



Politecnico di Milano

PowerEnjoy Service - Project Plan Document

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Version 1.1

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1 Introduction

1.1 Revision History

This section records all revisions to the Document.

Version	Date	Authors	Summary
1.1	22/01/16	Domenico Favaro, Caio Zuliani, Matheus Fim	Initial Release

1.2 Purpose and Scope

The Project Plan Document (PPD) is fundamental to organize the production of the System. The main purpose of the Document is to study the complexity of the System, analize the difficulties that can be present in any stage of its development and deployment and give an overall estimation of the effort and cost that can be needed up to the final release of the product. The analysis will be done in terms of size, time and budget needed. This is fundamental to present our stakeholders a preview before the start of production in case they need to do any project changing decision before hand.

The second part of the Document helps the organization of our production by giving time estimations for each step and managing the workload of our resources accordingly. This serves our production team to make any project management decision but also our development team to know how they can organize themselves to follow the schedule and if by any reason the schedule can't be followed, they can notify the production. This is fundamental to keep track of the project developing at every stage of production.

Finally we present possible risks that can arise during the development and for each risk we have identified a contingency plan to avoid or minimize the possibility of harming the production.

1.3 Definitions and Abbreviations

- **RASD:** Requirements And Specifications Document.
- **DD:** Design Document.
- **ITPD:** Integration Test Plan Document.
- **PPD:** Project Plan Document
- **App:** Application, refering to Web or Mobile App.
- **LOC:** Lines of Code, is a software metric used to measure the size of a computer program by counting the number of lines in the text of the program's source code.

- **FSM:** Functional Size Measurement, technique for measuring software in terms of the functionality it delivers.
- **FP:** Function Points. Unit of measurement used to express the amount of functionality for an information system. We'll be using them to compute a FSM of software.
- **VAF:** Value Adjustment Factor, used to adjust the Function Points estimation to the context of the project.
- **UFP:** Unadjusted Function Points, raw measurement of the total FP before the VAF is applied.
- **ILF:** Internal Logic Files, FP Function Type.
- **EIF:** External Interface Files, FP Function Type.
- **EI:** External Input, FP Function Type.
- **EO:** External Output, FP Function Type.
- **EQ:** External Inquiries, FP Function Type.
- **COCOMO:** Constructive Cost Model is a procedural software cost estimation model that we'll be using for this document.

For other concepts concerning the Service definition look in the **Glossary** section of the RASD, DD and ITPD.

1.4 Reference Documents

- Specification Document: Assignments AA 2016-2017.pdf
- PowerEnjoy Requirements And Specifications Document (RASD)
- PowerEnjoy Design Document (DD)
- PowerEnjoy Integration Test Plan Document (ITPD)
- Example Document - Project planning example document.pdf
- Project Planning Tools Documentation:
 - Function Points Table
 - <http://www.qsm.com/resources/function-point-languages-table>
 - COCOMO II - Manual
 - COCOMO Model Definition Manual
 - Project Management Software: Jira/Trello
 - <https://www.atlassian.com/software/jira>
 - <https://trello.com/>

2 Project Size, Cost and Effort Estimation

This section deals with the estimation of the expected size, cost and effort needed to develop the PowerEnjoy Service. For the size estimation we'll use the Function Points approach, once calculated we'll have an approximated size in LOC, and this measurement will be used later with COCOMO to predict the cost and amount of effort that will be required to develop the program.

2.1 Size Estimation: Function Points

The Function Mode approach is based in giving to each function needed in the code of the program a Category and a Complexity, once this is done, using Function Point Tables, a number of UFP is given to them. The VAF is then applied to the total of UFP. After the Total FP are calculated, it can then be translated into LOC. The Categories for FP are 5, and each has its own rating table for complexity according to the number of Data Elements present:

- Internal Logic Files (ILF):

Translate to the sets of data used and managed by the application.

- External Interface Files (EIF):

Similar to ILF set of data used by the application but generated and maintained by other applications.

Their complexity table is the same as ILF.

