics. PM’s can access special menus such as “Activities waiting for approval” (fig. 3).
The project manager is the only person who can define new tasks, approve work hours and assign employees to tasks with a particular role.

- **External user**

  These users can only view the project status, the week activities and tasks in the project.

**CONCLUSIONS AND FUTURE WORK**

It is almost impossible to find a free application for project management and tracking of a small or medium scale software project. Modern products in the areas of software development tracking and control are not adapted for project-oriented small and medium enterprises with restricted budget. WebPT’s goal is to fill this niche.

Besides the basic functionality available in most of the applications in the area, WebPT introduces some innovative features, such as: roles of assignment, price rate defined for each role, work hours approval, and period activities reports. Its easy user interface and tracking maintenance plus straightforward issuing of billing invoices for business clients makes WebPT very attractive for project-oriented companies.

One of the things that could be elaborated in the future is the reports system. Once we have data in the database we could add additional reports and to improve the reports visualization with more graphics. By developing additional report exporters and formatters, companies may have customised progress reports in various formats based on tasks, roles, and time.

Nowadays we are witnesses of the creation of huge software systems with the participation of many employees. There is a need of modern communication channels for all the project participants for improving the inter-communication process. One way to do it is to build a messaging system so that the users are able to send and receive all kinds of messages such as e-mails, instant messages, SMS/MMS messages and so on [6].

The application is inherently open, portable, and scalable because of the Java 2 enterprise technology used for its development. It provides small end medium enterprises with a plenty of project tracking functionalities with easy maintenance at low cost.

**REFERENCES**


**ABOUT THE AUTHORS**

Stanka Andonova, SAP Labs Bulgaria. Phone: +359 88 657059, e-mail: atania@lycos.com.

Boyan Botnchev, PhD, Associate Professor at Department of Information Technologies, Faculty of Mathematics and Informatics, Sofia University. Phone: +359 88 988948, e-mail: boyan@bonea.com.