ASTRONOMICAL LARGE PROJECTS MANAGED WITH MANATEE: MANAGEMENT TOOL FOR EFFECTIVE ENGINEERING

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ABSTRACT

This paper describes MANATEE, which is the Management project web tool developed by FRACTAL, specifically designed for managing large astronomical projects. MANATEE facilitates the management by providing an overall view of the project and the capabilities to control the three main projects parameters: scope, schedule and budget.

MANATEE is one of the three tools of the FRACTAL System & Project Suite, which is composed also by GECO (System Engineering Tool) and DOCMA (Documentation Management Tool). These tools are especially suited for those Consortia and teams collaborating in a multi-discipline, complex project in a geographically distributed environment.

Our Management view has been applied successfully in several projects and currently is being used for Managing MEGARA, the next instrument for the GTC 10m telescope.

Keywords: Project management, Software Tool, Quality Control, System Engineering

1. INTRODUCTION

The Project Management Tool (MANATEE) helps to plan and to manage the activities that are carried out in an organization providing an overall view of the project and control tools to track the three main projects parameters (scope, schedule and budget). Besides, MANATEE allows a global management of all the projects that are carrying out within a given organization, facilitating the resources optimization.

The information that can be stored and managed by MANATEE includes:

- Project management data such as WPs, Milestones, Cash Milestones, WBSs and WBS Progress Reports.

- Human resources information such as the hourly costs and the Personal Time Reports (PTR).

- Project quality control data such as project risks, non-conformities and preventive and corrective actions.

In MANATEE, different users, such as Project Manager, Work Package (WP) manager or Work Breakdown Structure (WBS) tasks responsible, have different permissions. Access rights are defined at the level of users and projects.

MANATEE is part of the FRACTAL System and Project Suite, which includes also the tools GECO (System Engineering and Configuration Tool) and DOCMA (Documentation Management Tool). All these tools are being successfully applied to carry out international, complex and geographical distributed projects. An example is the development of the instrument MEGARA[1], the future fiber fed optical spectrograph for the GTC 10-m telescope, for which FRACTAL is responsible of both Management and System Engineering Work Packages.

In the following sections, we first introduce FRACTAL System and Project Suite, to provide an overview of the set of applications that are used in combination with MANATEE to track and manage projects. Then, we describe in detail MANATEE functionality. Finally, we quickly summarize how the information must be introduced in MANATEE to use the application while tracking a project.

2. FRACTAL SYSTEM AND PROJECT SUITE

Having computer-aided tools is particularly important when generated data increases (which occurs as the projects or organizations evolve). In such cases, the information can become unmanageable very fast and the need for a specific software tools to control it becomes essential.

This assessment is particularly important for companies or organizations where most of the involved people are geographically distributed (which is the own FRACTAL situation). In such a case, people located in different work centers (often in different cities or even different countries) need to access the project data in a controlled way.

FRACTAL is a company founded in 2005 and dedicated to carry out engineering and scientific projects mainly related with telescope and professional astronomical instrumentation. Our main customers are universities and research centers involved in large Consortia responsible for delivering cutting-edge developments for the ground-based professional observatories and/or Space missions. It is also important to mention that most of the people working or collaborating in our company and/or our customer's organizations, is geographically distributed, which makes the effective communication becomes a key tool for project success.

For this reason, we have developed several customized tools fully focused on solving the main problems found when participating in instrument development projects. Our tools (FRACTAL Suite) share a common database and help the entire project team to access and exchange information, and to perform and coordinate the Management and/or System Engineering activities:

- **GECO - System engineering and configuration control.**

    System Engineering is defined as the interdisciplinary effort that governs the global technical effort done in a project framework to transform the initial requirements into the final system. Therefore, Systems Engineering provides the basis to establish a good organization during the technical development of a project, and will be essential to provide the needed help to Project Management to fulfill both the system requirements and the project schedule and budget. This discipline is always essential for the success of any project, especially the more complex ones, which include different professional skills and whose partners and working groups are often geographically distributed.

