Project Plan Document - Software Engineering 2

PowerEnjoy

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Chapter 1

1 Function Points estimation

Function Points are units of measure for functional size and it is the major global functional sizing methodology. Function Points is a standard method for quantifying the software deliverable based upon the user view. In this document we are going to consider Internal Logical Files (ILF), External Logical Files (ELF), External Inquiries (EQ), External Outputs (EO) and Unadjusted Function Points (UFP). We apply Function Points to estimate the size and then COCOMO to estimate effort and cost.

Table 1: Internal Logical Files (ILF)

	Data Elements (DET)		
Record element types (RET)	1-19	20-50	51 or more
1	Low (7)	Low (7)	Average (10)
2 to 5	Low (7)	Average (10)	High (15)
6 or more	Average (10)	High (15)	High (15)

Table 2: External Logical Files (ELF)

	Data Elements (DET)		
Record element types (RET)	1-19	20-50	51 or more
1	Low (5)	Low (5)	Average (7)
2 to 5	Low (5)	Average (7)	High (10)
6 or more	Average (7)	High (10)	High (10)

Table 3: External Inputs (EI)

	Data Elements (DET)		
File Type Referenced (FTR)	1-4	5-15	Greater than 15
Less than 2	Low (3)	Low (3)	Average (4)
2	Low (3)	Average (4)	High (6)
Greater than 2	Average (4)	High (6)	High (6)

Table 4: External Inquiries (EQ)

	Data Elements (DET)		
File Type Referenced (FTR)	6-19	5-15	Greater than 19
Less than 2	Low (3)	Low (3)	Average (4)
2	Low (3)	Average (4)	High (6)
Greater than 2	Average (4)	High (6)	High (6)

Table 5: External Outputs (EO)

	Data Elements (DET)		
File Type Referenced (FTR)	6-19	5-15	Greater than 19
Less than 2	Low (4)	Low (4)	Average (5)
2	Low (4)	Average (5)	High (7)
Greater than 2	Average (5)	High (7)	High (7)

Table 6: Unadjusted Function Points (UFP)

Function Types	Simple	Medium	High
Internal Logic Files	7	10	15
External Logic Files	5	7	10
External Inputs	3	4	6
External Inquiries	3	4	6
External Outputs	4	5	7

1.1 Internal Logical Files (ILF)

ILFs (Internal Logical Files) are containers of logically related data maintained within an application boundary. In the case of the PowerEnjoy App we are developing at the moment we identify as such business data to be stored in our relational database tables such as:

- **(1)User**
- **(2)Car**
- **(3)Search**
- **(4)Reservation**
- **(5)Payment**
- **(6)Ride**
- **(7)Safe Area**

and rules/ control data expressed in a **(8)Server Configuration** file, an **(9)API usage details** file and a **(10)Terms Of Service** file. The function points associated to each of them are calculated taking into account their respective DETs and RETs, a shown in table 1.2; the number of DETs and RETs for the business data was inferred from the UML class diagram provided in the referenced DD, whereas in the case of the control data they were based on a generic estimation.

Table 7: Internal Logical Files

	Data Elements (DET)		
Record element types (RET)	1-19	20-50	51 or more
1	Low (7) **(1 - 7)**	Low (7)	Average (10)
2 to 5	Low (7)	Average (10)	High (15) **(8, 9, 10)**
6 or more	Average (10)	High (15)	High (15)

ILF= 2*7+3*15=59 FPs

1.2 External Logical Files (ELFs)

We classify external logical files as containers of logically related data referenced by the application yet maintained outside the application boundary. As stated in the referenced DD the project team plans to use Google Maps API to perform multiple tasks such as reverse geocoding or map marking, processes that will require a certain degree of interaction between our system and remote service provider when maps will have to be generated on the client side. According to the amount of data associated to such objects (consisting of many RETs and few DETs we classify maps files as mildly complex ones.