Record Types	1-5	6-19	> 19
0-1	Low	Low	Avg
2-3	Low	Avg	High
> 3	Avg	High	High

- External Inputs (EI):

Defined as operations to receive and manage data coming from the external environment.

File Types	1-4	5-15	>15
0-1	Low	Low	Avg
2	Low	Avg	High
> 2	Avg	High	High

- External Outputs (EO):

They are elementary operations that generates data for the external environment. It usually includes managing data from logic files

- External Inquiries (EQ):

Operation that involves both input and output, managing the data themselves without significant intervention from logic files.

Their complexity table is the same as EO.

File Types	1-5	6-19	>19
0-1	Low	Low	Avg
2-3	Low	Avg	High
> 3	Avg	High	High

To measure the complexity in FP, weights are given to each Function Type using the following table:

Function Type	Low	Avg	High
ILF	7	10	15
EIF	5	7	10
EI	3	4	6
EO	4	5	7
EQ	3	4	6

2.1.1 Internal Logic Files (ILF)

The PowerEnjoy System is organized to store a number of information to provide its functionalities. This information corresponds to the Entities that compose the System and will be managed by the Entity Beans in the Controllers (*see DD*). The ILF will then correspond to managing the information of these entities, which are:

- Cars: Cars will be stored in the system DB and replicated by persistent entities in the JEE2 environment for managing their status. Their information include CarID, Location, Status, BatteryStatus, if it's PluggedIn and Number of Passengers.

Car element count is 6 Fields.

- Users: Users tuples will be added by the System in the DB as well for the Registration feature, their attributes include UserID, if it's LoggedIn, UserName, Password, Email, DriverLicense, PaymentInfo and Location.

User count is 8 Fields.

- CRM: Although not directly added by the System, the loggedIn status of the CRMs is important for the Chat feature. It stores their CRMID, Password, Name, Email and if it's LoggedIn.

CRM count is 5 Fields.

- Reservations: Will link Users with Cars and will have a status to know whether the reservation is active or not. Their attributes are ReservationID, UserID, CarID, Status, ReservationTime, PickUp-Time.

Reservation elements count is 6 and references 2 Record Types.

- Rides: Once the Reservation has been confirmed a Ride is created, it refers to the Reservation and it tracks the use of the Car. It has RideID, ReservationID, CarID, Status, StartTime, EndTime, LocationPath.

Ride count is 7 and references 2 Record Types.

- Payments: When the Ride is finished it generates the Payment for the User to pay, it tracks the input made by the Car, Rides and Users and include also eventual Discounts and Extra Fees. It has PaymentID, RideID, TotalFee, PassengerDiscount, BatteryDiscount, PluggedInDiscount, LowBatteryFee, NoPlugNearFee.

Payment has 8 fields, references 1 Record Type.

- User Reports: Tracks any fault in the Service by Users or Cars and are handled by CRMs. They have the following fields: UserReportID, UserID, CRMID, CarID, Description.

User Report has 5 fields, references 3 Record Types.

- Locations: Although not managed by the System, the record of safe parking and plug in areas has to be kept and accessed by the LocationHelper. They have basic Info like LocationID, Latitude, Longitude, Type.

Locations have 4 fields.

Using the Complexity Table for the ILF we obtain the following.

ILF	Complexity	FP
Car Data	Low	7
User Data	Low	7
CRM Data	Low	7
Reservations	Avg	10
Rides	Avg	10
Payments	Low	7
User Reports	Low	7
Locations	Low	7

The Total UFP for ILF is **62**.

2.1.2 External Interface Files (EIF)

Our only external data source comes from Google Maps API, that offers the map service. It's used by the Location Helper and by the User and CRM Interface Components. It'll be accessed to retrieve the map interface find directions and show the location of the User and the Cars, as well as to retrieve walking and driving distances. The response is given in JSON and it provides numerous fields, however it doesn't reference any record types so we count only the number of parameters the response gives us.

EIF	Complexity	FP
API Map Retrieval	Avg	10
Direction Retrieval	Low	7

This gives us that the UFP for EIF are**17**.