    The System Engineering group must produce the System Engineering plan for the development of a system. During the implementation of such plan, the system configuration data are generated: Product Tree (PT) elements, requirements, interfaces, specification documents, verification matrix, configuration control records, non-conformities records, etc.

    GECO is a Configuration Management Tool that provides the means to manage the configuration data generated in all phases of a project, i.e., not only during the design phases of a system but also during its integration, verification and, even later, when the system enters into operation.

    The application has been developed with two objectives: firstly, to assist the System Engineering Group and Configuration Control Group to control and maintain the configuration items of a system and, secondly, to make this information available to other groups within the organization or the consortium in charge of developing and operating the system.

    GECO helps to keep updated the configuration data, to establish the links among data (e.g. requirements traceability) and to manage configuration changes, non-conformities and anomalies. The final goal is to facilitate the configuration control process by tracking correctly the system development in order to ensure the successful system development and integration.

    Finally, this tool can automatically generate the requirement section of the documents from the updated requirements stored in GECO database, which helps to keep a coherent set of requirements and to avoid maintaining duplicated information, reducing considerably at the same time the work needed to have the documents updated. Requirement Documents are an important view of the system and these documents have to be distributed to third parties, such as contractors and/or customers, and have to keep updated to comply with the intended project milestones and reviews.

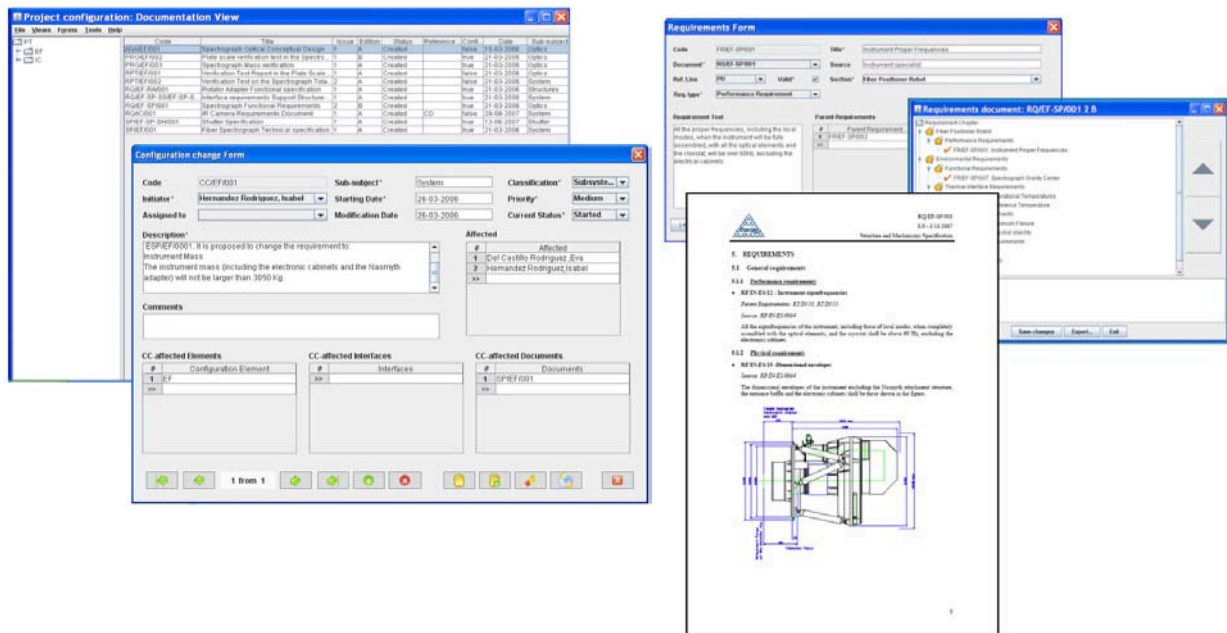   Fig. 1 provides several view of the GECO graphical user interface.

