POLITECNICO
MILANO 1863

"PowerEnjoy"

Project Management Document

Version 1.0 *(22/01/2017)*

Giorgio Marzorati (876546)
Aniel Rossi (877018)
Andrea Vaghi (877710)

INDEX OF CONTENTS

INTRODUCTION 3

Purpose & Scope 3

Reference Documents 4

PROJECT SIZE, COST AND EFFORT ESTIMATION 4

Size Estimation: Function Points 4

Internal Logic Files (ILFs) 4

External Interface Files (EIFs) 8

External Inputs (EIs) 10

External Inquiries (EQs) 12

External Outputs (EOs) 13

Overall size estimation 14

Cost and Effort Estimation: COCOMO II 14

Scale Drivers 14

Cost Drivers 16

Platform factors 18

Personnel factors 19

Project Factors 21

Effort equation 23

Schedule and Resource Allocation 24

RISK MANAGEMENT 28

EFFORT SPENT 30

Giorgio Marzorati 30

Aniel Rossi 30

Andrea Vaghi 30

CHANGELOG 31

INTRODUCTION

Purpose & Scope

In this document, named Project Plan Document (PPD), we make a deep analysis on the complexity of the project in order to try to make the most real and feasible estimation of the costs and the effort involved in the entire developement. The main focus of this analysis is to estimate the required budget needed, the schedule of the activities and the allocation of the resources in order to cover all the duties.
In the first part of the document we use two techniques of size estimation (Function Points and COCOMO II) that help us to have an idea respectively on the final number of lines of code(SLOC) of the software and on the relation between the cost and the effort required to complete all the identified activities coherently with our planning.
In the second part we propose a schedule of the identified activities distributed along the period of time selected for the realization of the entire project, from the analysis of requirements to the final deployment and start up.
In the third part we assign each activity to one or more members of the team, based on the effort that we want to concentrate in them and the criticity that they represent respect to the entire project.
In the last part we make an evaluation of the risks in which our project could be involved. This analysis takes into account three main categories of risks:

- Project risks
- Technical risks
- Business risks

After the evaluation, we propose for each identified risk a mitigation strategy in order to handle the situation when the possibility of that risk becomes reality.

Definitions, Acronyms, Abbreviations

- FP: Function Points.
- ILF: Internal logic file
- ELF: External logic file.
- EI: External Input.
- EO: External Output.
- EQ: External Inquiries.
- DBMS: Database Management System.
- API: Application Programming Interface.
- ETA: Estimated Time of Arrival.
- UI: User Interface.
- GPS: Global Positioning System.
- RASD: Requirements and Analysis Specification Document
- DD: Design Document

Reference Documents

• PowerEnjoy Requirement Analysis and Specification Document: RASD.pdf
• The Project Plan Example documents: Project Planning Example Document.pdf and Project Management Basics + Advanced.pdf
• The Function Points complexity evaluation tables.
• The COCOMO II Model Definition Manual (version 2.1, 1995 – 2000 Center for Software Engineering, USC).

PROJECT SIZE, COST AND EFFORT ESTIMATION

In the next section we present a valuation of the expected size of the PowerEnjoy project (expressed in SLOC), then an estimate of the cost and the required effort, using the following two approaches:

- Function Points for the size estimation, based on each functionality that the business logic of the application has to offer and the corresponding lines of code to be written in order to correctly implement it;
- COCOMO II approach for the cost and the required effort, taking into account that we find ourselves into a Post-Architecture case of analysis

Size estimation: function points

Internal Logic Files (ILFs)

In this paragraph we describe the Internal Logic Files on which the PowerEnjoy data structure is based on, in order to be able to implement all the functionalities it offers. We focus in particular in the description of their complexity, to justify the amount of FPs we decided to apply to every single ILF.

ILF Rating (Low = 7 FPs, Avg = 10 FPs, High = 15 FPs):

	Data Elements		
Record Elements	1-19	20-50	51+
1	Low	Low	Avg
2-5	Low	Avg	High
6+	Avg	High	High

Here is a brief description of the entities we use and the complexity assigned:

1) Client

Attributes:
- Driving License Id
- Email
- PIN
- Name
- Surname
- Card Circuit
- Card Expiration Date
- Card Number
- Card CVV

The Client file is composed of 1 single record with 9 data elements in total and we think we will reach a number of 10000 clients to be stored in the first year. By the way, since it can be represented with a single table, we assign a low complexity level.

---

2) Car

Attributes:
- License Plate
- Locked Status
- Availability
- Battery Level
- Last Latitude Position
- Last Longitude Position

As for the Client, the Car file can be represented with a single table, for a total amount of 6 data elements. Here we assign a low complexity level too.

---

3) Car Identification

Attributes:
- Identification Id
- Driving License Id (Client)
- License Plate (Car)
- Time of Identification

To correctly store a Car Identification, we need a dedicated entity with the time of the identification, the Client who performs it and the Car to be identified. The total amount of Data Elements is then 17 with 3 records element. Its complexity is low.

---

4) Car Reservation

Attributes:

- Reservation Id
- Driving License Id (Client)
- License Plate (Car)
- Time of Reservation
- Validity

A Car Reservation file is identified with a dedicated table that store the reservation time and its validity (expired or not), plus the information regarding the Client who performs it and the Car to be identified. So it requires 3 record elements and 18 data elements, and the complexity is low.

---

5) Ride

Attributes:

- Ride Id
- Driving License Id (Client)
- License Plate (Car)
- Start Latitude Position
- Start Longitude Position
- End Latitude Position
- End Longitude Position
- Start Time
- End Time
- Ride Charge
- Number of Passengers

The Ride file is quite more complex than the previous, because it still requires 3 record types (Ride, Car, Client) but the Data Elements required are higher (24). So we evaluated it with an average complexity.

