MEDIS: A Methodology for the Formation of Highly Qualified Engineers at Masters Level in the Design and Development of Advanced Industrial Informatics Systems

WP2.1 Chapter 3.1: Project starting

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Context

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0.1	01/03/2014	UPV Team	Initial draft
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Table of Contents

1 Executive summary

WP 2.1 details the learning materials of the Advanced Industrial Informatics Specialization Modules (AIISM) related to the Industrial Computers Module.

The contents of this package follows the guidelines presented in the UPV's documentation of the WP 1 (Industrial Computers Module)

- The PBL methodology was presented in WP 1.1
- The list of the module's chapters and the temporal scheduling in WP 1.2
- The required human and material resources in WP 1.3
- The evaluation in WP 1.4

During the development of this WP a separate document has been created for each of the chapters of the Industrial Computers Module (list of chapters in WP1.2).

In each of these documents, section 2 introduces the chapter; sections 3, 4, 5 and 6 details the Lecture, Laboratory, Seminar and Mini-project of the chapter; section 7 lists the bibliography and the references.

2 Introduction

The chapter #3 provides a sketch of the traditional method of project management. When a project is initiated, as it is limited in time it should has clear objectives as to what should be achieved by the end of this limited period. In order to achieve the objective, a strategy is formulated which identifies tasks and expected results as well as the financial and human resources that are needed to meet the goal. Furthermore, responsibilities have to be clarified, decision-making processes agreed, and a common understanding on monitoring the implementation process agreed.

3 Lecture

3.1 Objectives

- To understand the concept of project management and basic related concepts.
- To know the project management phases
- To know the tools for project management and how to use it.
- To be able to define a project planning.

3.2 Introduction

In order to develop the project and achieve the objectives, a strategy should be formulated identifying the activities and expected results as well as the financial and human resources that are needed to meet the objectives. Furthermore, responsibilities have to be clarified, decision-making processes agreed, and a common understanding on monitoring the implementation process found.

If good project management procedures are established, there is still potential for failures and pitfalls in project management. The main reasons for such failures are the following:

The overall context is not analysed and considered systematically enough. The interests and ideas of the relevant stakeholders are not sufficiently enough included or examined. The objectives and expected results / outputs in combination with the foreseen time frame are too ambitious. The planning process and implementation of the project are not executed by the same partners. Underestimation of unexpected and therefore 'unplanable' events, no space left for flexibility.

3.3 Project phases

Dividing a project into phases makes it possible to lead it in the best possible direction. Through this organization into phases, the total work load of a project is divided into smaller components, thus making it easier to monitor. The following paragraphs describe a phasing model that has been useful in practice. It includes the following six phases.

3.3.1 Initiation phase

The initiation phase is the beginning of the project. In this phase, the idea for the project is explored and elaborated. The goal of this phase is to examine the feasibility of the project. In addition, decisions are made concerning who is to carry out the project, which party (or parties) will be involved and whether the project has an adequate base of support among those who are involved.

In this phase, the current or prospective project leader writes a proposal, which contains a description of the above-mentioned matters. Examples of this type of project proposal include business plans and grant applications. The prospective sponsors of the project evaluate the proposal and, upon approval, provide the necessary financing. The project officially begins at the time of approval. Questions to be answered in the initiation phase include the following:

- Why this project?
- Is it feasible?
- Who are possible partners in this project?
- What should the results be?
- What are the boundaries of this project (what is outside the scope of the project)?

3.3.2 Definition phase

After the project plan (which was developed in the initiation phase) has been approved, the project enters the second phase: the definition phase. In this phase, the requirements that are associated with a project result are specified as clearly as possible. This involves identifying the expectations that all of the involved parties have with regard to the project result.

It is important to identify the requirements as early in the process as possible.

[Wijnen (2004)] distinguishes several categories of project requirements that can

serve as a memory aid:

- Preconditions
- Functional requirements
- Operational requirements
- Design limitations

Preconditions form the context within which the project must be conducted. Examples include legislation, working-condition regulations and approval requirements. These requirements cannot be influenced from within the project.