Table 8: External Logical Files

	Data Elements (DET)		
File Type Referenced (FTR)	1-19	20-50	51 or more
1	Low (5)	Low (5)	Average (7)
2 to 5	Low (5)	Average (7)	High (10)
6 or more	Average (7) (**Map Generation**)	High (10)	High (10)

External Logical Files=1*7=7 FPs

1.3 External Inputs

An external input is to be understood as the result of the processing of data coming from an external environment. Were gonna distinguish between information sent from the users to the system and information sent by the cars belonging to the service to the system, providing some degree of explanation for the less intuitive ones. We identified as members of the first group:

- **(1)User Registration**
- **(2)User Login**
- **(3)Password Retrieval**
- **(4)Reservation Request**
- **(5)Reservation Deletion**
- **(6)Car Opening Request**
- **(7)Damage Info Message**,

whereas

- **(8)RideBeginning Signal** (this signal gets sent when the engine is started: its purpose is to trigger the procedure managing of the beginning of a new ride)
- **(9)MSO Activation**
- **(10)Ride End Signal** (this signal encloses the basic price of the ride, that is, the one calculated on a time basis, the weight perceived by the sensors at the beginning of the ride, data regarding how many belts were fastened, info telling whether the car was left to charge at the end of the ride or not, its position, its battery level: its purpose is to trigger the payment calculation procedure)

belong to the second group.

User Login, Password Retrieval, Car Opening Request, Reservation Request and Reservation Deletion , Ride Beginning Signal and MSO Activation, all have a low level of complexity as they are all uniquely determined by a few fields (few DETs) and reference only text files. The complexity slightly increases in the case of the Damage Info Message as it references image format files as well, becoming average, and it further increases being describable as high in the case of User Registration and Ride End Signal as they contain lots of data elements and reference files of different type (in the case of the registration this happens because of the driving license photo attached to the form).

Table 9: External Inputs

	Data Elements (DET)		
File Type Referenced (FTR)	1-4	5-15	Greater than 15
Less than 2	Low (3)	Low (3) **(2, 3, 4, 5, 6, 8, 9)**	Average (4)
2	Low (3)	Average (4) **(7)**	High (6) **(1, 10)**
Greater than 2	Average (4)	High (6)	High (6)

External Inputs=7*3+1*4+2*6=37 FPs

1.4 External Inquiries

External Inquiries are elementary processes aimed to retrieve data from ILFs and ELFs. Within our project we classify as such:

- **(1)Payment Details Queries**
- **(2)Ride Histories Queries**
- **(3)Search Queries**
- **(4)Car Details Queries**

The third and the fourth being actually operations performed each time the user wishes to send certain external inputs. The complexity of the four of them is low for obvious reasons, with the exception of the third, and occasionally of the second, whose complexity can be considered average due to the high amount of DETs (sometimes, in the case of the second) involved.

Table 10: External Inquiries

	Data Elements (DET)		
File Type Referenced (FTR)	6-19	5-15	Greater than 19
Less than 2	Low (3) **(1, 4)**	Low (3)	Average (4) **(2, 3)**
2	Low (3)	Average (4)	High (6)
Greater than 2	Average (4)	High (6)	High (6)

External Inquiries=2*3+2*4=14 FPs

1.5 External Outputs

The external outputs can be conceived as the opposite of an external input, being the result of a communication of derived data from the inside to the outside. We counted among them:

- **(1)Notifications to user through app**
- **(2)Notifications to car**
- **(3)Registration confirmation mail**

We grouped the somewhat diverse notifications to the user in a single group as the complexity of them is homogeneously fairly low, since all of them are characterized by few DETs and a number of FTR equal to 1. The same goes for the notifications to car and the registration confirmation mail.

Table 11: External Outputs

	Data Elements (DET)		
File Type Referenced (FTR)	6-19	5-15	Greater than 19
Less than 2	Low (4) **(1,2,3)**	Low (4)	Average (5)
2	Low (4)	Average (5)	High (7)
Greater than 2	Average (5)	High (7)	High (7)

External Outputs =3*4=12 FPs

1.6 Overall Estimation

ILF + ELF + External Inputs + External Inquiries + External Output = 59 + 7 + 37 + 14 + 12 = 129

1.6.1 Lower Bound

SLOC = 129 * 46 = 5934

1.6.2 Upper Bound

SLOC = 129 * 67 = 8643

1.6.3 Average

SLOC = 7288

Chapter 2

2 Cocomo II estimation

The COCOMO model has been used to evaluate the effort for the PowerEnjoy implementation and the results have been compared with the time actually spent.