---

6) Ride Charge

- Payment Id
- Ride Id (Ride)
- Amount
- Payment Evaluation (true/false)

and

7) Fee

- Fee Id
- Reservation Id (Reservation)
- Payment Evaluation (true/false)

The payments information we store about ride charged and fees for expired reservations are characterized by an average complexity. They in fact require 4 records element: Client, Car, Ride, plus Ride Charge for the first one and Fee for the second one. The number of Data Elements required is 20 for the Fee and 27 for the Ride Charge, so complexity is average for both.

---

8) Assistance Request

- Request Id
- License Plate (Car)
- Type
- Description
- Solved (true/false)

An Assistance Request is automatically created when sensors notice an anomaly in the car. The corresponding file is identified with 2 record elements, Assistance Request with the details and the Car. The complexity is low, as it needs 12 data elements.

---

9) Safe Area

- Safe Area Id
- Latitude Position
- Longitude Position
- Is Special (true/false)

Only the dedicated table uniquely identifies a Safe Area file, so it has a low complexity.

---

10) Power Grid

- Power Grid Id
- Safe Area Id
- Is Plugged (true/false)
- Is Busy (true/false)

To identify a Power Grid file, we use a dedicated table with the id, the availability and if it is actually plugged. We also need the information about the corresponding Safe Area, and so here there are 2 Record Element and 7 Data Elements. The complexity is low.

Overall FPs assignment:

ILF	Complexity	FPs
Client	Low	7
Car	Low	7
Car Identification	Low	7
Car Reservation	Low	7
Ride	Avg	10
Ride Charge	Avg	10
Fee	Avg	10
Assistance Request	Low	7
Safe Area	Low	7
Fee	Low	7
Total		79

External Interface Files (EIFs)

In this section we explain the interaction between PowerEnjoy and some sets of data provided by other independent applications/providers. In particular our system relies on two main external services, the *Mapping Service* and the *Payment Service Provider*. The information retrieved through the interaction between the system and these components sometimes need a certain amount of analysis and processing in order to be useful in our system. There may be situations in which the complexity of some of those interactions needs to be considered in a proper way, taking into account the dimension of the data exchanged and the amount of business logic required to process it. The list of the interactions is the following:

EIF Rating (Low = 5 FPs, Avg = 7 FPs, High = 10 FPs):

	Data Elements		
Record Elements	1-19	20-50	51+
1	Low	Low	Avg
2-5	Low	Avg	High
6+	Avg	High	High

Mapping Service:

- City Map Retrieval:
  This information is requested for the displaying of the city map on the user's mobile application. The operation of retrieving is quite simple, because it requires just the user position or an address, but the amount of data returned is high and needs some logic to be forwarded to the client. Thus, we decided to assign a high complexity value

- Address - Position Conversion Result
  The Mapping Service is able to convert an address provided in String format to a pair of coordinates that will be used to update a single table on the database for each request, so the complexity of this EIF is low

- Money Saving Mode Data:
  Money saving mode data is a collection of information that the user gets when activates that mode (ETA, Distance to the destination, Information about the path and so on). We need some logic operation in order to provide to the client the information it requires in the right way. So we decided to assign a medium grade of complexity.

- Distance Retrieval:
  The distance between two pairs of coordinates is a simple data expressed with a double precision floating point value, computed by the Mapping Service. As inputs, that external component needs only the coordinates representing the start point and the end point. Since we only need to provide this kind of information (that we mainly store in the database) and we don't have to apply any logic to the returning data (maybe just some formatting operation), we classify this operation with a low complexity

Payment Service Provider:

- Transaction Acknowledgement:
  The only information we receive from the Payment Service Provider is an acknowledgment for the outcome of a user payment for a ride or a fee for an expired reservation. Since we store the payments in a single ILF, all we have to do with the data incoming from the Payment Service Provider is an update on a single field of a table on the database, we assume that the complexity of this operation can be evaluated as low

Overall FPs assignment:

EIF	**Complexity**	**FPs**
City Map Retrieval	High	10
Address/Position Convertion	Low	5
Money Saving Mode Data	Avg	7
Distance Retrieval	Low	5
Transaction Ack	Low	5
Total		32

External Inputs (EIs)

In our PowerEnjoy system, the back-end section interacts with different categories of client, providing a set of functionalities in response of several types of inputs.
In this section we focus on the complexity of each EI (grouped by clients), explaining our considerations in every case of analysis.

EI Rating (Low = 3 FPs, Avg = 4 FPs, High = 6 FPs):

	Data Elements		
File Type Referenced	1-4	5-15	15+
2-	Low	Low	Avg
2	Low	Avg	High
2+	Avg	High	High

End User:

- Registration:
  The user registration involves the data processing by the Registration Manager, some, database checks, a record insert and the Notification Manager effort for sending the PIN. As we can notice, it is not a straightforward operation, so it can be considered with an average complexity.

- Login/Logout:
  The user Login & Logout operations are quite simple, as they affect just the Login Manager and include simple database operations (a check and a basic update). The overall complexity is low (3 FPs for each operation).

- Lost Password Retrieval:
  If a user loses its password, there are different steps in order to deliver a new one: database operation to delete and update fields, generation of a new one by the Account Manager and the Notification Manager to communicate it to the user. This complexity is evaluated as average.

- Car Reservation:
  This operation involves the Reservation Manager to perform a series of tasks, as it has to create a new Reservation entity based on the information provided by the user (driving license, car license plate) and instantiate a timer that determines the validity of a reservation for 60 minutes. It also has to update the availability of a car in the database. We assign an average level of complexity.

- Car Identification:
  Identification of a car by a user is a complex operation. In fact, to achieve successfully this task, different components (and the respective managed entity on the database) have to be involved: the Identification Manager has to send a message to the Car Manager that forwards it to the right car, unlocking it physically. The Identification Manager has also to communicate to the

Reservation Manager, in order to be sure that a car is actually available and to end a possible reservation made by the same user who performs the identification. Due to these considerations, we assign a high level of complexity.

