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Software Engineering 2

Assignment 5: Project Plan

Version 1.0

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1 Introduction

1.1 Purpose and Scope

The main purpose of the project plan is to plan time, cost and resources adequately to estimate the work needed and to effectively manage risk during project execution. A failure to adequately plan reduces the project's chances of successfully accomplishing its goals.

Project planning generally consists of:

- Identifying deliverables and creating the work breakdown structure;
- Identifying the activities needed to complete those deliverables and networking the activities in their logical sequence;
- Estimating the resource requirements for the activities;
- Estimating time and cost for activities;
- Developing the schedule;
- Developing the budget;
- Resource allocation (organization of work loads);
- Risk planning.

This document is based on an analysis made with two different algorithmic metrics of the system for *myTaxiService*. The first one is the Function Points (FP), which is used to estimate the software dimension (code size), which is directly used to evaluate the cost. The second is the COCOMO II that is used to estimate the efforts required in the development of a project by taking in account: characteristics of people, products and process.

1.2 List of Definitions and Abbreviations

The following acronyms are used in this document:

- FP: Function Points
- COCOMO: COnstructive COst MOdel
- ILF: Internal Logic File
- EIF: External Interface File
- PM: Person-Months
- SLOC: Source Lines of Code
- KSLOC: Thousands of SLOC
- SD: Scale Drivers
- EAF: Effort Adjustment Factor

The following definitions are used in this document:

- Deliverables: are work that are delivered to the customer, e.g. a requirement document for the system.

2 Function Point analysis

2.1 Introduction

The Function Point estimation approach is based on the amount of functionalities in a software and their complexity. Indeed the effort to develop a software project grows with the number of external inputs and outputs, user interactions, files and interfaces used by the system; therefore a weight is associated to all these functionalities and the total effort is computed summing all the partial values.

The parameters used to perform this estimation are summarized in the following tables, taken from COCOMO II, Model Definition Manual at:
http://csse.usc.edu/csse/research/COCOMOII/cocomo2000.0/CII_modelman2000.0.pdf.

The schema below defines the weights assigned to every level of complexity for all the FP types.

Table 3. UFP Complexity Weights

Function Type	Complexity-Weight		
	Low	Average	High
Internal Logical Files	7	10	15
External Interfaces Files	5	7	10
External Inputs	3	4	6
External Outputs	4	5	7
External Inquiries	3	4	6

Here is a brief explanation of the FP types:

- Internal Logic File: homogeneous set of data used and managed by the application
- External Interface File: homogeneous set of data used by the application but generated and maintained by other applications
- External Input: elementary operation to elaborate data coming from the external environment
- External Output: elementary operation that generates data for the external environment (it usually includes the elaboration of data from logic files)
- External Inquiry: Elementary operation that involves input and output (without significant elaboration of data from logic files)

2.2 FP types estimation

The assignation of the complexity to each functionality is based on the number of fields and interactions with other components required to implement it.

- ILF

Functionalities	**Complexity**	**FP Count**
Users	Simple	7
Ride	Complex	15
Request	Medium	10
Zone	Medium	10
Taxi	Simple	7
Payment-Receipts	Simple	7
Total:		56

- EIF

Functionalities	**Complexity**	**FP Count**
Payment Data	Medium	7
Google Maps	Medium	7
Push notification metadata	Simple	5
Total:		19

- Ext. INPUT

Functionalities	**Complexity**	**FP Count**
Login	Simple	3
SignUp	Simple	3
Create request	Simple	3
Pay	Medium	4
Delete request	Complex	6
Set taxi availability	Simple	3
Accept/reject ride request	Simple	3
Update taxi position	Simple	3
Manage taxi drivers	Medium	4
Create ride	Complex	6
Allocate taxi	Complex	6
Total:		44

- Ext. INQUIRY

Functionalities	**Complexity**	**FP Count**
Request history	Simple	3
Manage profile	Simple	3
Ride history	Simple	3
Public API	Medium	4
DB	Medium	4
Total:		17

- Ext. OUTPUT

Functionalities	**Complexity**	**FP Count**
SMS	Simple	4
Email	Simple	4
PushNotification	Simple	4
Monitor Zone	Medium	5
Total:		17

- Total and conclusions

FP types	**Value**
ILF	56
EIF	19
Ext. INPUT	44
Ext. INQUIRY	17
Ext. OUTPUT	17
Total:	153

The total number of FPs it then 153.