Fig. 1. GECO snapshots. Some views on documentation , requirements and configuration-change views are shown.

More information on GECO can be found in FRACTAL webpage http://www.fractal-es.com/en/GECO.html

▪ **DOCMA - Project documentation.**

All organizations produce and store a good amount of documents. The number of documents is high enough to make a documentation management tool always a need. When several companies and/or institutions collaborate in a multi-discipline, complex project in a geographically distributed environment, a documentation tool starts to be even more important. In such a case, the number of documents generated and stored in the diverse work centers, with different versions, written and reviewed by several individuals can become a communication problem in the project, being unmanageable very fast. Then, a specific computer-aided tool becomes essential.

DOCMA is a Documentation Management Tool that provides the means to manage the documents generated in a company or organization during the whole document life-cycle and according to the permission granted to the users. This allows us to keep and organize documents and to improve the internal communication among the different members involved in a project.
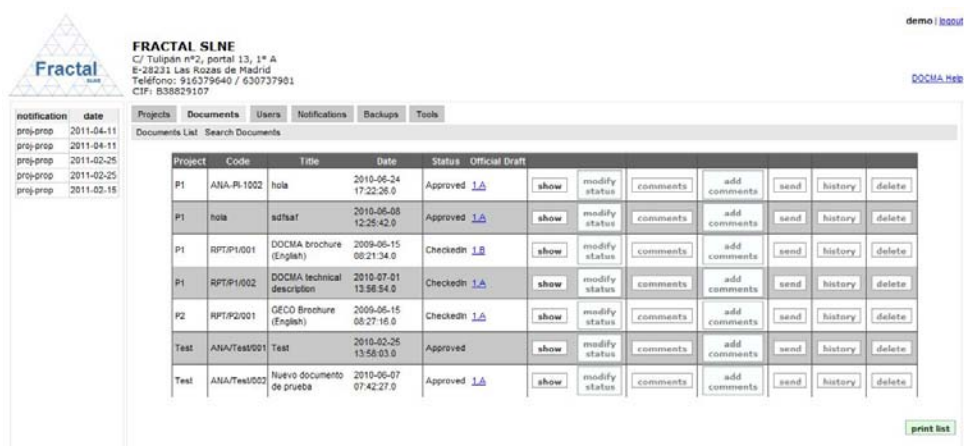

Fig. 2. DOCMA web interface view.

▪ **MANATEE – Project Management.**

A project is a strategy to reach a goal. All projects must be defined in terms of Scope (Performance), Schedule (calendar a time relationships among tasks) and Price (overall budget and cash-flow along the project). These three parameters must be planned from the beginning of a project, but the real difficulty appears when trying to control them and their inter-relationships as far as the project progresses. The core management activities are usually a huge amount of day-to-day tasks related to making decisions, managing and coordinating the team that could lead to a provisional abandon of the crucial project control task. MANATEE has been designed to help in the optimization of the project achievement, acting as an electronic project controller able to be fed by the team members and to inform them and the managers of the project progress, generating also warning when important deviation from the planned goal are detected.

The set of tasks managed by the same overall responsible, oriented to produce a single deliverable or to offer certain kind of services to the project are called Work Packages. The WPs are usually divided by the nature of the tasks to do (usually due to the skills of the people that have to carry out the work) or by organizational needs. Each Work Package has an associated deliverable (or set of deliverables) in such a way that the sum of the Work Packages is the system to be delivered. Each WP is divided in sub-work packages and these into smaller pieces of work, tasks, and all together constitutes the Work Breakdown Structure, WBS. The Project Manager has to propose the Work Breakdown Structure at the time of designing a project plan. The WBS is a deliverable-oriented grouping of project elements, which organizes and defines the total scope of the project via the needed tasks to complete all the deliverables. The WBS technique uses a hierarchical tree structure. Each task is an activity and it is an element of work with clear assigned project parameters.