- Money Saving Mode Enabling:
  Money Saving Mode data is a collection of information that the user gets when activates that mode (ETA, Distance to the destination, Information about the path and so on). Although this data are computed by the mapping service, we need several logic operations in order to provide to the external service the information it requires (two pairs of coordinates, one for the user actual position and one for the Special Parking Area). Specifically, the choice of the second one is based on the final destination of the user, the availability of Special Parking Areas and the distribution of cars, so to suggest the right place to park we need several database queries, distance computation and comparisons. Taking into account these considerations, we decided to assign a high level of complexity.

Car:

- Generic Sensor Data Transmission
  The data sensor transmission involves the Car Manager that receives and processes them to check if they respect some parameter (if the car is damaged or has some kind of issue. If not, it has to interact with the Assistance Manager for creating an automatic reporting that has to be stored in the database. The complexity is average.

- Ride Start Data Transmission
  When a ride starts, the car transmits different data to the Car Manager (start position, battery level, number of passengers) which has to interact with the Ride Manager for the creation of a Ride entity. It is not a very complex operation, but it requires some effort due to checks and data collecting from different entities, so we assign an average level of complexity.

- Ride End Data Transmission
  The end of a ride implies a high effort by various components the same way as for the ride start, but with the addiction of all the processes to determine the charge to be paid, including discount and overcharge calculation and the direct interaction with the Payment Manager. For this reason, we evaluated this complexity as high

Assistance Team:

- Telephone Assistance Requests Inserting
  The assistance team's task that include a direct interaction with the Central Server is the one regarding the insert in the system of the requests they receive via telephone. It is a simple insert or update operation, translated by the server in a database statement, so we rate it as a low complexity one.

Overall FPs assignment:

EI	Complexity	FPs
Registration	Avg	4
Login/Logout	Low	2x3
Lost Password Retrivial	Avg	4
Car Reservation	Avg	4
Car Identification	High	6
Money Saving Mode Enabling	High	6
Generic Sensor Data Transmission	Avg	4
Ride Start Data Transmission	Avg	4
Ride End Data Transmission	High	6
Teleph. Assistance Req. Inserting	Low	2x3
Total		50

External Inquiries (EQs)

In this paragraph we analyse the External Inquiries (EQs) influencing our system, that are basically data retrieval request by an user, without a big amount of business logic being involved in the process. PowerEnjoy supports some of these kind of operations, everyone characterized by a low complexity level since here is not involved big amount of data and the effort for retrieval is quite low (except for the car retrieval, which needs the comparison between the user position and the car position by the Mapping Service):

- A user can request the available car in an area around its position or an inserted address
- A user can request the history of its past reservations
- A user can request the history of its past rides
- A user can request the history of its past payments (fees and ride charges)
- The Assistance Team can request assistance requests with several type of filters (by cars, users, zones, times etc)

Overall FPs assignment:

EIF	Complexity	FPs
Available Cars Request	Avg	4
Past Reservation Request	Low	3
Past Reservation Ride	Avg	3
Past Reservation Payments	Avg	3
Assistance Requests	High	3
Total		16

External Outputs (EOs)

In the last part of the Function Point analysis we focus on the External Outputs, that are situation in which PowerEnjoy needs to communicate with the external environment, sending various types of information. This communications are:

- PIN notification to the user:
  A simple operation via E-Mail that involves just the Notification Manager and the Database Manager, to set up a right PIN creation. Complexity: low.

- Fee notification to a user:
  It's a simple E-Mail message sent to the user by the Notification Manager when a Reservation expires. Complexity: low.

- Car Unlocking:
  It's a simple outcome sent to the Car System by the Car Manager, to perform the unlocking. Complexity: low.

- Fee and Ride Charge Payment Details:
  The Payment Manager sends this info to the Payment Service Provider. The system needs to collect some data in order to achieve this task (user's billing details, amount to be paid), retrievable from few tables in the database. Complexity: average for both.

- Assistance Request notification
  The Assistance Manager has to collects sensors data passed by the Car Manager, and information about the car (license plate, position), attaching the type of problem (interpreting sensor's data) and pass them to the Assistance Team System. Complexity: average.

Overall FPs assignment:

EIF	**Complexity**	**FPs**
PIN Notification	Low	4
Fee Notification	Low	4
Car Unlocking	Low	4
Fee/Ride Charge Payment Details	Avg	2x5
Assistance Requests	Avg	5
Total		27

Overall size estimation

Function Type	FPs
Internal Logic Files	79
External Interface Files	35
External Input	50
External Inquiries	16
External Output	27
Total	207

We consider JEE as our platform for the development for the entire business logic. The client's mobile application is not included in this calculation, since we designed our system to contain the business logic in the back-end side.

Estimated lines of code:

Lower bound - SLOC = 207 * 46 = 9522

Upper bound - SLOC = 207 * 67 = 13869

COST AND EFFORT ESTIMATION: COCOMO II

In this section we use the second estimation method mentioned in the introduction, COCOMO II. The purpose is to make an analysis of the costs and the effort needed in order to be able to build the project in terms of time and money.

Scale Drivers

The first thing we did was evaluating some scale factors, making a sort of highlighting of some of the main properties of the project and the team. For this purpose we refer to the following official COCOMO II table (next page):

Table 10. Scale Factor Values, SF_i, for COCOMO II Models

Scale Factors	Very Low	Low	Nominal	High	Very High	Extra High
PREC	thoroughly unprecedented	largely unprecedented	somewhat unprecedented	generally familiar	largely familiar	thoroughly familiar
SF_i:	6.20	4.96	3.72	2.48	1.24	0.00
FLEX	rigorous	occasional relaxation	some relaxation	general conformity	some conformity	general goals
SF_i:	5.07	4.05	3.04	2.03	1.01	0.00
RESL	little (20%)	some (40%)	often (60%)	generally (75%)	mostly (90%)	full (100%)
SF_i:	7.07	5.65	4.24	2.83	1.41	0.00
TEAM	very difficult interactions	some difficult interactions	basically cooperative interactions	largely cooperative	highly cooperative	seamless interactions
SF_i:	5.48	4.38	3.29	2.19	1.10	0.00
PMAT	The estimated Equivalent Process Maturity Level (EPML) or					
	SW-CMM Level 1 Lower	SW-CMM Level 1 Upper	SW-CMM Level 2	SW-CMM Level 3	SW-CMM Level 4	SW-CMM Level 5
SF_i:	7.80	6.24	4.68	3.12	1.56	0.00

A brief description for each scale driver:

• Precedentedness: it reflects the previous experience of our team with the development of large scale projects. In our case the value is low, our team made together only one another large scale project except this.