We can use this number to estimate the number of lines of code needed for the project; to do this a conversion factor is used: 46.
This value is obtained from the average value for J2EE language from the table at http://www.qsm.com/resources/function-point-languages-table.

Thus the estimate of SLOC will be:

$$153 FPs * 46 = 7038 \ SLOC$$

This result is the starting point for the next evaluation technique, the COCOMO approach.

3 COCOMO II analysis

3.1 Introduction

This estimation is achieved through a complex, statistical model that takes in account the characteristics of the product but also of people and process. The result of this technique is the estimation of Person-Months required to develop the project.
The COCOMO II calculations are based on the estimated of the software dimension in source lines of code (SLOC). Two very important metrics are used for this evaluation:

- Scale Drivers: the 5 SD determine the exponent used in the "effort equation"
- Cost Drivers: the 17 Cost Drivers represent the multiplicative factors that determine the effort required to complete the project

The result, the so-called "*Effort equation*" is:

$$€ffort = 2.94 * EAF * (KSLOC)^E \ [Person\text{-}Months]$$

Where:

- EAF: Effort Adjustment Factor derived from Cost Drivers (product of the effort multipliers corresponding to each of the cost drivers for the project)
- E: Exponent derived from SD
- $KSLOC$: SLOC measured in thousands

Once the effort has been computed it is possible to calculate the number of months required to complete the project with the duration equation:

$$Duration = 3.67 * (€ffort)^E \ [Months]$$

Where:

- *€ffort*: is the effort computed above
- E: is the schedule equation exponent derived from the five Scale Drivers

When both the *€ffort* and the *Duration* are available then the number of people required to complete the project is:

$$N_{people} = \lceil €/D \rceil \ [People]$$

3.2 Parameters choice and estimation

A first estimation is carried out considering a project with all nominal Cost Drivers and Scale Drivers: this means an EAF of 1.00 and exponent E of 1.0997. The effort equation thus becomes:

$$€ffort = 2.94 * 1.0 * (7.038)^{1.0997} = 25.13 \ Person\text{-}Months$$

Proceeding with the computation of the schedule equation the formula with the nominal parameter of $E = 0.3179$ becomes:

$$Duration = 3.67 * (25.13)^{0.3179} = 10.23 \ Months$$

The size of the team is then:

$$N_{people} = \lceil 25.13/10.23 \rceil = \lceil 2.45 \rceil = 3 \ People$$

The analysis gives the following result: it takes about 10 months of 3 people-work to finish this project.