In order to control the project parameters (scope, schedule and budget), it is essential to follow in detail the tasks execution or, in other words, to have close access to the relevant tasks data that allow to understand the status of the project. This includes figures such as the level of complexion of the tasks, the number of hours assigned and spent in each task, additional resources needed to carry out the tasks (like hardware or software elements, access to facilities), etc. Project managers need to receive (or to access) feedback on these data (from the people in charge of their development) in order to analyze how the project is being developed and to anticipate any risk or problem (delays, budget deviations, de-scoping, functionality loss, etc.). At the same time, the people participating in the project need to have the means to record the information relative to the tasks that they are responsible or just carrying out.

In addition to the above items, when the project office is geographically distributed and/or when the project is too complex, in terms of number of disciplines, number of resources, funding sources, etc. a web-based software tool allows people being more active in the project and keep them fully informed on the project status. The tool also makes the relevant information available to everybody.

MANATEE is a project management tool that provides the means to facilitate controlling the project development. This paper describes this tool in detail.

An additional feature, common to all the applications of the suite, is that they have been developed to run on different environments and at different locations. This is important taking into account the geographical distribution of the personnel in the organizations involved in these kinds of projects. Besides, in order to minimize the maintenance costs and complexity, we have chosen a platform-independent technology; providing simple ways to install the software in a distributed environment and implement a user access policy and encryption features to protect the project's data.

GECO is developed in Java, while DOCMA and MANATEE provides a graphical user interface based on WEB forms. The three tools allow accessing the full functionality and the project data remotely from any place.

3. MANATEE

3.1 Overview

The Project Management Tool (MANATEE) is mainly intended to:

- define the projects,
- facilitate the management of the project,

- maintain the project quality,

- make the project information available to all authorized users according to the access rights given to them,

- maintain the affected users informed

The MANATEE functionality can be divided into the following areas:

- Project management:

  This part of the tool is devoted to plan and to track the formal project parameters.

  o Project administration: it is possible to define new projects; to set or modify their properties; to end a project, to remove the project from the archive; to print the project summary, to define, access and print the project plan (including all WPs and WBSs), to plot a project Gantt chart, to produce a quality summary, to access and to print the project budget summary, the milestone summary, the cash flow summary and/or the external expenses summary.

  o WP management: this functionality allows the definition of new WP's; setting or modifying their properties; deleting a WP and printing the WP information at the selected level.

  o Milestones management: it allows the Project Manager to define new Milestones; to set or modify their properties and to delete a Milestone.

  o Cash Milestones management: this part of the tool is in charge of defining new Cash Milestones; setting or modifying their properties and deleting a Cash Milestone.

  o WBS management: the user can define new WBS's; set or modify their properties; delete a WBS and print the WBS information.

  o WBS Reports generation: the responsible for the defined WBS tasks can create and upload new WBS Reports; set or modify the information introduced in the report and print the WBS Report.

- Project quality control:

  This set of utilities allows the user to define, resolve and track some elements that are essential to measure the project quality: risk assessment and administration, non-conformities management and actions definition, assignation and tracking.

  o Risks administration: this includes defining new risks, setting or modifying their properties; deleting a risk and printing the risk information.

  o Non-conformities administration: this allows defining new non-conformities; setting or modifying their properties; deleting non-conformity and printing the non-conformities information.

  o Actions administration: this functionality completes the quality control tools and allows defining new actions; setting or modifying their properties; deleting an action and printing the action information.

- Human resources utilities:

  MANATEE also includes some basic tools to evaluate the human resources/personnel manpower in terms of level of occupation, cost and work distribution among the different project tasks.

  o Man-hours cost management: define the hourly-rate cost for the project/organization personnel and set or modify their properties. These values can be customized for each people participating in a given project and/or for the organization personnel.

  o PTRs administration: this tool allows each member of the team filling the weekly Personal Time Reporting (PTRs) sheets; as well as displaying and printing the PTR information.

  o Graphical summary view: Some simple plots can display the people occupation summary

- Management analysis tools utilities:

o   Global control: this graphical tool displays and prints a summary of the global budget and displays a summary of the global cash flow.

o   Graphics: these plots provide a visual image of the user occupation, project manpower and cash flow.