Functional requirements are requirements that have to do with the quality of the project result, such as efficiency or others aspects. Operational requirements involve the use of the project result. E.g. the number of malfunctions that occur must be reduced by ninety per cent. Finally, design limitations are requirements that involve the realisation of the project. For example, the project cannot involve the use of toxic materials.

The result of the definition phase is a list of requirements from the various parties who are involved in the project. Every requirement obviously has a reverse side. The more elaborate the project becomes, the more time and money it will cost. In addition, some requirements may conflict with others and some requirements must be negotiated.

Ultimately, a list of definitive requirements is developed and presented for the approval of the project's decision-makers. Once the list has been approved, the design phase can begin. At the close of the definition phase, most of the agreements between the customer and the project team have been established. The list of requirements specifies the guidelines that the project must adhere to. The project team is evaluated according to this list. After the definition phase, therefore, the customer can add no new requirements.

3.3.3 Design phase

The list of requirements that is developed in the definition phase can be used to make design choices. In the design phase, one or more designs are developed, with which the project result can apparently be achieved. Depending on the subject of the project, the products of the design phase can include dioramas, sketches, flow charts, site trees, web designs, prototypes, etc. The project supervisors use these designs to choose the definitive design that will be

produced in the project. This is followed by the development phase. As in the definition phase, once the design has been chosen, it cannot be changed in a later stage of the project.

3.3.4 Development phase

During the development phase, everything that will be needed to implement the project is arranged. Potential suppliers are brought in, a schedule is made, materials and tools are ordered, instructions are given and so forth. The development phase is complete when implementation is ready to start. All matters must be clear for the parties that will carry out the implementation.

In some projects, particularly smaller ones, a formal development phase is probably not necessary. The important point is that it must be clear what must be done in the implementation phase, by whom and when.

3.3.5 Implementation phase

The project takes shape during the implementation phase. This phase involves the construction of the actual project result. Programmers are occupied with encoding, designers are involved in developing graphic material, contractors are building, the actual reorganisation takes place. It is during this phase that the project becomes visible to outsiders, to whom it may appear that the project has just begun. The implementation phase is the ‘doing’ phase.

At the end of the implementation phase, the result is evaluated according to the list of requirements that was created in the definition phase. It is also evaluated according to the designs.

Those who are involved in a project should keep in mind that it is hardly ever possible to achieve a project result that precisely meets all of the requirements that were originally specified in the definition phase. Unexpected events or advancing insight sometimes require a project team to deviate from the original list of requirements or other design documents during the implementation of the project. This is a potential source of conflict, particularly if an external customer has ordered the project result. In such cases, the customer can appeal to the agreements that were made during the definition phase. As a rule, the requirements cannot be changed after the end of the definition phase. This also applies to designs: the design may not be changed after the design phase has been completed. Should this nonetheless be necessary (which does sometimes occur), the project leader should ensure that the changes are discussed with those involved (particularly the decision-makers or customers) as soon as possible. It is also important that the changes that have been chosen are well documented, in order to prevent later misunderstandings. The chapter 10 presents the information about the project documentation.

3.3.6 Follow up phase

Although it is extremely important, the follow-up phase is often neglected. During this phase, everything is arranged that is necessary to bring the project to a successful completion. Examples of activities in the follow-up phase include writing handbooks, providing instruction and training for users, setting up a help desk, maintaining the result, evaluating the project itself, writing the project report, holding a party to celebrate the result that has been achieved, transferring to the directors and dismantling the project team.

3.4 Project management

Adopting the six phases creates clarity in a project, thereby making it easier to administer. What exactly does managing a project entail?

First, project leaders and project teams are involved with the following components:

A. Team

A project team is comprised of a group of people who will realise the project result. The group is often comprised of people who have various backgrounds, each of whom contributes knowledge and skills.

B. Goal

A product result (or goal) is desired. After a project has been completed, something has been realised. A new piece of software has been written, a re-organisation has been carried out or a bridge has been built. The project goal is sometimes vague or less firmly established. In many projects, it is necessary to adapt the goal as the project proceeds.