2.1 Scale Drivers

Precedentness: as no member of our team has ever worked on a project of this magnitude, nor in the market area associated to it, we consider the value of this parameter to be very low.
Development flexibility: nominal, since a neat description of the requirements was provided by the commissioner but a reasonable degree of freedom was granted during the development itself.
Risk Resolution: High, since a quite long share of the time allotted to the planning was dedicated to risk analysis and we are confident in its extensiveness
Team Cohesion: Very High. Though it was our first time working on a project together, an even distribution of the work that took into account the strengths of each member led to a great synergy.
Process Maturity: Very High, as we recognize ourselves in the description of the corresponding CMM level 4: It is characteristic of processes at this level that, using process metrics, management can effectively control the AS-IS process (e.g., for software development). In particular, management can identify ways to adjust and adapt the process to particular projects without measurable losses of quality or deviations from specifications. Process Capability is established from this level., (from Wikipedia)

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_j	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_j	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_j	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_j	5.48	4.38	3.29	2.19	1.10	0.00
PMAT	Level 1 Lower	Level 1 Upper	Level 2	Level 3	Level 4	Level 5
SF_j	7.80	6.24	4.68	3.12	1.56	0.00

Scale Drivers total:

SF=$\sum SF(i)$

$SF = 6.20 + 3.04 + 2.83 + 1.10 + 1.56 = 14.73$

$E = B + 0.01 * SF$

$B = 0.91$

$E = 0.91 + 0.01 * 14.73 = 1.0573$

2.2 Cost Drivers

2.2.0.1 RELY : Nominal. Since we have a backup and the MTTR was estimated to be short.

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

2.2.0.2 Database size : in the previously delivered RASD we estimated the primary memory size to be around 4GB. Given the upper and lower bound SLOC values above proposed, we derive a D/P ratio comprised between 462 and 674, that is, between 100 and 1000. Consequently we assigned a high rating level to database size.

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

2.2.0.3 Product complexity : Nominal. Similar applications already developed have this same value for this parameter.

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

2.2.0.4 Required reusability : Nominal. The client has not expressed any preference on the matter and we are not working on any parallel project using the same hardware or having the same client.

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

2.2.0.5 Documentation match to life cycle needs : High, as even future possible implementations were taken into consideration.

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

2.2.0.6 Execution Time constraint : Nominal. The complexity of PowerEnjoy will be fairly average and this will lead to an average usage of the CPU.

TIME Cost Driver						
TIME Descriptors			≤ 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

2.2.0.7 Storage Constraints : Nominal. We think our hardware i suited to our needs on this aspect.

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

2.2.0.8 Platform Volatility : Low. The hardware used is fairly up-to-date and the client does not plan to substitute it soon, and we expect compatibility with evolved versions of the client devices as well.

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

2.2.0.9 Analyst Capability : High. The real world implementation has been considered to be the final stage since the beginning of the project.

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

2.2.0.10 Programmer Capability : Nominal. We think our programming capabilities are average.

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

2.2.0.11 Application Experience : Low. We have never worked in a Java EE environment, nor have we programmed mobile apps.

APEX Cost Driver						
APEX Descriptors	$\leq$ 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

2.2.0.12 Platform Experience

: Low. Everything weve worked with til now was provided to us in a didactic context.

PLEX Cost Driver						
PLEX Descriptors	$\leq$ 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

2.2.0.13 Language and Tool Experience

: Low. We have never used before most of the tools required for this project.

LTEX Cost Driver						
LTEX Descriptors	$\leq$ 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

2.2.0.14 Personnel Continuity

: Very Low. Very little time is available to us to work on the project.