- Information control:

o   Controlled access to the information introduced in the application according to the permissions defined for each user.

o   Keep all the involved users automatically informed (via e-mail and internal notifications) about the creation, modification or removal of a project, WP, Milestone, WBS, risks, non-conformities and actions and trigger the necessary alarms to warn the project manager and/or the WP managers when deviations with respect to the planned parameters are detected.

- System administration:

o   User administration: it is in charge of defining new users; modifying their attributes and permissions in connection with each project; and unsubscribing users.

o   Tools: this allows importing WBS's from a text file.

o   Database administration: it handles the data backup or restore; and the upgrades.

As already mentioned, MANATEE user interface is made by using WEB forms. This means that anyone who has access to the Internet may gain access to a project's information, if this person has an account in the system and the suitable permissions have been granted to him/her. The main advantage is that there is no need to install any specific software on the client computers; the WEB browser is enough. Similarly, the user does not need to access the e-mail, as the notifications are managed by the Tool and made available to the user via the WEB-based interface. The information is stored internally using a public relational database, which is shared with GECO and DOCMA.

Fig. 3. MANATEE project list view

In the following sections we describe each function in deeper detail.

3.2 Project definition and management

MANATEE provides the capabilities required to manage the projects that are kept into the system during their whole lifecycle.

Fig. 4 shows all the states that a project could have during its lifecycle; i.e., since the project is created until it is deleted from the system or, even, afterwards, if the project is again restored.
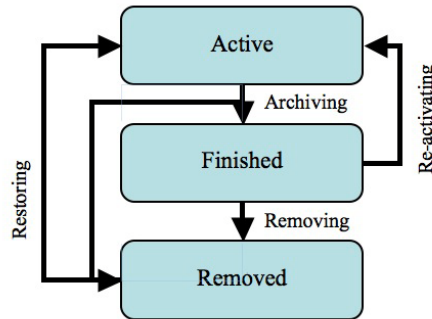
Fig. 4. Project lifecycle diagram

All the information required to track the project execution can be defined and maintained in MANATEE by filling the application forms. Projects details such as planned and real dates, manpower, hardware and software resources, deliveries, objectives, etc. are added to WP, WBS, Milestones and Cash Milestones in order to ease the low level project control. During the project development, data must be periodically reviewed and completed.

In order to provide these functions, the following forms are available:

- Project management: a form is provided for defining new projects, as well as for modifying the properties of the already existing ones. The project management involves editing the project properties (project managers, project description, project start and end dates, etc); finalizing a project: removing a project from the system and/or restoring the project.

- WP management: a form is provided for defining new WPs, as well as for modifying the properties of the already existing ones. The WP management involves editing the WP properties (title, description and responsible) and removing the WPs from the system.

- Milestone management: a form is provided for defining new Milestones, as well as for modifying the properties of the already existing ones. The Milestone management involves editing the Milestone properties (date, criticality, etc) and removing the Milestone from the system. These milestones can be defined at the level of the project and then being assigned to the different WBS task when appropriate.

- Cash milestone management: a form is provided for defining new Cash milestones, as well as for modifying the properties of the already existing ones. The Cash milestone management involves editing the Cash milestone properties (date, criticality, etc) and removing the Cash milestone from the system.

- WBS management: a form is provided for defining new WBSs (dates, responsible, assigned personal, etc), as well as for modifying the properties of the already existing ones (dates, percentage of the WBSs that has been completed, budget deviations, etc). The WBS management involves editing the WBS properties and removing the WBSs from the system. The tool also allows generating WBS reports, where the status and the deviations in scope, budget an schedule of the WBS are described.

- WBS Reports management: a form is also provided that facilitates the generation of the WBS reports, where the level of complexion of the tasks, the resources spent, etc are reported. The WBS reports are essential to know the project status and the deviations from the planned project parameters: scope, budget and schedule.