• Development flexibility: it reflects the degree of flexibility in the development process with respect to the external specification and requirements. Since we don't have any particular constraint (especially technical) specified in the specifications the flexibility is very high.

• Risk resolution: reflects the level of awareness and reactiveness with respect to risks. The risk analysis we performed is quite extensive, evaluating both internal and external risks, dividing them also in categories. The value is set to high.

• Team cohesion: it's an indicator of how well the team members know each other and work together in a cooperative way. Here the value is high due to the fact that we know each other very well and we did another project together as a team before .

• Process maturity: due to the fact that we work on a well defined development process this value is set to nominal.
The results of our evaluation is the following (next page):

Scale Driver	Factor	Values
Precedentedness	Low	4.96
Development Flexibility	Very High	1.01
Risk Resolution	High	2.83
Team Cohesion	High	2.19
Process Maturity	Nominal	4.68
Total		15.67

Cost Drivers

Reliability:

A possible shutdown of the server in a particular amount of time leads only to the loss of the payments of the rides that are happening in that moment and the impossibility to reserve or identify a car. In the case of missed payments we can easily recover the rides that weren't paid from the database. In our case the value is set to Low.

RELY Cost Drivers						
RELY Descriptors	slightly inconvenience	easily recoverable losses	moderate recoverable losses	high financial loss	risk to human life	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	0.82	0.92	1.00	1.10	1.26	n/a

Database Size:

This measure considers the effective size of our database. Our estimation considering the tables and fields we have is to reach a 3GB database. Since it is distributed over 9.000-14.000 SLOC, the ratio D/P (measured as testing DB bytes/program SLOC) is between 209 and 314, resulting in the DATA cost driver being High.

DATA Cost Drivers						
DATA Descriptors		$\frac{D}{P} < 10$	$10 \leq \frac{D}{P} \leq 100$	$100 \leq \frac{D}{P} \leq 1000$	$\frac{D}{P} > 1000$	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	n/a	0.90	1.00	1.14	1.28	n/a

Product Complexity:

Complexity is divided into five areas: control operations, computational operations, device-dependent operations, data management operations, and user interface management operations.
In our case the functions will be mostly functions with normal complexity of calculus and construction and they will be simple to use and understand. The value is set to Nominal.

CPLX Cost Driver						
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	0.73	0.87	1.00	1.17	1.34	1.74

Required Reusability:

This cost driver accounts for the additional effort needed to construct components intended for reuse on current or future projects. In our case, the reusability requirements are limited in scope to the project itself, so the RUSE cost driver is set to Nominal.

RUSE Cost Driver						
RUSE Descriptors		None	Across project	Across program	Across product line	Across multiple product lines
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	n/a	0.95	1.00	1.07	1.15	1.24

Documentation match to life-cycle needs:

This parameter describes the relationship between the documentation and the application requirements. The rating scale goes from Very Low (many life-cycle needs uncovered) to Very High (excessive for life-cycle needs). In our case the value is Nominal, due to the fact that in the documentation are covered the main life-cycle needs, so the document descriptors can be considered right-sized to life-cycle needs.

DOCU Cost Driver						
DOCU Descriptors	Many life-cycle needs uncovered	Some life-cycle needs uncovered	Right-sized to life-cycle needs	Excessive for life-cycle needs	Very excessive for life-cycle needs	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	0.81	0.91	1.00	1.11	1.23	n/a

Platform factors

These types of factors refer to the complexity of the hardware talking about the machine level.

Execution Time Constraint

This is the measure of the execution time constraint imposed upon a software system. Since we do not have many accesses in the same moment, we are not going to handle too many parallel operations and these are going to be simple one. For these reasons, we choose the value High of the table corresponding to the rate 1.11. The rating express the percentage of the available execution time expected to be used by the system or subsystem consuming the execution time resource.

TIME Cost Driver						
TIME Descriptors			$\leq$ 50% use of available execution time	70% use of available execution time	85% use of available execution time	95% use of available execution time
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	n/a	n/a	1.00	1.11	1.29	1.63

Main storage constraint

This rating represents the degree of the main storage constraint imposed on a software system or subsystem. Because of the low cost and the high capacity of disks on the market, we consider this parameter as Nominal.

STOR Cost Driver						
STOR Descriptors			≤ 50% use of available storage	70% use of available storage	85% use of available storage	95% use of available storage
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	n/a	n/a	1.00	1.05	1.17	1.46

Platform volatility

In this section with platform we are going to mean the complex of hardware and software (form OS to DBMS) that the software has to call to perform its tasks. Since we would like to be aligned with all the software products on which we rely on (car software, payment method, OS client), but there are in a small number of them we can imagine to have not so many changes during the time, for that reasons we get a Nominal parameter (1.00).

PVOL Cost Driver						
PVOL Descriptors		Major change every 12 mo., minor change every 1 mo.	Major: 6mo; minor: 2wk.	Major: 2mo, minor: 1wk	Major: 2wk; minor: 2 days	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	n/a	0.87	1.00	1.15	1.30	n/a

Personnel factors

People factors have the strongest influence in determining the amount of effort required to develop a software product and they rate the development team's capability and experience.

Analyst capability

This value represents the design ability and efficiency, the ability to communicate and cooperate of the analyst, personnel who work on requirements and high-level design and detailed design. Since we spent a lot of time analysing the requirements deeply and building a solid system during the requirement analysis and the design phase we could think that we are going to have less problem in the future phase for the development so we choose the High value with rate 0.85.