2.1.3 External Inputs (EI)

The System relies on many interactions provided for the User to allow them the functionalities of the service, others involve or are shared by the CRM, we'll present all of them and give a complexity estimation for each one. They consist on a function activated by the User Input.

Shared:

- Login: Controls that the parameters are correct and logs in the User. Low Complexity.
- Logout: Signs out the connected User. Low Complexity.
- Reserve Car: Creates a new Reservation. It involves User, Car and Reservation. Complexity Average.

- Cancel Reservation: Cancels already created Reservation, interacts just with User and Reservation. Complexity Low.

Users:

- Register: Creates a new User and inserts his/her data in the system, has many fields but concerns only the User. Complexity is Low.
- Confirm Reservation: Unlocks the Car and starts a new Ride. Average Complexity.
- End Ride: Finishes current Ride and creates a new Payment. Complexity is Average.

CRM:

- Create User Report: Links User, CRM and Car in case of any issue. Average Complexity.
- Lock Car: Signals the Car to Lock. Low Complexity.
- Unlock Car: Low Complexity.

EI	Complexity	FP
Login	Low	3 x2
Logout	Low	3 x2
Register	Low	3
Reserve Car	Avg	4 x2
Cancel Reservation	Low	3 x2
Confirm Reservation	Avg	4
End Ride	Avg	4
Create User Report	Avg	4
Lock Car	Low	3
Unlock Car	Low	3

This gives us a Total UFP for the EI of **47**.

2.1.4 External Outputs (EO)

PowerEnjoy External Outputs are limited to sending Emails in case of User Registration to send the password, End of Ride to send the Payment and Time Limit over the Reservation to notify the User.

- Email Password: Involves just the User, Low Complexity.
- Email Payment: Sends Payment to User, Low Complexity.
- Send Late Reservation Notification: Notifies status of Reservation to User, Low Complexity.

EO	Complexity	FP
Notify Password	Low	4
Notify Payment	Low	4
Notify Reservation	Low	4

The Total UFP for the EO is **12**.

2.1.5 External Inquiries (EQ)

Similar to EI but sends a data response instead for the User. Basically a query of our system. PowerEnjoy EQ are:

- Search Nearby Cars: Gives a List of close by available Cars from the User Location. Has Low Complexity.
- Money Saving Option: Calculates the best Re-Charging station according to a standard Deviation Algorithm (*see DD*) and returns it to the User so a discount for the ride can be applied. Is of Average Complexity.
- Find Location: Gives a Path to arrive to the given Location.
- Find Cars: Returns all desired Cars for the CRM.
- Find Users: Returns all Users for the CRM.
- Find Reservations: Returns desired Reservations for the CRM.
- Find Rides: Returns all Rides for the CRM.
- Find Payments: Returns given Payments for the CRM.
- Find User Reports: Returns the User Reports for the CRM.

All the Finding Functions are considered to have Low Complexity.

EQ	Complexity	FP
Search Nearby Cars	Low	3
Money Saving Option	Avg	4
Find Location	Low	3
Find Cars	Low	3
Find Users	Low	3
Find Reservations	Low	3
Find Rides	Low	3
Find Payments	Low	3
Find User Reports	Low	3

This gives us a Total UFP for the EQ of **28**.

2.1.6 Overall Estimation

The following table shows the estimation results for each Function Type:

Function Type	Value
ILF	62
EIF	17
EI	47
EO	12
EQ	28

The added Total of UFP is **166**.

To have an idea of the size of our project in the code we translate the total of UFP to LOC using the Function Points Languages Table. Since we'll develop in the J2EE platform the measures are *Median* = 49, *High* = 67.

$$LowBoundLOC = 166 * 49 = \mathbf{8134}$$

$$HighBoundLOC = 166 * 67 = \mathbf{11122}$$

We can expect a software ranging from the size of 8200 to 11150 LOC.

2.2 Cost and Effort Estimation: COCOMO II

In the estimation of the cost and effort needed in the development of the PoweEnjoy Service it will be employed the COCOMO II.