C. Limited resources

The amount of time and money that is available for completing a project is always limited. No project is completely free of time pressure.

D. Uncertainty (risk)

One characteristic feature of projects is that their success is never guaranteed beforehand. Even if the desired goal is already being reached, it is uncertain whether it will be achieved within the available budget or within the proposed time. It is not unusual for a project to take three times as long and to cost twice as much as originally estimated. It is also not unusual for only thirty per cent of the original project team members to be working on the project upon its completion.

Although project managers must attend to many matters, they actually direct projects along only the following parameters.

3.4.1 Time

The time factor manifests itself in a project in the form of deadlines for tasks and the amount of time that these tasks may take. Managing time involves ensuring that tasks are completed on time.

Time in project plans:

- Determine which activities should take place in which phase.
- Estimate how long each activity will take
- Determine the order in which activities should be completed.
- Allocate people and materials.
- Allocate activities over time.
- Determine the deadlines.

Time in progress monitoring:

- Monitor progress.
- Monitor deadlines.
- Adjust schedules.

Time schedules are based on a work-breakdown structure (WBS). A WBS is a decomposition of the tasks that must be completed in order to achieve the project result. Developing a time schedule requires knowing the amount of time that is needed for each task, who will complete each task and when. One frequently used tool for planning time is the bar chart or Gantt chart. A variety of software packages is available for making and maintaining bar charts (Xplanner, MS Project, Fasttrack and others).

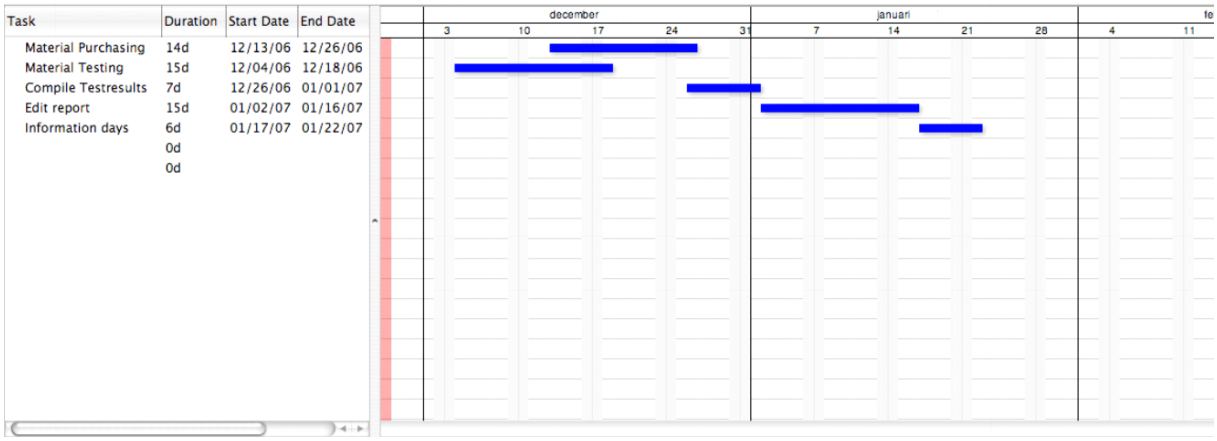

Figure 1: Gant chart used for time planning

3.4.2 Quality

The project result must fulfill a number of quality requirements. This also applies to the various intermediate products of the project. When managing a project, it is particularly important for quality requirements to be determined, agreed upon and recorded in writing during the definition phase. These requirements should never remain implicit. A clear list of requirements can be checked at the end of the implementation phase. This can allow the project team to prove that they have carried out the project according to specifications. Additional quality requirements may be specified for various tasks within the project. For example, a particular task can be carried out only by certified personnel.

In the project planning should be established the desired quality of the project result and the intermediate products. And in progress monitoring the quality should be established in order to test the intermediate results and address any quality problems.