Fig. 5. WBS Report form view

3.3 Human Resources utility

MANATEE provides several capabilities that have been designed to facilitate the human resources activities that are usually performed in any organization. These capabilities include defining and maintaining the hourly cost of the people working in the organization and providing the PTR (Personal Time Report) forms to be filled by the people working in the organization. The following forms are available:

- Man-power hourly cost management: a form is provided for defining and modifying the hourly cost assigned to each worker. This information is used to automatically update the personnel budget in the WBS and can be changed as far as the project progresses.

- PTR management: a form is provided for filling the time spent in the different WBS. The tool shows to each worker only the WBSs assigned to him/her.

PTR week 33, User: ema

Monday 2009-08-10 - Friday 2009-08-14

WBS Code	WBS Title	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
WBS-MGR-001-01	Feasibility study	8	0	0	0	0	0	0
WBS-P1-001	Optics	0	4	0	0	0	0	0
WBS-TST-001-02	Feasibility study	0	4	0	0	0	0	0
WBS-TST-001-1	Feasibility study review meeting	0	0	8	8	8	0	0
WBS-TST-002-01	Management: Conceptual design	0	0	0	0	0	0	0
	Total hours	8.0	8.0	8.0	8.0	8.0	0.0	0.0

Total Week hours 40.0

Fig. 6. PTR filling form view

3.4 Management analysis tools

MANATEE uses the project and human resources information described in the previous points to generate different reports and graphs, which helps to visualize how each project is being developed and, in general, to manage the organization resources.

Those analyses provide an overview of project and organization budgets, external expenses, cash-flow, manpower distribution among the different projects, project Gantt charts, people occupation, etc. The following graphs and/or reports can be generated:

- Reports and graphs from the project and human resources data.

- Summary report of the project plan

- Gantt charts (that can be exported to other project management software application as, for example, Microsoft Project)