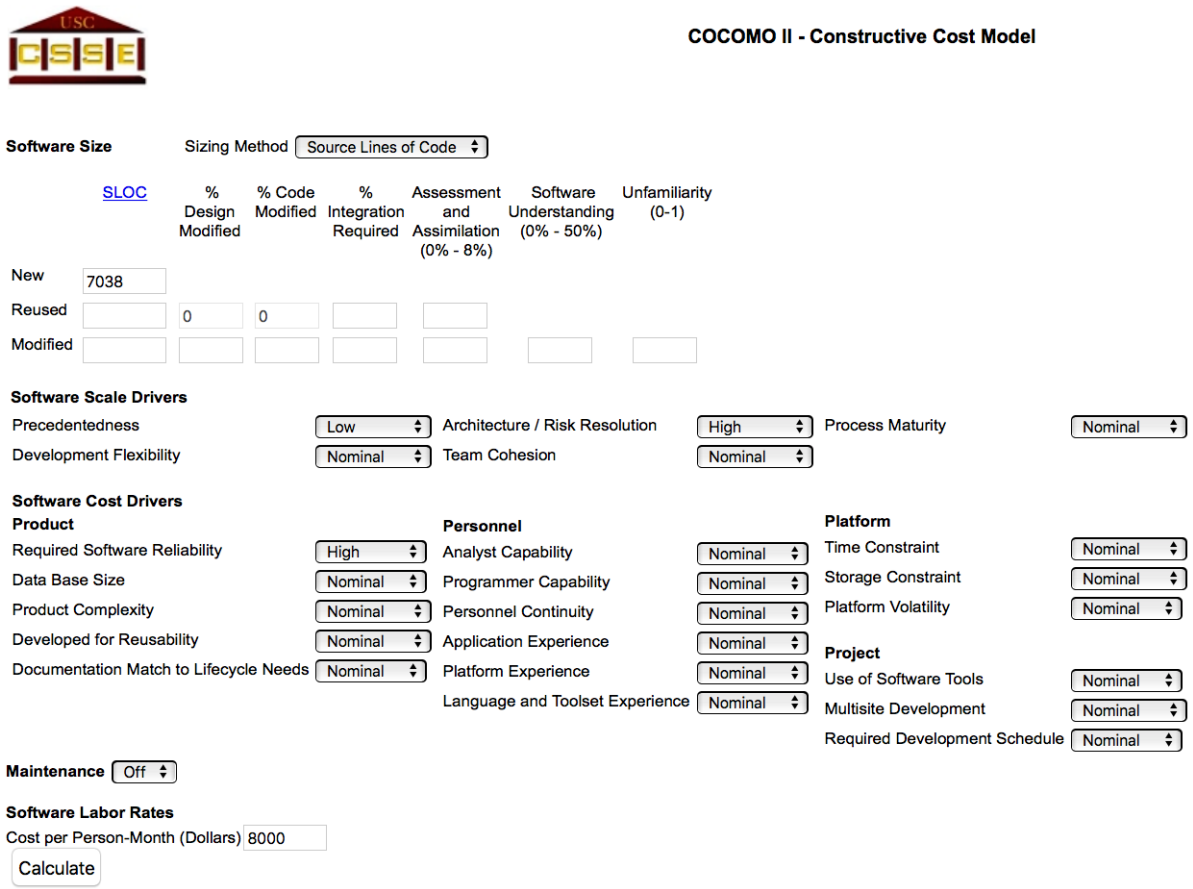
3.3 Second analysis with automated tool

A second analysis is here presented; it has been done with the help of an online tool (http://csse.usc.edu/tools/COCOMOII.php), where it is easier and immediate to evaluate the difference in effort and scheduling as parameters of drivers change.

In particular the variations with respect to the nominal case are the following:

- Precedentedness: LOW, because the team has not much experience on large scale Java Enterprise projects with such high quality and reliability requirements
- Architecture/Risk Resolution: HIGH, since the team wants to avoid mistakes that can be raised during the development at a late stage that could involve the feasibility of the project itself; this is achieved through a thorough analysis of the architecture and the possible risks.
- Required Software Reliability: HIGH, since the expected quality of the system is very high, and on it depend a lot of processes (passenger clients, drivers, the public transportation for whole cities...)

Below are the settings of this analysis.



Below is the output of the analysis.

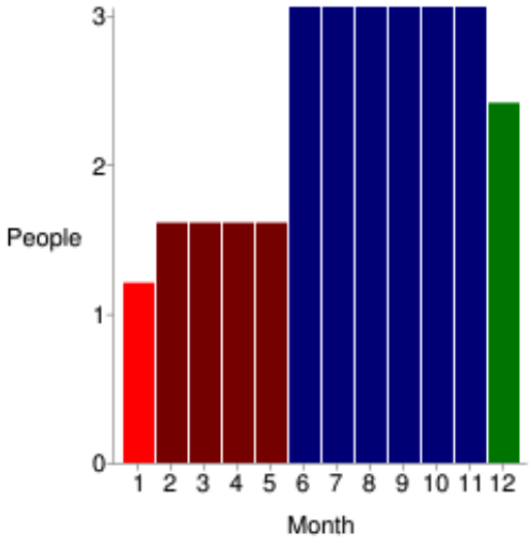
Results

Software Development (Elaboration and Construction)

Effort = 27.6 Person-months
Schedule = 11.0 Months
Cost = $220459

Total Equivalent Size = 7038 SLOC

Staffing Profile



Acquisition Phase Distribution

Phase	Effort (Person-months)	Schedule (Months)	Average Staff	Cost (Dollars)
Inception	1.7	1.4	1.2	$13228
Elaboration	6.6	4.1	1.6	$52910
Construction	20.9	6.9	3.1	$167549
Transition	3.3	1.4	2.4	$26455

Software Effort Distribution for RUP/MBASE (Person-Months)

Phase/Activity	Inception	Elaboration	Construction	Transition
Management	0.2	0.8	2.1	0.5
Environment/CM	0.2	0.5	1.0	0.2
Requirements	0.6	1.2	1.7	0.1
Design	0.3	2.4	3.4	0.1
Implementation	0.1	0.9	7.1	0.6
Assessment	0.1	0.7	5.0	0.8
Deployment	0.0	0.2	0.6	1.0

The slight variation due to the different parameters does not really change the estimation:

- Duration: from about 10 to 11 months.
- Size of the team: always 3 people required ($N_{people} = \lceil 27.6/11 \rceil = \lceil 2.5 \rceil = 3\ People$)

This obvious result is a direct consequence of the increase in risk control and high-quality-software objectives prefixed with the parameters.