2.2.1 Scale Drivers

In the evaluation of the Scale Drivers it was used the following table provided by the COCOMO II approach.

Scale Factors	Very Low	Low	Nominal	High	Very High	Extra High
PREC SFj	thoroughly unprecedented 6.20	largely unprecedented 4.96	somewhat unprecedented 3.72	generally familiar 2.48	largely familiar 1.42	thoroughly familiar 0.00
FLEX SFj	rigorous 5.07	occasional relaxation 4.05	some relaxation 3.04	general conformity 2.03	some conformity 1.01	general goals 0.00
RESL SFj	little (20%) 7.07	some (40%) 7.07	often (60%) 4.24	generally (75%) 2.83	mostly (90%) 1.41	full (100%) 0.00
TEAM SFj	very difficult interactions 5.48	some difficult interactions 4.38	basically cooperative interactions 3.29	largely cooperative 2.19	highly cooperative 1.10	seamless interactions 0.00
PMAT SFj	SW-CMM Level 1 Lower 7.80	SW-CMM Level 1 Upper 6.24	SW-CMM Level 2 4.86	SW-CMM Level 3 3.12	SW-CMM Level 3 1.56	SW-CMM Level 5 0.00

Analysing each point that compose the Scale Drivers:

- Precedentedness: It's about if the team/organization has a previous experience with this type of project. As the team don't have a large professional experience the item will be evaluate as low.
- Development flexibility: It's about the degree of flexibility in the development process. In this project there were several specifications for the system when becomes of functionalities thus the item will be evaluate as low.
- Risk resolution: It's about the risk analysis made. It was carried out several risk evaluations during the different parts of the project so the item will be evaluated as high.
- Team cohesion: It's the evaluation of how well the development team knows each other and work together. As the team has achieved

a excellent level of work since the division of the workload until the respect to the deadlines the item will be evaluated as very high.

- Process maturity: It's about the process maturity of the organization/team that is known as CMM. Considering that it's the team first project of this kind especially involving Java EE the item will be evaluated as Level 2. Moreover it's important to emphasize the proactive of the group even if it's not characteristic of the evaluation of Level 2 of CMM.

Thus the evaluation is:

Scale Driver	Factor	Value
Precededness (PREC)	Low	4.96
Risk resolution (RESL)	High	2.83
Team cohesion (TEAM)	Very high	1.10
Process maturity (PMAT)	Level 2	4.68
	Total	13.57

2.2.2 Cost Drivers

- Required Software Reliability (RELY): Being the measure of the "extent to which the software must perform its intended function over a period of time" the RELY will be set as high because as the main business is renting the cars through the app, an interruption of the service means directly financial losses. Moreover customers will expect a reliable service and any interruption can cause unnecessary instabilities.

Required Software Reliability (RELY)						
RELY Descriptors	Slight Inconvenience	Low, easily recoverable losses	Moderate, easily recoverable losses	High financial loss	Risk to human life	
Rating	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 (DATA): It's possible to estimate the database size according to the COCOMO II with the D/P ratio(DB bytes/LOC). Considering such variables as the tables, fields and their respective growing it was estimated a 4 GB database. As the LOC is the range

of 8200-11150 it is obtained a DP of the range of 386 to 524. Thus the DATA is evaluated as high.

Database size (DATA)						
DATA Descriptors		D/P<10	10 < D/P <100	100 < D/P <1000	D/P >1000	
Rating	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 (CPLX): In accordance with the COCOMO II standards for the evaluation the CPLX, whose is composed by five parameters, the rating level in our system was evaluated as very high. It was concluded that mostly because of the Computational Operations component due the fact that of our system has more complexes numerical analyses such as the partial differential equations used in the Standard Deviation Algorithm of the Money-Saving option.

Product complexity (CPLX)						
Rating	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 (RUSE): The main requirements of the project don't established the reuse of the code as a goal so the evaluation of this cost driver will be as nominal.