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

2.2.0.15 Usage of Software Tools
: High. We use strong and well-integrated tools.

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

2.2.0.16 Multisite development
: Nominal. High, we all live in the same city.

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

2.2.0.17 Required Development schedule
: High. We found the project tasks to be very time-consuming.

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

Overall, our results are expressed by the following table: EAF $= \prod C(i) EAF = 1*1.14*1*1*1.11*1*1*0.87*0.85*1*1.10*1*1*1.29*0.9*1*1 = 1.195$

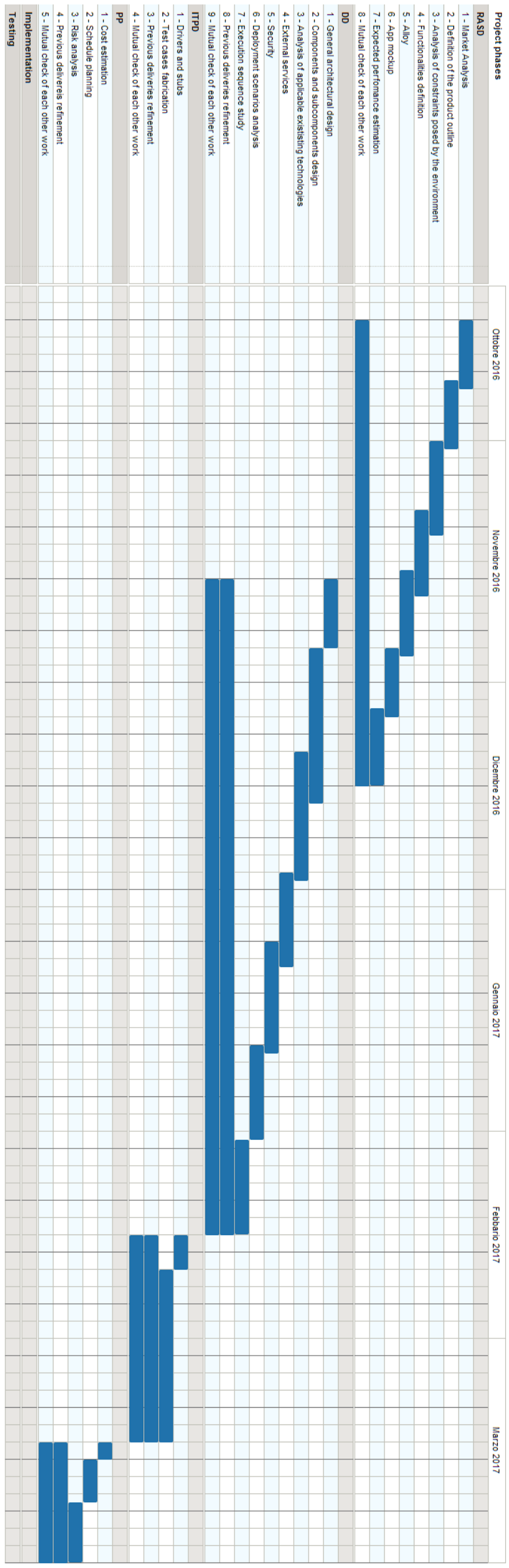
Effort equation
Effort = A * EAF * KSLOC^E
$A = 2.94$
$Effort = 2.94 * 1.195 * 7.288^{1.0573} = 28.7 person - months$

Schedule estimation
F = 0.28 * 0.2 * (E-B)
F = 0.28 + 0.2 * (1.0573-0.91) = 0.30946
Duration = 3.67 * Effort ^{F}
$Duration = 3.67 * 28.7^{0.30946} = 10.37 months$