- Budget reports and graphs at project and organization level

- Project external expenses reports

- Cash-flow reports and charts

- Project manpower organization charts

- User occupation charts
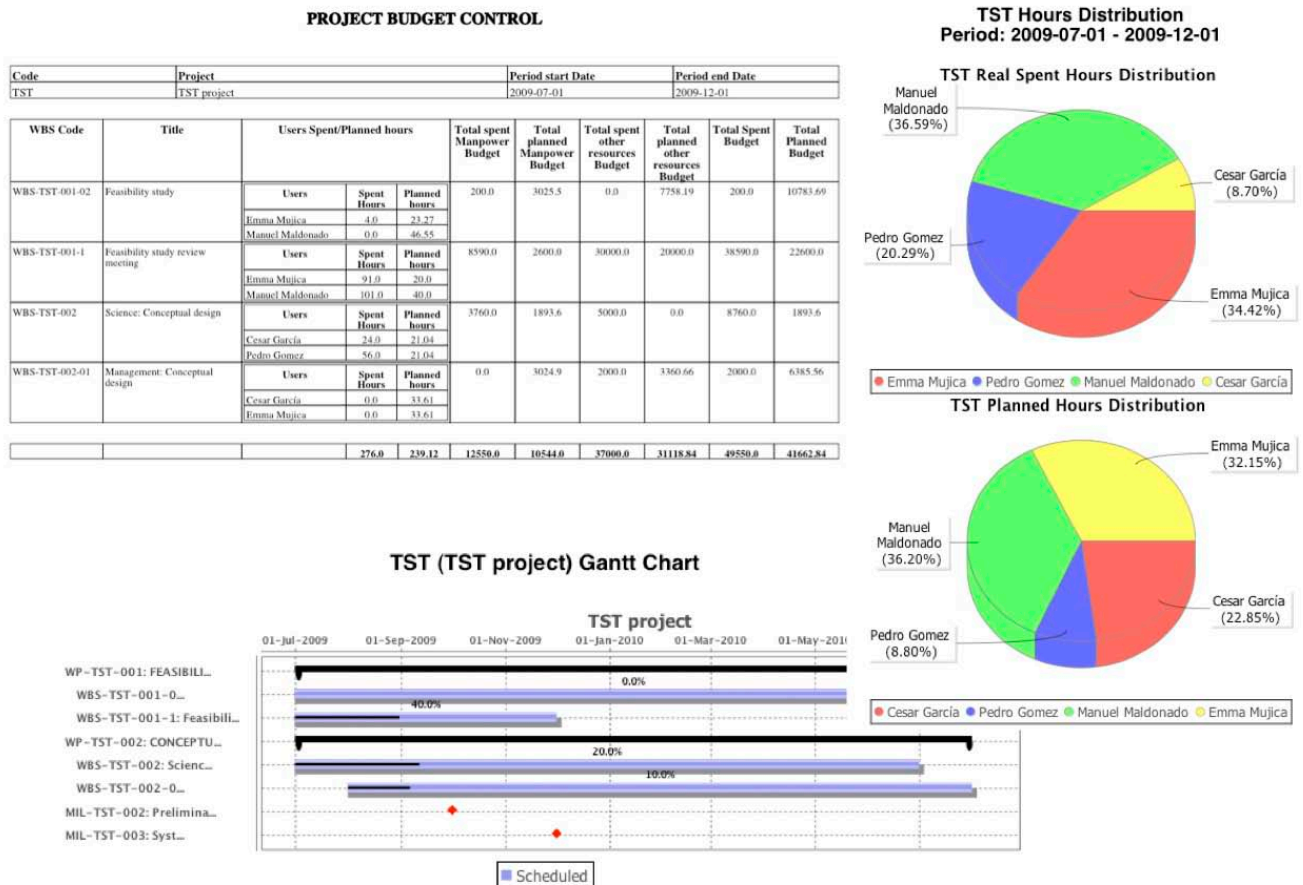
Fig. 7. Several MANATEE graphical views

3.5 Project quality control

The application also helps to maintain the quality of the projects by managing risks, non-conformities and preventive and corrective actions.

- Risk management: a form is provided for defining a new Risk, as well as for modifying the properties (title, description, severity, probability, etc) of the already existing risks.

- Non-conformities management: a form is provided for defining new Non-conformities, as well as for modifying the properties (title, description, priority, etc) of the already existing ones.

- Preventive and Corrective Actions management: a form is provided for defining new Actions, as well as for modifying the properties (title, description, responsible, due date, etc) of the already existing ones.

Fig. 8. Actions Management form view.

3.6 System administration

Finally, MANATEE provides several system administration functions that are as follows:

- Notification management (Warnings): a list is provided for viewing and handling the notifications that the users may receive from the system. The Tool includes a set of predefined notifications, both internal and external (via e-mail through SMTP protocol), that are automatically generated whenever a relevant event takes place. For instance: when a new project is created, when a new user is registered, when the status of an action is modified, etc.

- System management: The tool includes the capabilities to perform backups of the information registered in the application and to retrieve this information if, for any reason, the information would be lost or the application would need to be reinstalled.

- Import WBS´s: the application provides the capability to import a set of WBS´s in a row (the aim is to speed up the detailed definition of the projects by facilitating the incorporation of the WBS´s information defined externally to the application).

4. USING MANATEE

MANATEE has been mainly designed with the aim to add efficiency to the project management tasks improving the way in which complex projects can be tracked and, therefore, driving the project goals achievement.

All project relevant data must be initially introduced and kept updated. Generally the following steps shall be followed:

1. At the beginning of the project, the project structure must be defined and all the relevant data introduced in the tool. The different project roles have been granted with different permissions.

2. Project Manager defines WP's, Milestones and Cash milestones.

3. WP Manager defines WBS´s and assigns manpower and other resources to the tasks. This must be done in agreement with the Project manager, who must validate the WBS's created in the project.

4. WBS responsible must periodically produce the WBS Progress Reports, where the status and the deviations in scope, budget and schedule of the project can be identified.