4 Tasks identification

The "Waterfall Model" of the software life-cycle is used as a guideline for the choice of the tasks and their order of execution.

ID	Task	Effort [Person-Days]	Duration [Days]	Dependencies
T1	Stakeholders identification	5	2	
T2	Actors identification	5	2	T1
T3	Goals identification	12	4	T2
T4	Requirements identification	18	6	T3
T5	Use Case and Scenarios	11	4	T4
T6	Class diagram	18	6	T5
T7	Alloy model	10	5	T6
T8	Components and interfaces	24	12	T7
T9	Deployment architecture	17	9	T8
T10	Runtime elements	15	8	T9
T11	Algorithms design	28	10	T8
T12	Sequence diagrams	19	7	T8
T13	User interface mock-up	25	25	T5
T14	Client manager development	30	15	T10, T11, T12, T13
T15	Account manager development	32	16	T10, T11, T12
T16	Request manager development	65	22	T10, T11, T12
T17	Ride manager development	38	19	T10, T11, T12
T18	Zone manager development	73	25	T10, T11, T12
T19	Taxi manager development	15	15	T10, T11, T12
T20	Notification manager development	18	18	T10, T11, T12
T21	Payment manager development	18	18	T10, T11, T12
T22	Integration testing strategy	35	12	from T14 to T21
T23	Integration testing execution	40	14	T22
T24	Software deployment	10	4	T23

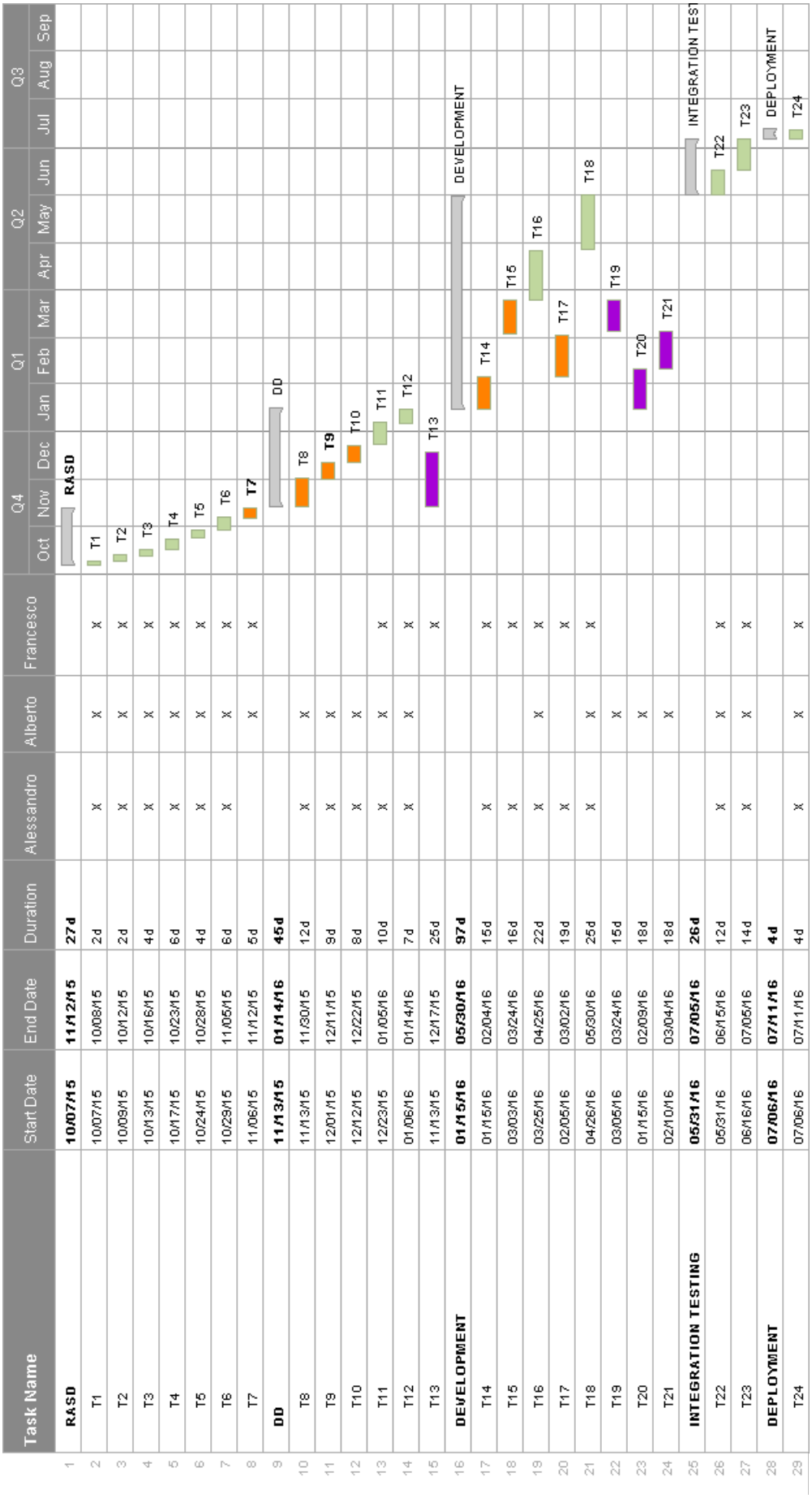
The effort measured in Person-Months can be converted in Person-Days taking into account that in a months there are about 21 working days, so the 27.6 Person-Months are equivalent to $27.6 * 21 = 580$ *Person-Days*. The sum of the column "Effort" of the table above should match that figure.