3.4.3 Organization

Within a project, the team must be managed. In the narrowest sense, team management involves determining who will do what from the list of activities. In broader terms, it also involves all of the soft skills (e.g. motivational techniques, communication skills, leadership styles) that are needed to achieve a goal with a group of people. Regardless of their importance, these soft skills exceed the scope of this handbook.

Organization in project should plan and assemble the team, assign authority, assign tasks to team members, make agreements concerning the availability of people with other managers. On the other hand the organization in progress monitoring should direct the team, monitor human aspects and mediate between the parties who are involved in the project, among others.

3.4.4 Information

The information factor concerns how, by whom and on which basis decisions can be taken. Who may decide about which matters in the project? Is it the project leader, the client or a substantive expert within the team? What will be archived and by whom? Will tools (e.g. project website, issue tracker, e-mail notification, joint agenda) be used? These and other informational questions must be answered before a project can be started. Organisations that regularly work with projects have a number of tools (e.g. Word templates) on hand for handling information within a project.

Information in project should plan which information must be provided to whom and in which form, which information will be recorded, distributed and archived, and which information tools will be used. During progress monitoring should be arranged for periodic consultation, should be ensured that the right information is provided to the right person, should be determined whether agreements have been met.

In chapter 10 a number of samples of information forms will be provided:

- Issue list
- Action-and-decision list
- Risk log
- Meeting report

The issue list contains all of the points that must be discussed. This list must be discussed regularly. For keeping track of progress and registering decisions that have been taken, a model for an action and decision list has been included. A risk log has been included to help document risks that are identified during a project.

These risks must then be discussed in the next meeting of the project team and, where necessary, eliminated.

One important aspect of securing the information concerning a project is that all decisions should be reproducible. Decisions are often taken orally and not archived. Regardless of how clear such decisions may seem at the time for both parties, they must eventually appear in writing. If this is not possible, the undocumented decision can become a source of misunderstanding or even conflict.

3.5 Uncertainty in project planning

Projects involve uncertainty. At the beginning of a project, the exact amount of time that will be needed is not known, nor is the precise amount that the project will eventually cost. For some projects, it is even uncertain whether the intended goal will be reached at all. In a world of fast-paced change, the foundations of a project have sometimes already changed before the project is completed. This sometimes occurs because of technological developments or developments in the market or political arena.

When preparing project plans, project leaders can only estimate the control factors (i.e. time, money, team, quality goals and necessary information) of the project. As the project proceeds, more knowledge emerges about the project itself. In the initiation phase, only an idea exists. In the definition phase, the idea is refined according to requirements. In the design phase, possible designs are examined and developed, providing even more clarity. In the development phase, it becomes clear how the design should be realised. In the implementation phase, the actual project result is built, and in the follow-up phase, all of the loose ends are tied together. Clarity increases as a project progresses. It is therefore pointless to make a detailed budget for the follow-up phase (which will take place later) during the initiation phase. At this stage, it is still possible for the project to proceed in any of a number of possible directions. The idea has yet to be elaborated. The exact form of the follow-up phase is probably also known only in the broadest terms. This is too little information upon which to base a realistic, detailed estimate for the follow-up phase. A broad outline of a budget is the most that can be expected at this stage.

Project plans therefore work as follows: a global budget is made for the entire project, along with a concrete budget for the next subsequent phase. For example, if a project team is preparing to enter the implementation phase (after the development phase), they are well aware of what must happen. At that point, it is possible to make a detailed budget for the implementation phase.

The global budget estimates for the total project must be adjusted after each phase. After each phase, there is more knowledge and decisions have been taken that allow the global budget to be completed in more detail. In this way, estimates of the total costs of the project become increasingly accurate after each phase.

One result of the way in which grant makers and foundations tend to work is that many organisations request amounts that are based on rough estimates of the project costs. Project activities are subsequently fitted to the budget that has been made available. This puts the project team in a tight position from the start, even though the most flexibility is needed in the early stages.