5. All organization staff must fill the weekly PTR´s, where the hours spent in the different WBS's are reported.

6. Project risks and non-conformities can be identified and reviewed periodically as well as the preventive and corrective actions that are defined to control or solve them.

Fig. 9. Setting-up a project

All these data is taken into account by MANATEE to provide different views that facilitate the Project Manager's labor.

For example, reports for different periods can be produced to check the status of the project budget (i.e., compare the manpower real spent hours with the planned ones as well as the budget for other resources).

At every relevant instance, MANATEE also sends notifications (by e-mail and internally) to inform the corresponding user about project modification, tasks completion, delays etc.

Finally, MANATEE allows the General Manager of any organization to keep the relevant management information in one tool and to control the organization resources (planned and real) and several projects at a glance.
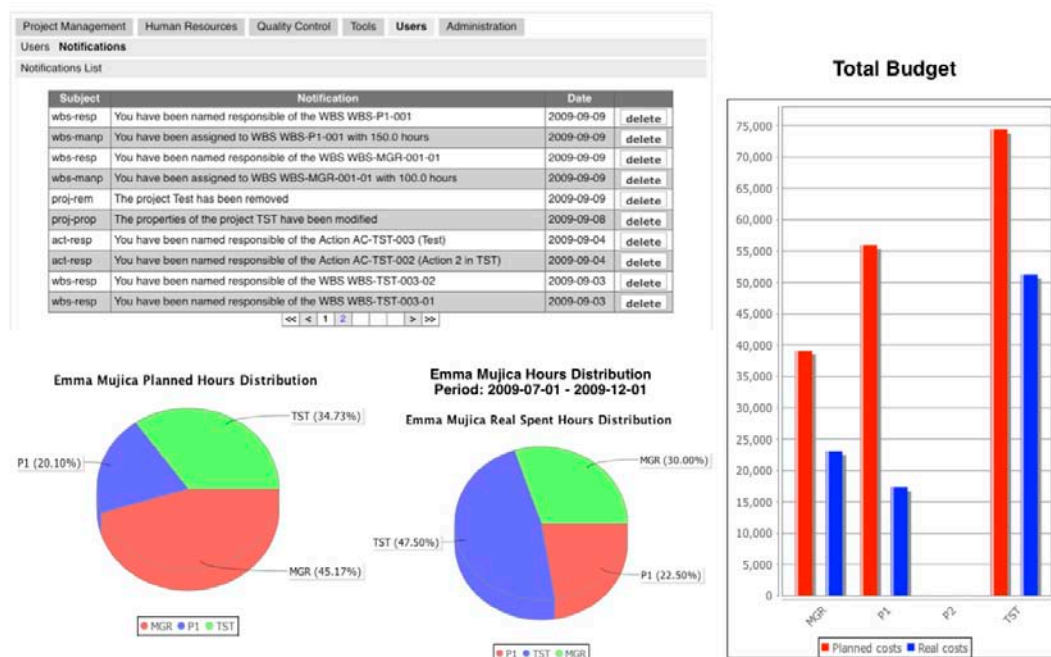

Fig. 10. Notification list view and examples of organization resources and budgets graphs

5. CONCLUSIONS

This paper describes MANATEE, the Project Management Tool developed by FRACTAL to facilitate the management of the projects that are carried out in an organization providing the overall view of each project and helping to control the three projects parameters (scope, schedule and budget).

MANATEE is part of the three tools that conforming the FRACTAL System and Project Suite. MANATEE deals with most of the information that is generated during the project's lifetime, from the start of the system design to the operation phase. Although MANATEE can be used to manage any kind of project, this tool was designed from their user requirements with the aim of being applicable to plan, track and control astronomical instrumentation projects. These projects are quite complex, multidisciplinary, and are organized in large consortia whose members belong to different kind of organizations (universities, technological centers, research centers, private companies, observatories etc.) that are usually geographically distributed.

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