Required reusability (RUSE)						
RUSE Descriptions		None	Across project	Across program	Across product line	Across multiple product lines
Rating	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 (DOCUM): The DOCU evaluate how adapted the project's documentation is in relation with

its life-cycle needs. As the project documentation was up to date with the life-cycle needs the evaluation will be set as nominal.

Documentation match to life-cycle needs (DOCU)						
DOCU Descriptions	Many life-cycle needs uncovered	Some life-cycle needs uncovered	Right-sized to life-cycle needs	Excessive for lifecycle needs	Very excessive for life-cycle needs	
Rating	Very Low	Low	Nominal	High	Very High	Extra High
Effort multipliers	0.81	0.91	1.00	1.11	1.23	n/a

- Execution time constraint (TIME): Being the measure of the use of the CPU processing power, regarding the total capacity available it was estimated that as very high due the fact that the software has multiple functions such as keeping track of the rides, cars and users requests. Furthermore the system need to be available in a full regime because of it's real time nature.

Execution time constraint (TIME)						
TIME Descriptions			<= 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	Very Low	Low	Nominal	High	Very High	Extra High
Effort multipliers	n/a	n/a	1.00	1.11	1.29	1.63

- Storage constraint (STOR): The STOR evaluates the main storage constraint that is imposed in one software. As this constraint is considered as of easily solution nowadays, this cost driver was set as nominal.

Storage constraint (STOR)						
STOR Descriptions			<= 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	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 (PVOL): The PVOL measure the volatility in terms of updates in the system per time. As the system is structured in 3 tiers that are Client Tier(Web App, Mobile App, Car), Server Tier (Java EE Web and Application Server), EIS Tier (DataBase Server) the PVOL will be evaluated as nominal because it's not expected major changes when becomes of the Server and EIS tier. But it is expected that the Client Tier will required changes due the volatility in the smartphone market where there are several new occurrences such as system updates and launching of new devices in a short period of time.

Platform Volatility (PVOL)						
PVOL Descriptions		Major change every 12 month, minor change every 1 month.	Major change every 6 month, minor change every 2 weeks.	Major change every 2 month, minor change every 1 week.	Major change every 2 weeks, minor change every 2 days.	
Rating	Very Low	Low	Nominal	High	Very High	Extra High
Effort multipliers	n/a	0.87	1.00	1.15	1.30	n/a

- Analyst Capability (ACAP) : The ACAP measure the level of ability, efficiency and communication skills of an Analyst. It will be evaluated as high due the fact that the team has developed an extensive work of analyses of how to bring into the software the functions that were required by the stakeholder.

Analyst Capability (ACAP)						
ACAP Descriptions	15th percentile	35th percentile	55th percentile	75th percentile	95th percentile	
Rating	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 (PCAP): The PCAP is based on the measure of the capacity of the programmers as a team estimating their ability, cooperation and communication. As the project was not implemented we estimated this evaluation having as a parameter the work developed until now and with the personal abilities of the components of the team. Therefore the PCAP will be set as high.

Programmer Capability (PCAP)						
PCAP Descriptions	15th percentile	35th percentile	55th percentile	75th percentile	90th percentile	
Rating	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 (PCON): The personnel continuity factor (PCON) measures the annual personnel turnover. As in the stipulated time of the project the group did no have turnovers the PCON will be evaluated as very high.

Personnel Continuity (PCON)						
PCON Descriptions	48% per year	24% per year	12% per year	6% per year	3% per year	
Rating	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 (APEX) :The APEX evaluated the experi-

ence of the team with the application. As it is the first application of the king that the team develop it will be evaluated as low .

Application Experience (APEX)						
APEX De-scrip-tions	<= 2 months	6 months	1 year	3 year	6 year	
Rating	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 (PLEX) : Being the rating of the experience of the team with the platform, in the case Java EE, the PLEX will be evaluated as low although the team has had a previous experience with Java especially the SE, databases.

Platform Experience (PLEX)						
PLEX De-scrip-tions	<= 2 months	6 months	1 year	3 year	6 year	
Rating	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 (LTEX): The LTEX measure the experience of the team with the language and tools used for the development of the project. Being the first time of the group working with Java EE the evaluation will be low. Although the members of the group have some previous experience with java and databases.