5 Task scheduling and Resources allocation

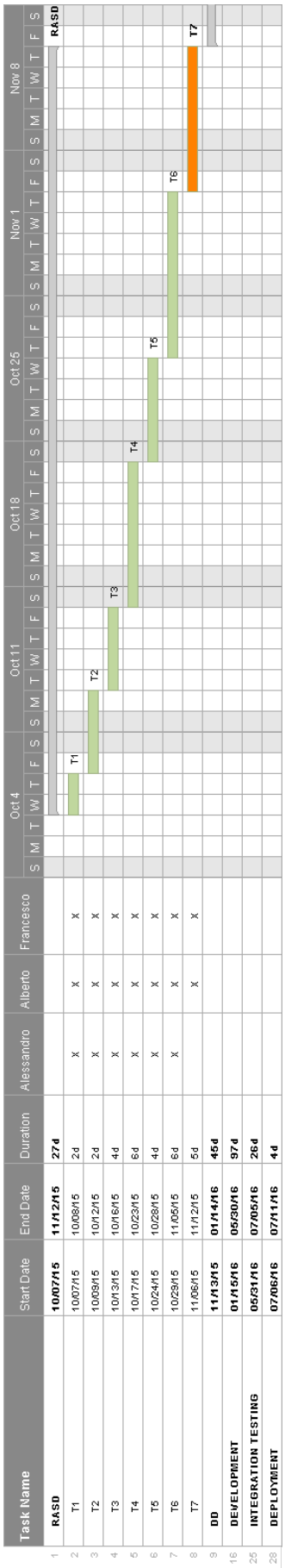
Below are shown the Gantt diagrams representing the guideline for the scheduling of the project which helps respecting the deadlines and deliverables.
First is presented an overall view of the whole project, later on the focus is on the particular of every section of the project.
Be aware that in the charts the US date format is used!

The meaning of the colors is:

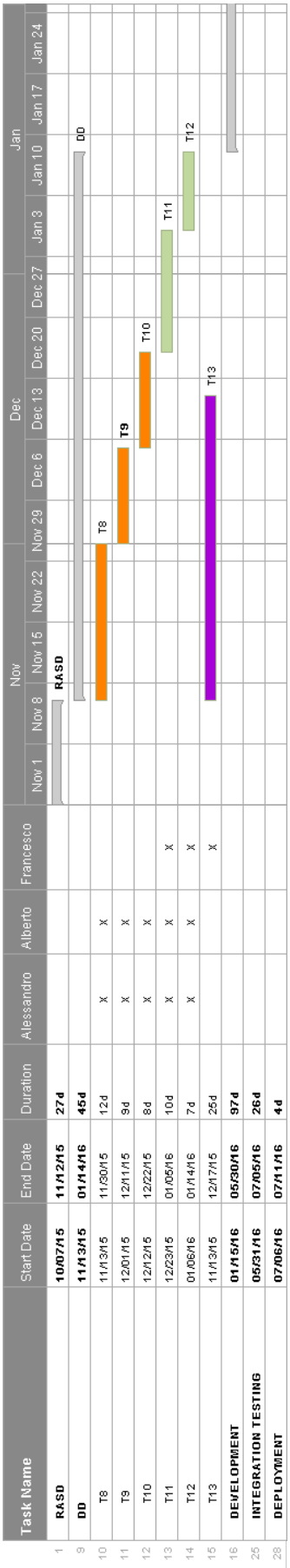
- GREEN: all the 3 members of the team are working on the task
- ORANGE: two member of the project are working on the task
- PURPLE: just one member of the group is working on that task.