Chapter 3

3 Task and schedule

Since we estimated our project to last around 10 months (see section 2) we defined a Gantt to describe the allocation of our temporal resources covering a span of about 10 months, starting from the 16th of October 2016 and ending around the 15th of August. With some obvious exceptions, such as development and testing, the time allotted to each activity is not really different from activity to activity and a certain degree of overlapping was planned to take place with the aim of optimization.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RASD
1 - Market Analysis
2 - Definition of the product outline
3 - Analysis of constraints posed by the environment
4 - Functionalities definition
5 - Alloy
6 - App mockup
7 - Expected perfomance estimation
8 - Mutual check of each other work
DD
1 - General architectural design
2 - Components and subcomponents design
3 - Analysis of applicable existating technologies
4 - External services
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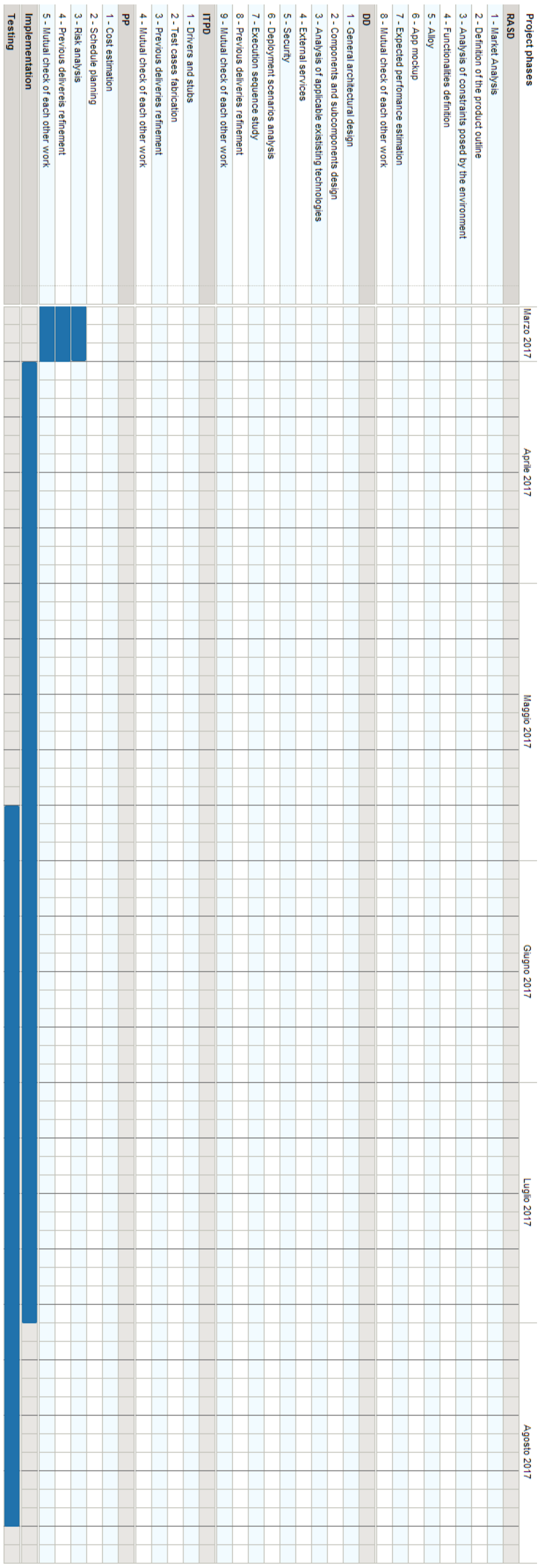
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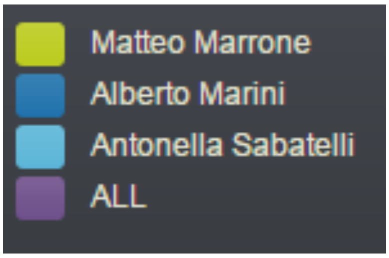
Chapter 4