ACAP Cost Driver						
ACAP Descriptors	15th percentile	35th percentile	55th percentile	75th percentile	90th percentile	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.42	1.19	1.00	0.85	0.71	n/a

Programmer capability

Since with this value we represent the ability, the efficiency and the thoroughness of our team of programmers we set an High value (0.88) because we consider us an efficient team, since we had some previous experiences of this kind together.

PCAP Cost Driver						
PCAP Descriptors	15th percentile	35th percentile	55th percentile	75th percentile	90th percentile	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.34	1.15	1.00	0.88	0.76	n/a

Personnel continuity

Considering our period of work and development of the project, we think that we are going to be present during almost every meeting, so we choose the High value.

PCON Cost Driver						
PCON Descriptors	48% / year	24% / year	12% / year	6% / year	3% / year	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.29	1.12	1.00	0.90	0.81	n/a

Application experience

This rating is dependent on the level of applications experience of the project team developing the software system or subsystem in term of year of experience. We choose a Nominal value of 1.00 because we developed together another project before this one.

APEX Cost Driver						
APEX Descriptors	≤ 2 months	6 months	1 year	3 years	6 years	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.22	1.10	1.00	0.88	0.81	n/a

Platform experience

With this value, we consider the platform (graphic user interface, database, etc.) and knowledge experience. Because of our past project involving databases, graphic user interfaces, we would choose a Nominal value, but because of our non-deep knowledge of these platforms we prefer setting the value to Low(1.09).

PLEX Cost Driver						
PLEX Descriptors	≤ 2 months	6 months	1 year	3 years	6 years	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.19	1.09	1.00	0.91	0.85	n/a

Language and tool experience

This rating depends on the level of knowledge and experience of the programming language and the software tool used, including the ones used in the requirements and design phases, configuration analysis, document extraction and so on. Because of our average knowledge, we set the value to Nominal.

LTEX Cost Driver						
LTEX Descriptors	≤ 2 months	6 months	1 year	3 years	6 years	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.20	1.09	1.00	0.91	0.84	n/a

Project Factors

Account for influences from the use of modern software tools, compression of the project schedule or location of development team.

Use of software tools

It reflects the tool capability, maturity and integration. Because we are going to use solid tools and we are not going to use open source ones, which could create some problems, we choose the High value.

TOOL Cost Driver						
TOOL Descriptors	edit, code, debug	simple, frontend, backend CASE, little integration	basic life-cycle tools, moderately integrated	strong, mature life-cycle tools, moderately integrated	strong, mature, proactive life-cycle tools, well integrated with processes, methods, reuse	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.17	1.09	1.00	0.90	0.78	n/a

Multisite development

Since we program to build the great part of the system during our meetings we consider the Very High parameter.

SITE Cost Driver						
SITE Collocation Descriptors	International	Multi-city and multi-company	Multi-city or multi-company	Same city or metro area	Same building or complex	Fully collocated
SITE Communications Descriptors	Some phone, mail	Individual phone, fax	Narrow band email	Wideband electronic communication	Wideband elect. comm., occasional video conf.	Interactive multimedia
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.22	1.09	1.00	0.93	0.86	0.80

Required development schedule

This rating measures the constraint imposed on the project team developing the software in terms of percentage of schedule stretch-out or acceleration with respect to the nominal schedule. Because of our hard work during requirements and design phases we think that the right value is the High one.

SCED Cost Driver						
SCED Descriptors	75% of nominal	85% of nominal	100% of nominal	130% of nominal	160% of nominal	
Rating level	Very low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.43	1.14	1.00	1.00	1.00	n/a

Effort equation:

Effort = A * EAF * KSLOC^E

$$PM = A * size^{E} \prod_{i=1}^{17} EM_i$$

$$E = B + 0.01 \sum_{j=1}^{5} SF_i$$

$$A = 2.94 \quad B = 0.91$$

Our results:

E=1.07

Size = KSLOC -> Lower bound = 9.52 Upper bound = 13.87

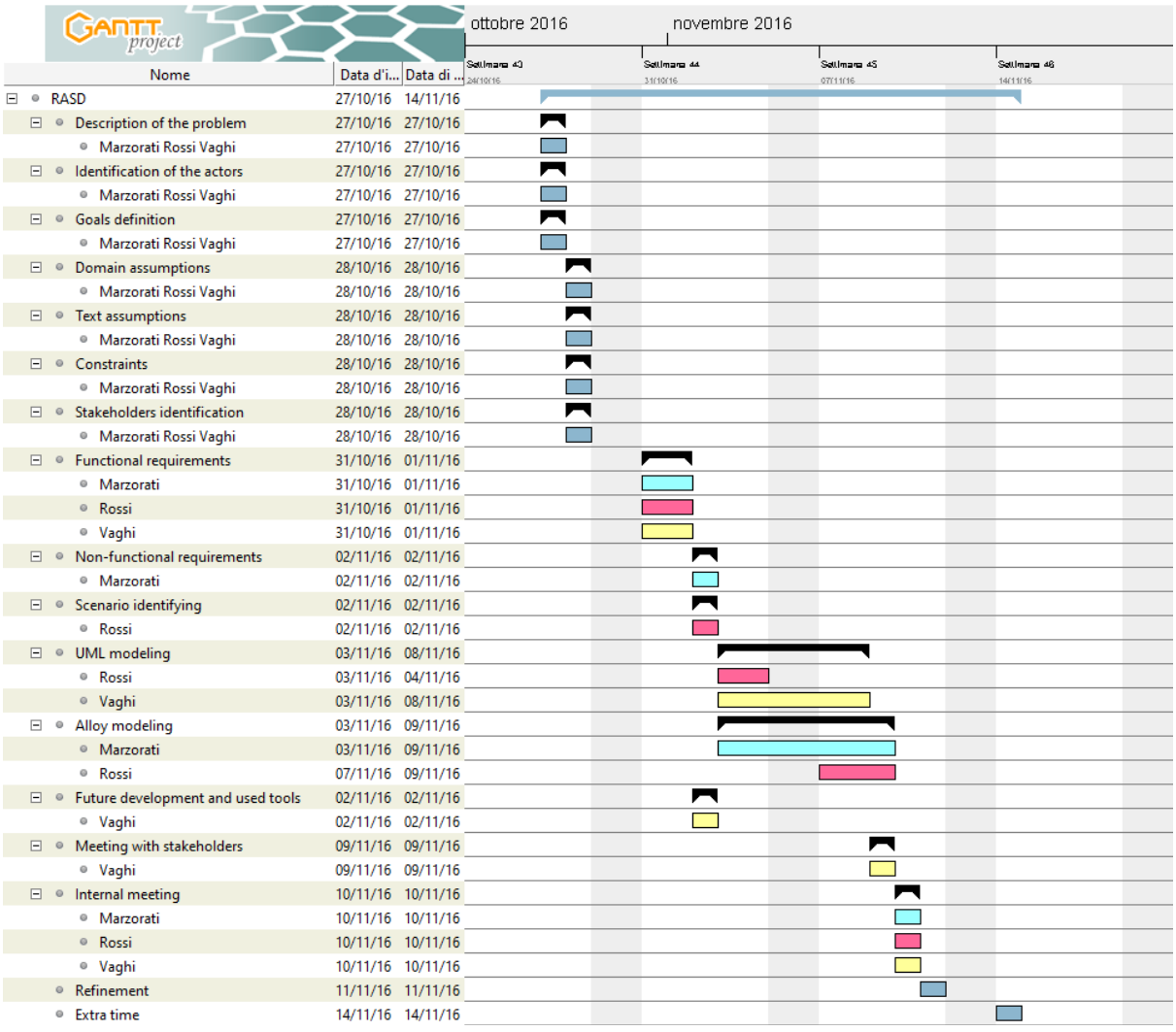
$\prod_{i=1}^{17} EM_i = 0.66$

Lower bound effort = 2.94 * 11.15 * 0.66 ≈ **22 PM**
Upper bound effort = 2.94 * 16.67 * 0.66 ≈ **32 PM**

Schedule and Resource Allocation

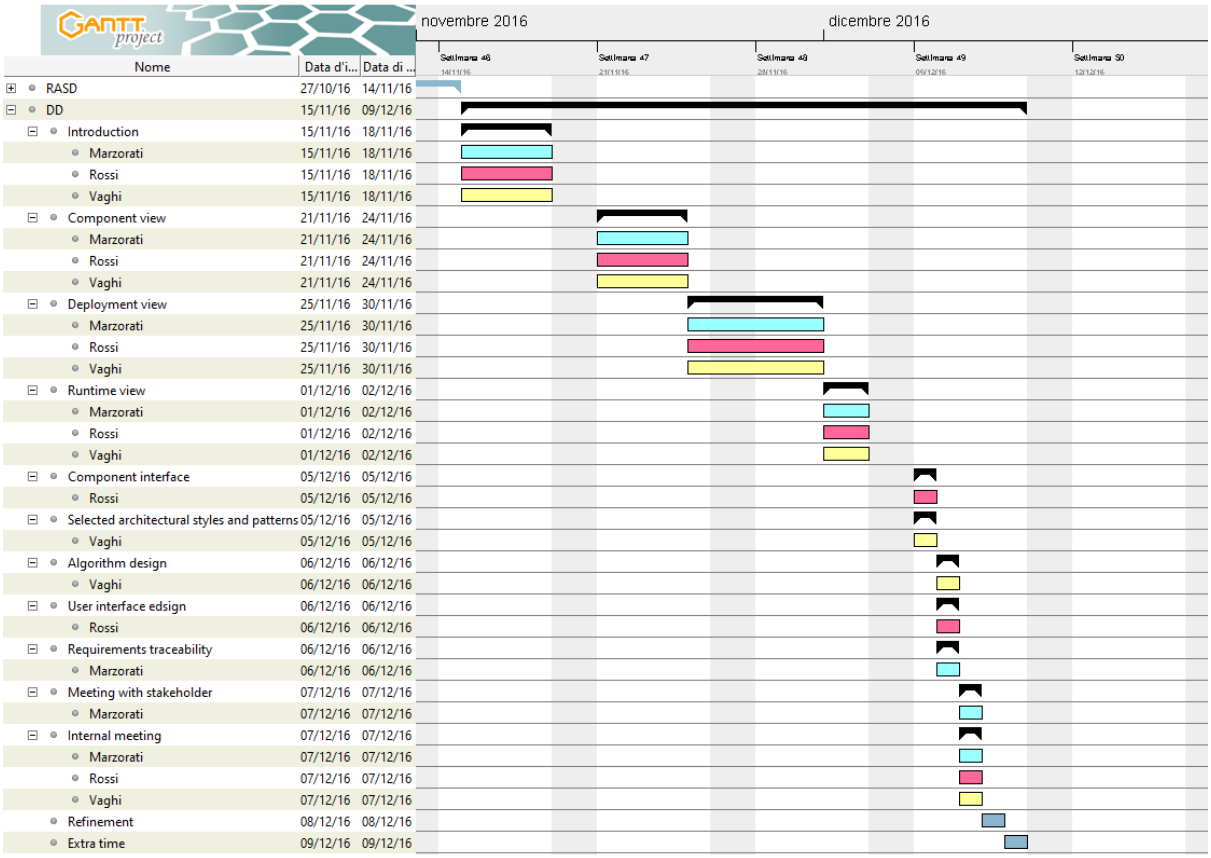
In this chapter we provide a general time scheduling of all the activities involved in this project from the very beginning (requirement analysis) to the end (start-up).
In the same diagram we also specify the percentage of work that each member will spend on each of these tasks.
The amount of time considered is from October to March.