The process of elaborating concepts during the definition and design phases, therefore, often reveals that the timeline that was proposed in the grant application is not feasible. The budget may also prove inadequate, including too much for some items and not enough for others. Any additional requirements from the grant maker (e.g. no item may deviate more than five per cent) place the project team under immense pressure. Matters must be implemented in too little time and within a budget that is too tight. This situation often leads to considerable shuffling among the various items in the budget. Considerable text and analysis is then necessary in the project statement to explain why the desired result was not achieved.

The situation would improve if grant makers were to couple their financing onto the various phases instead of providing funds at one time in advance. The initial financing would then be intended for the definition and the design phases. The requirements would be investigated and a number of alternative designs would be prepared within this limited budget. A subsequent application based on these designs would then be submitted for implementation and follow-up. This would allow projects to avoid unnecessary pressure. An additional advantage would be that the expectations of the involved parties would be more realistic, saving money and time.

3.6 Estimating the amount of time necessary to implement a funcionality

The waterfall method assumes a number of phases. In their project plans, project leaders must include estimates of the amount of time (and therefore money) that will be needed for each phase. We have already seen that time estimates are generally difficult for any project, particularly if they must be made in the early stages of a project. For software projects, it is simply impossible. Imagine that it were feasible to compile a qualitatively adequate list of functionalities in the definition phase. In theory, the project team should then be able to provide a reasonable estimate of how much time will be necessary to implement each functionality. In practice, however, there are too many uncertainties to allow a reasonable estimate [McConnell, 1996)]:

- Once a functionality has been made, it is often discovered that the customer does not need it after all. The hours that were used in implementing this functionality can therefore be regarded as useless.
- Requirements change during the project.
- Should the functionality be implemented expensively or inexpensively? There are many possible methods of implementation and realisation.
- How will the functionality be designed technically? The design largely determines the amount of time that will be needed to make it.
- How high must the quality of the functionality be? For example, should a web application always remain completely available, or can it be offline for a few hours each year?
- The time needed to identify and repair errors in software can vary from minutes to weeks.
- How long will it take to install and integrate the new software into the customer's existing systems?

- The lack of knowledge concerning possible solutions also complicates the
- estimation of time. Further, it is difficult to estimate how long it will take to acquire the necessary knowledge.

The list above shows that many factors can affect the amount of time that will ultimately prove necessary to implement a new piece of software. Research [(McConnell, 1996, p. 168)] has shown that the estimates of the time needed to implement a functionality at the beginning of a project varies between four times too little time and four times too much time. This means that the amount of time necessary can turn out to be either four times higher or four times lower than a faulty estimate. These estimates become more accurate as the project progresses. After the functional design has been made, the margin is reduced to twenty-five per cent too much or too little. Only when the functionality is implemented can an estimate be provided with a high level of certainty.

The uncertainty that is illustrated by the examples above does not simplify the writing of project plans. It also complicates agreements between the parties involved. Someone must assume the risks for extra work that must be done. If payment is on an hourly basis, the customer assumes the risk. If a fixed price has been agreed (as in grant-funded projects), the software builder assumes the risk. When more than two parties are involved, it becomes even more complicated. In such a case, who should pay for the extra hours in the project? Discussions often arise concerning who should be responsible for delays. In many cases, the guilty party is difficult to identify. It is quite possible that none of the parties involved is at fault, as the ‘delay’ is actually the result of a faulty initial estimate of the number of hours that would be needed. Exceeding the number of project hours and the question of who should pay are frequent sources of conflict.

4 Lab

4.1 Objective

The main goal is to learn the basic steps to prepare a schedule for a project.

4.2 Equipment

- PC compatible computer with Microsoft Windows 7 operating system.
- Xplanner, MS Project.

4.3 Departing point

The student should have completed the previous practices.

4.4 Introduction

In this lab we will work with a planning tool. Such tools are vital when facing a project because it will allow us to estimate the necessary resources (time, cost, personal, etc.), seeing if the project itself is viable or not.

Once the project started these tools are also important because they allow us to examine the project's progress, detecting the earliest possible deviations from estimates. Thus we can anticipate potential problems and reduce risks.