Task Name
Start Date
End Date
Duration
Alessandro
Alberto
Francesco
Q4
Oct
Nov
Dec
Q1
Jan
Feb
Mar
Q2
Apr
May
Jun
Q3
Jul
Aug
Sep
1 RASD 10/07/15 11/12/15 27d
2 T1 10/07/15 10/08/15 2d
3 T2 10/09/15 10/12/15 2d
4 T3 10/13/15 10/16/15 4d
5 T4 10/17/15 10/23/15 6d
6 T5 10/24/15 10/28/15 4d
7 T6 10/29/15 11/05/15 6d
8 T7 11/06/15 11/12/15 5d
9 DD 11/13/15 01/14/16 45d
10 T8 11/13/15 11/30/15 12d
11 T9 12/01/15 12/11/15 9d
12 T10 12/12/15 12/22/15 8d
13 T11 12/23/15 01/05/16 10d
14 T12 01/06/16 01/14/16 7d
15 T13 11/13/15 12/17/15 25d
16 DEVELOPMENT 01/15/16 05/30/16 97d
17 T14 01/15/16 02/04/16 15d
18 T15 03/03/16 03/24/16 16d
19 T16 03/25/16 04/25/16 22d
20 T17 02/05/16 03/02/16 19d
21 T18 04/26/16 05/30/16 25d
22 T19 03/05/16 03/24/16 15d
23 T20 01/15/16 02/09/16 18d
24 T21 02/10/16 03/04/16 18d
25 INTEGRATION TESTING 05/31/16 07/05/16 26d
26 T22 05/31/16 06/15/16 12d
27 T23 06/16/16 07/05/16 14d
28 DEPLOYMENT 07/06/16 07/11/16 4d
29 T24 07/06/16 07/11/16 4d
RASD
DD
DEVELOPMENT
INTEGRATION TEST
DEPLOYMENT

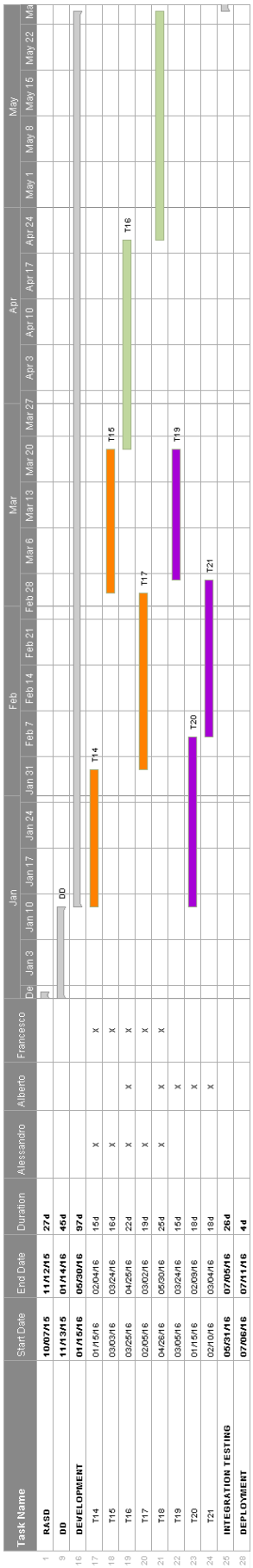
Scheduling and resources allocation for RASD document