4 Resource allocation to tasks

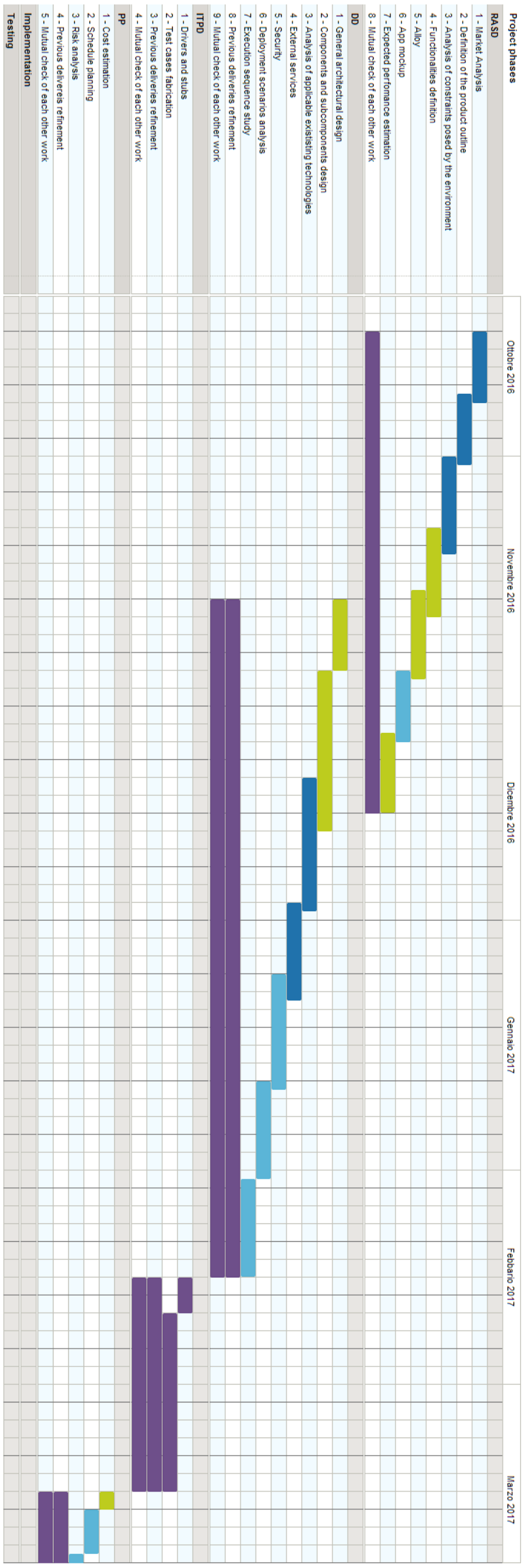
We decided to assign to each other responsibility for activities belonging to a tematically coherent core, resulting in:

- Alberto being in charge of Interaction with external entities technolgies and environment and product outline definition
- Matteo being in charge of study on Functional Requirements nature and feasibility and their architectural translation, cost and performance estimations
- Antonella being in charge of Organizational and presentation tasks and contextualization analysis

A mutual check of other members work is carried out at the end of each session



Legenda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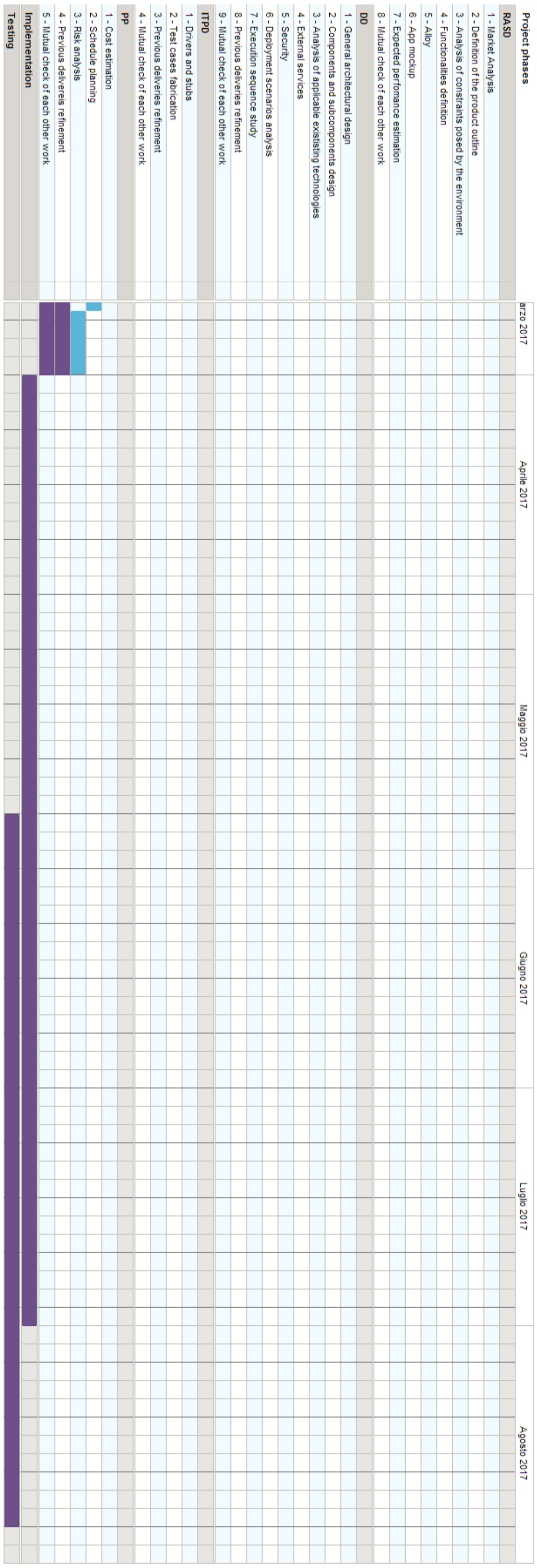
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Chapter 5