The tool to use is xplanner, a tool for planning and monitoring of projects, available under the GNU Lesser General Public License. The package deploys as a web application, which allows your team members and project stakeholders to get on board by using their favorite browsers. Once configured, you will be able to plan and track various aspects of your agile project's delivery via a simple web interface. This tool is particularly suitable for the XP management methodology (eXtreme Programming).

4.5 Getting started with xplanner

To enter the application will be in the browser: http: // localhost: 8080 / xplanner and when the login page appears we introduce our credentials.

To create a new project will click "Add Project":

Figure 2: Creating a project in XPlanner management tool

Put the name, description and click on "Create".

Now we see the project you just created, and you can click on it to go into detail:

Figure 3: Projects in XPlanner management tool

In this point we should create iterations or tasks in the project. To do this click on "Create Iteration":

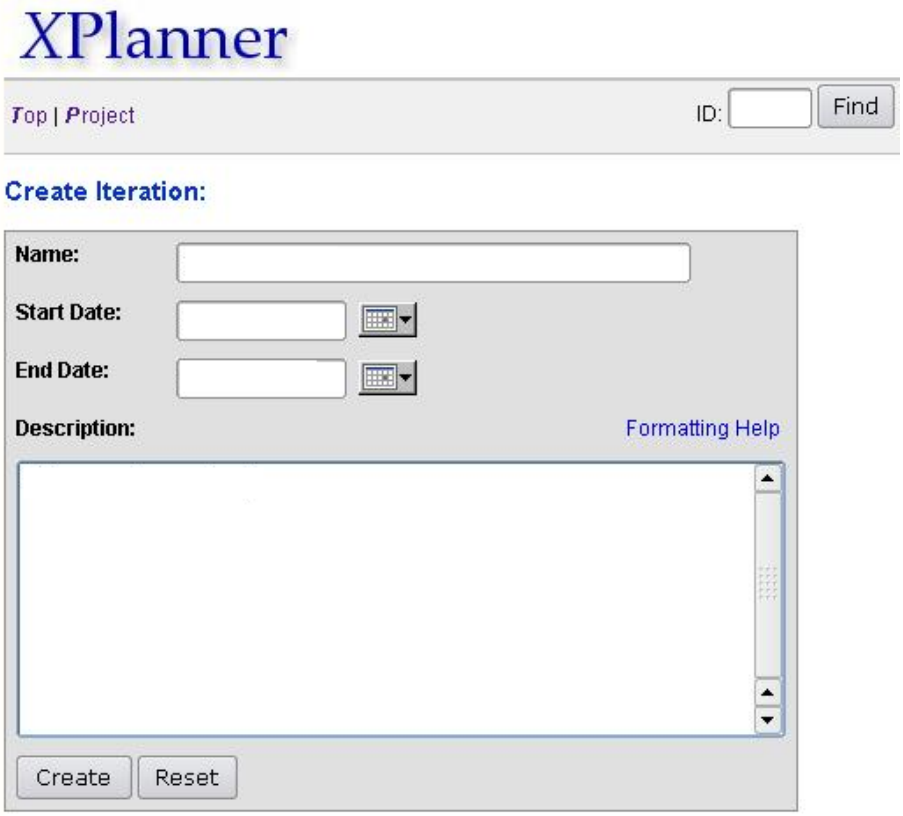

Figure 4: Creating a iteration task in XPlanner management tool

By clicking on the "Create" button return to the detail of the project which already appears the task we just created:

Figure 5: Listing iteration tasks of one project in XPlanner management tool

In this manner, and in an intuitive way, we can create all the elements that are part of the project management: Iterations, tasks, people, stories, etc. and obtain the different charts and diagrams about the project schedule and execution.

4.6 Estimate and record effort

A developer should be free to add additional tasks or modify existing tasks as further story details become available. XPlanner supports this flexibility by providing developers with full access for defining and editing a task. Each task can be assigned a type, such as debt, feature, or defect, to characterize the kind of work being done. Tasks are also specified with a disposition -planned or unplanned-, the accepting developer, a work description, and an estimate of the number of ideal hours required to conquer that task.