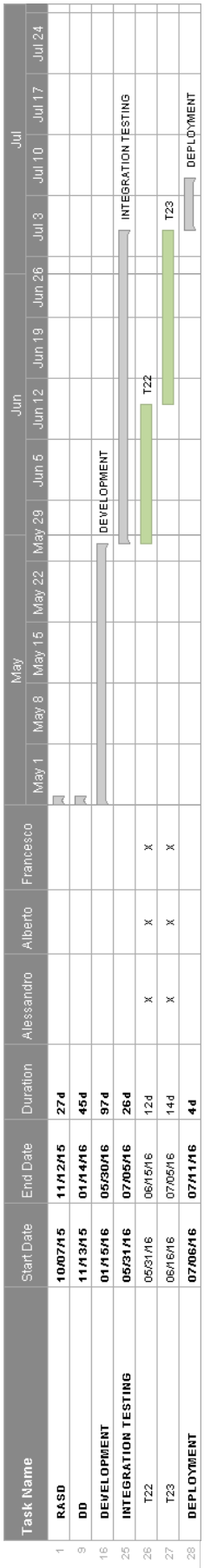
Scheduling and resources allocation for Design document



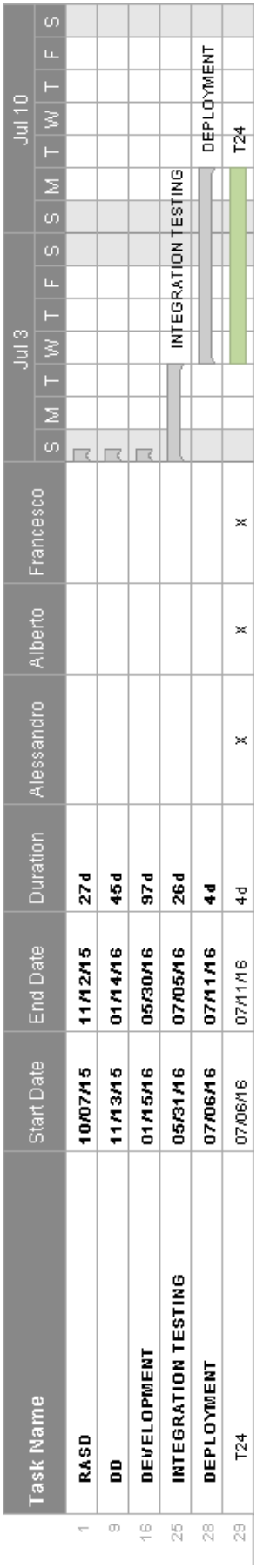
Scheduling and resources allocation for the development phase



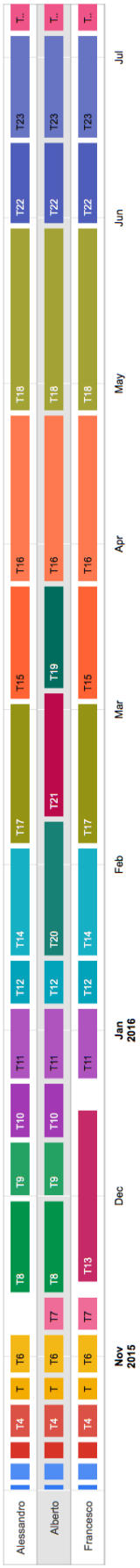
Scheduling and resources allocation for integration testing



Scheduling and resources allocation for deployment of the final product



The following diagram shows the allocation of the three people in the team in a more clear way, with the tasks grouped by person.



It is important to notice that in the scheduling of the project and in the allocation of resources the difference between business days and weekends has been taken into account. The workweek is from Monday to Friday, while the weekend is Saturday and Sunday. Days are 8 hours of work time.
For instance the tasks T1 and T2 are both 2-day long, but the latter covers the weekend, so it has been counted up for 4 days instead of 2.

Federal holidays have not been considered since this is an approximate schedule, but they could cause up to about 10 days of delay on the proposed schedule.

The proposed schedule matches the 10/11 months expected duration of the project forecast with the COCOMO analysis, in fact the planned work starts October 7, 2015 and ends July 11, 2016.

6 Risk planning and management

7 References

Material from Wikipedia

- Project management: https://en.wikipedia.org/wiki/Project_management#Planning

8 Appendix

8.1 Software and tools used

- TeXstudio 2.10.6 (http://www.texstudio.org/) to redact and format this document.
- Astah Professional 7.0 (http://astah.net/editions/professional)

8.2 Hours of work

The time spent to redact this document:

- Baldassari Alessandro: 12 hours.
- Bendin Alberto: 12 hours.
- Giarola Francesco: 12 hours.