5 Risks associated with the project

Three different kinds of risks are to be taken into consideration: project ones, technical ones and business related ones. Lets start from the formers.

Typically unwanted developments which threaten the project plan and schedule often stem from a bad management of the human resources: lack of interaction between project planners, developers and QA staff can lead to misunderstandings regarding how certain issues should be tackled which result in delays of the deliveries. As this is generally a common occurrence with a not negligible impact on the project, roles and responsibilities of team members will be clearly defined from the beginning, and dates for public discussions over key aspects will be established. Communication with our stakeholders will be frequent as well in order to prevent the as likely occurrence of a change in requirements late in the project, which would be even more problematic. On the other hand we do not believe to have significantly overestimated the skills of our team, which lacks, as mentioned before, experience in the project field as well as in the use of tools and in the programming in a Java EE environment, but has a clear vision of the task and is confident that its capabilities measure up to it. In spite of this, being the effect of a possible miscalculation on our part disastrous, well hire additional knowledgeable stuff beforehand to be able to handle a crisis.

As for the technical risks, the cloud solution described in the DD here referenced that we plan to implement should counteract potential scalability issues, that is, avoiding the need for a later redesigning in the case of a sharp increase in the amount of users and thus requested resources, whereas the backup servers we planned to rent in Ireland should allow the application to stay afloat even in the unlikely case of prolonged downtime, whose effect would otherwise prove very taxing economically speaking. Finally, the firewalls separating the tiers of our three tiered architecture (again, see DD) were made to face cyber attacks from hostile agents such as hackers employed by rival companies: even if the first firewall were to fall, data theft should be prevented being the data still safely located behind the second firewall. A much more serious problem could be posed by the malfunctioning of Google Maps API on which we deeply rely on for operations such as reverse geocoding; but because of our great trust in the service, we believe in the probability of such an event being very low.

Quite a few car sharing applications already exist in Milan at the present time such as car2go or Enjoy, but none of them allow for the renting of electric cars. We do consequently believe that many of the risks usually associated with the economical and legal environment is very unlikely to take place as:

– a change in the regulations for the car sharing would have a serious impact on all the other active car sharing companies as well, that we assume are lobbying for the law to stay the same, so getting permission should be an easy task;

– both institutions and the public are currently characterized by an eco-friendly attitude, that makes the market analysis according to which theyd welcome such a service believable.

Chapter 6

6 Appendix

6.1 Documents

- Requirements Analysis and Specification Document (RASD) PowerEnjoy - *Marini, Marrone, Sabatelli*
- Design Document (DD) PowerEnjoy - *Marini, Marrone, Sabatelli*
- Integration Test Plan Document (ITPD) PowerEnjoy - *Marini, Marrone, Sabatelli*

6.2 Software and tool used

- TomsPlanner - *https://www.tomsplanner.it/*

6.3 Link

- CodeProject - *https://www.codeproject.com/Articles/18024/Calculating-Function-Points*

6.4 Hours of work

- Alberto Marini: 8 hours
- Matteo Marrone: 8 hours
- Antonella Sabatelli: 8 hours