XPlanner makes it easy for a developer to record how much work has been invested in a given task or to update the original effort estimate. Note that effort estimates, as mentioned, should be specified in ideal hours. An ideal hour is an hour in which the developer experiences absolutely no interruptions.

4.7 Metrics

Metric is a measurement of some aspect of your project. A project progress metric is a particular measure specifically intended to track how far you've come and how far you have to go. A common progress metric in the agile world is the burn-down chart, which is a graphical metric pioneered by the Scrum methodology. The basic burn-down chart plots hours of effort remaining versus time. The effect is to immediately convey important trends in your progress that will illustrate, for example, how achievable the deadline is looking. XPlanner is able to produce such a chart on demand for your iterations.

5 Seminar

5.1 Introduction

This seminar will be to work about the GUIs development and several alternatives in its implementation. On the second part the seminar focuses on the importance of a good GUI.

5.2 Objectives

The main objectives are:

- To relate the GUI concepts with other technical concepts that usually are studied in different subjects, in a contextualized way.
- Acquire team-working skills, discussion the GUI development topic.
- Acquire documentation and presentation skills.
- Acquire critical searching of information skills, necessary to find new resources to develop modern, intuitive and impressive GUIs.

5.3 Disscussing cases of project management systems

This seminar will be to work on the fundamentals aspects of graphical user interfaces.

With internet we will collect the following information:

- List of GUI development libraries of components

- Main features of each library and the purpose of its components. The students should discuss about the possibilities of these libraries and components and the possibilitie to integrate it in the GUI of industrial applications.

- Comparative review of each of the components.

- Library would be chosen as the most suitable for the realization of a GUI for and industrial process.

After that students should work in groups of 4 people, in order to think about the resources and possibilities in GUI for industrial applications they search in internet and learned in the lecture and labs. At the end of the seminar they must explain and share their experiences with the whole group.

6 Mini-project

6.1 Mini-project planning

The activity related with the mini-project will consist in the development of the project planning following the guides provided in the lecture and seminar. The students should develop the schedule for all the mini-project, detailing phases, deliverables and delivery dates. With the report the students should deliver a Gant diagram with all this information in a graphical manner, as shown in the figure 6:

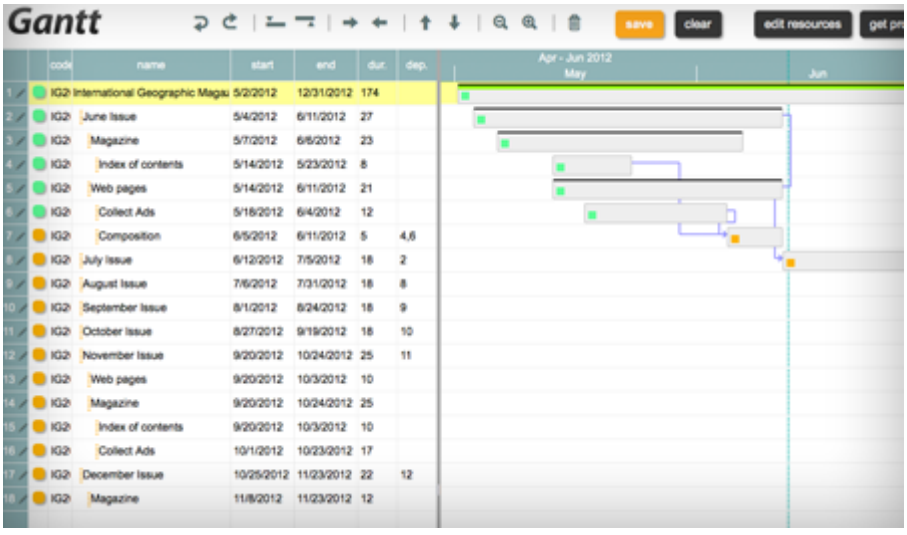

Figure 6: Gantt diagram of project planning

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