Requirements and Analysis Specification Document:



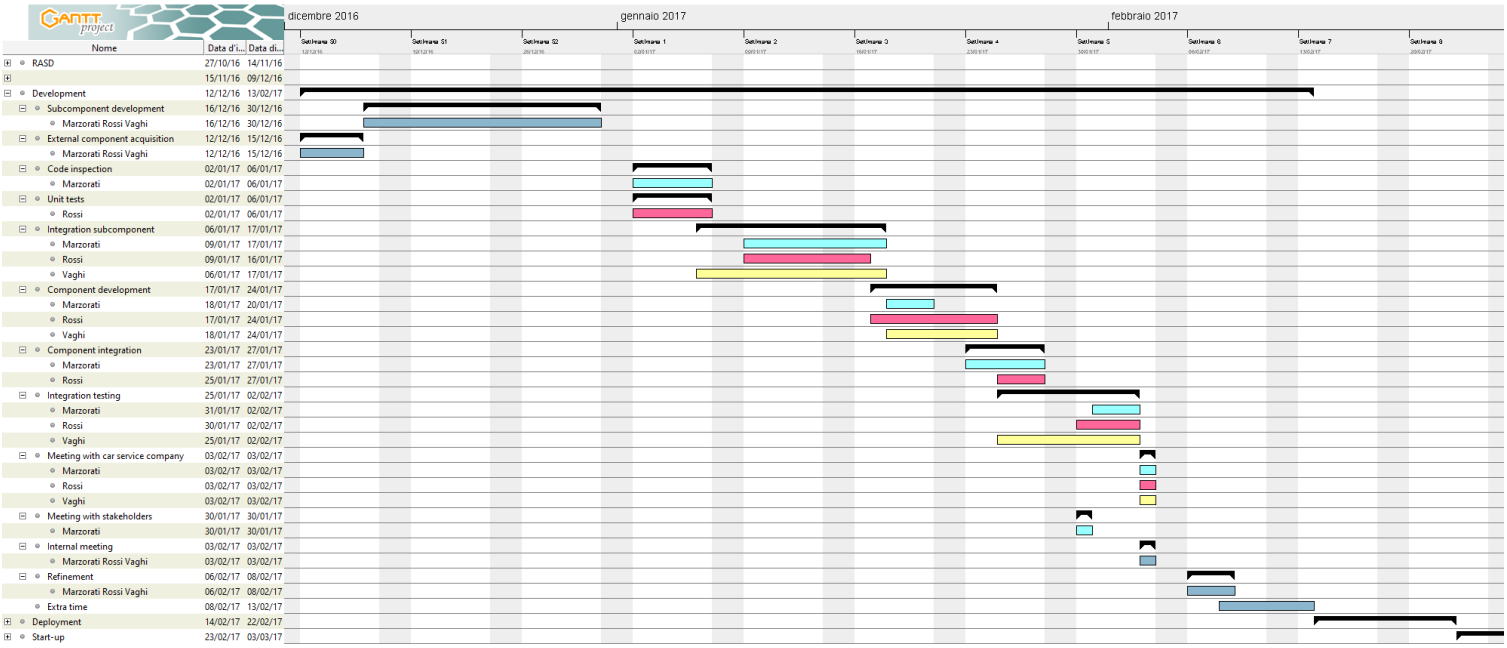
Nome	Data d'i...	Data di ...
RASD	27/10/16	14/11/16
Description of the problem	27/10/16	27/10/16
Marzorati Rossi Vaghi	27/10/16	27/10/16
Identification of the actors	27/10/16	27/10/16
Marzorati Rossi Vaghi	27/10/16	27/10/16
Goals definition	27/10/16	27/10/16
Marzorati Rossi Vaghi	27/10/16	27/10/16
Domain assumptions	28/10/16	28/10/16
Marzorati Rossi Vaghi	28/10/16	28/10/16
Text assumptions	28/10/16	28/10/16
Marzorati Rossi Vaghi	28/10/16	28/10/16
Constraints	28/10/16	28/10/16
Marzorati Rossi Vaghi	28/10/16	28/10/16
Stakeholders identification	28/10/16	28/10/16
Marzorati Rossi Vaghi	28/10/16	28/10/16
Functional requirements	31/10/16	01/11/16
Marzorati	31/10/16	01/11/16
Rossi	31/10/16	01/11/16
Vaghi	31/10/16	01/11/16
Non-functional requirements	02/11/16	02/11/16
Marzorati	02/11/16	02/11/16
Scenario identifying	02/11/16	02/11/16
Rossi	02/11/16	02/11/16
UML modeling	03/11/16	08/11/16
Rossi	03/11/16	04/11/16
Vaghi	03/11/16	08/11/16
Alloy modeling	03/11/16	09/11/16
Marzorati	03/11/16	09/11/16
Rossi	07/11/16	09/11/16
Future development and used tools	02/11/16	02/11/16
Vaghi	02/11/16	02/11/16
Meeting with stakeholders	09/11/16	09/11/16
Vaghi	09/11/16	09/11/16
Internal meeting	10/11/16	10/11/16
Marzorati	10/11/16	10/11/16
Rossi	10/11/16	10/11/16
Vaghi	10/11/16	10/11/16
Refinement	11/11/16	11/11/16
Extra time	14/11/16	14/11/16

Design Document:

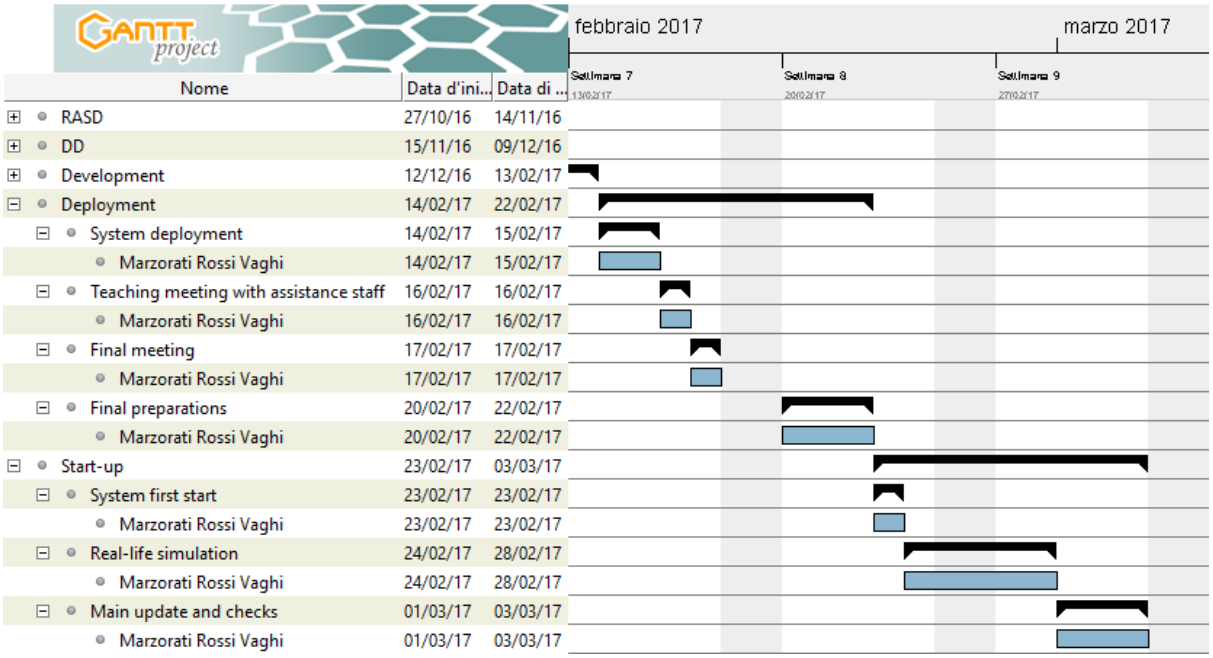


Nome	Data d'i...	Data di ...
RASD	27/10/16	14/11/16
DD	15/11/16	09/12/16
Introduction	15/11/16	18/11/16
Marzorati	15/11/16	18/11/16
Rossi	15/11/16	18/11/16
Vaghi	15/11/16	18/11/16
Component view	21/11/16	24/11/16
Marzorati	21/11/16	24/11/16
Rossi	21/11/16	24/11/16
Vaghi	21/11/16	24/11/16
Deployment view	25/11/16	30/11/16
Marzorati	25/11/16	30/11/16
Rossi	25/11/16	30/11/16
Vaghi	25/11/16	30/11/16
Runtime view	01/12/16	02/12/16
Marzorati	01/12/16	02/12/16
Rossi	01/12/16	02/12/16
Vaghi	01/12/16	02/12/16
Component interface	05/12/16	05/12/16
Rossi	05/12/16	05/12/16
Selected architectural styles and patterns	05/12/16	05/12/16
Vaghi	05/12/16	05/12/16
Algorithm design	06/12/16	06/12/16
Vaghi	06/12/16	06/12/16
User interface edsign	06/12/16	06/12/16
Rossi	06/12/16	06/12/16
Requirements traceability	06/12/16	06/12/16
Marzorati	06/12/16	06/12/16
Meeting with stakeholder	07/12/16	07/12/16
Marzorati	07/12/16	07/12/16
Internal meeting	07/12/16	07/12/16
Marzorati	07/12/16	07/12/16
Rossi	07/12/16	07/12/16
Vaghi	07/12/16	07/12/16
Refinement	08/12/16	08/12/16
Extra time	09/12/16	09/12/16

Development:



Deployment to the end:



RISK MANAGEMENT

In this chapter we analyse some of the risks that we may face during the project development, dividing them in 3 categories: project risks, technical risks and business risks.

1) Risk Description:

Code	Risk	Probability	Effect
PR1	A key member of the team quits the company or is ill in a critical point of the project development	Average	Serious
PR2	Some parts of the project require more time than expected (underestimating schedules)	Average	Serious
PR3	The external car software component doesn't work as expected or is not ready in time with the other components	Low	Catastrophic
PR4	Loss of entire or part of the source code	Low	Catastrophic
TR1	External commercial components change their configurations/protocols/API	Low	Catastrophic
TR2	A new paymenth method starts getting used widely	Average	Serious
BR1	Change in available car parking zone by the city administration	Average	Serious
BR2	The project does not satisfy the expectation of the city amministration when the development is finished	Average	Catastrophic
BR3	Budget overestimation	High	Serious
BR4	Budget underestimation	Average	Catastrophic
BR5	Missing agreement with the mobile data vendor	Average	Catastrophic

2) Mitigation:

Code	Mitigation strategy
PR1	Split duties and responsibilities among the highest number of people. In the worst case we can consider a first beta release with less functionalities than the defined ones during the requirement analysis phase
PR2	Forecast during the project's schedule preparation an extra time slots before the major releases
PR3	Oranize different meetings with the external software company to define deadlines and follow the development step by step
PR4	Use of backup systems and version revision repositories
TR1	Try to build components that are independent among them (modularity of the system) with a particular focus on interfaces implementation
TR2	Keep sistematically under control the new methods of payment on the market
BR1	Exploit the time between the proposal and the confirmation of the measure to update our system
BR2	Make the administration part of the development process (meetings and presentations on RASD and DD)
BR3	Propose an alternative way of using the residual budget (application support, future releases, new functionalities)
BR4	First release with less functionalities than the defined ones during the requirement analysis phase
BR5	Exploit the economy of scale in the market of mobile data providers

EFFORT SPENT

Giorgio Marzorati

16/01/2017 - 2h
17/01/2017 - 3h
18/01/2017 - 2h
19/01/2017 - 4h
20/01/2017 - 2h
21/01/2017 - 4h
22/01/2017 - 3h

Aniel Rossi

16/01/2017 - 1h
17/01/2017 - 2.30h
18/01/2017 - 2h
19/01/2017 - 3h
20/01/2017 - 3h
21/01/2017 - 4h
22/01/2017 - 4h

Andrea Vaghi

16/01/2017 - 1.30h
17/01/2017 - 2h
18/01/2017 - 3h
19/01/2017 - 3h
20/01/2017 - 2h
21/01/2017 - 4h
22/01/2017 - 5h

CHANGELOG

V1.0 - First release