Language and Tool Experience (LTEX)						
LTEX De-scrip-tions	<= 2 months	6 months	1 year	3 year	6 year	
Rating	Very Low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.20	1.09	1.00	0.91	0.84	n/a

- Use of Software Tools (TOOL): The TOOL try to scale the use of software tools during the developing of software. Due the availability a strong platform for the development of the project the TOOL will be evaluated as high

Use of Software Tools (TOOL)						
TOOL Descriptions	Edit, code, debug	Simple, front-end, backend CASE, little integration	Basic lifecycle tools, moderately integrated.	Strong, mature lifecycle tools, moderately integrated	Strong, mature, proactive lifecycle tools, well integrated with processes, methods, reuse.	
Rating	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 (SITE): The SITE try to evaluate the effects of the multisite development in a project. The two main factor of this cost driver are site collocation and communication support. The team is located in the same city and depends upon the communication via social media. Thus the SITE evaluation will be high.

Multisite development (SITE)						
SITE Collo-cation	International	Multi-city and multi-company	Multi-city or multi-company	Same city or metro area	Same building or complex	Fully collocated
SITE Communications	Some phone, mail.	Individual phone, FAX.	Narrow-band email.	Wide-band electronic communication.	Wide-band electronic communication.	Interactive multi-media.
Rating	Very Low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.22	1.09	1.00	0.93	0.86	n/a

- Required development schedule (SCED): Being the rate of schedule stretch-out or acceleration regarding a nominal amount of effort in the development of a project the SCED will be evaluated as nominal due the fact that the efforts in the development of the project were well distributed among the members of the group given the corresponding allocated time.

Required development schedule (SCED)						
SCED De-scrip-tions	75% of nominal	85% of nominal	100% of nominal	130% of nominal	160% of nominal	
Rating	Very Low	Low	Nominal	High	Very High	Extra High
Effort multipliers	1.43	1.14	1.00	1.00	1.00	n/a

Therefore the results of the previous analyzes are expressed in the following table:

Cost Drive	Factor	Value
Required Software Reliability (RELY)	High	1.10
Database size (DATA)	High	1.14
Product complexity (CPLX)	Very High	1.34
Required reusability (RUSE)	Nominal	1.00
Documentation match to life-cycle needs (DOCU)	Nominal	1.00
Execution time constraint (TIME)	Very High	1.29
Storage constraint (STOR)	Nominal	1.00
Platform Volatility (PVOL)	Nominal	1.00
Analyst Capability (ACAP)	High	0.85
Programmer Capability (PCAP)	High	0.88
Personnel Continuity (PCON)	Very High	0.81
Application Experience (APEX)	Low	1.10
Platform Experience (PLEX)	Low	1.09
Language and Tool Experience (LTEX)	Low	1.09
Use of Software Tools (TOOL)	High	0.90
Multisite development (SITE)	High	0.93
Required development schedule (SCED)	Nominal	1.00
Total		1.4366

2.2.3 Effort Equation

In order to obtain the effort estimation with units Person-Months(PM) it will be need the following formulas:

$$Effort = A * EAF * KSLOC^E$$

$$E = B + 0.01 * \sum_{i=1}^4 SF[i]$$

where the parameters are:

$$A=2.94$$

$$B=0.91$$

$$EAF = \text{Product of all cost drivers} = 1.4336$$

$$E = \text{Exponent derived from the scale drivers} = 0.91 + 0.01 * 13.57 = 1.0457$$

$$\text{LowBoundKSLOC}=8.134$$

$$\text{HighBoundKSLOC}=11.122$$

Thus for the lower bound of the KSLOC was obtained: and for the

$$Effort = 2.94 * 1.4336 * 8.134^{1.0457} = 37.73PM \approx 38PM$$

high bound of the KSLOC:

$$Effort = 2.94 * 1.4336 * 11.122^{1.0457} = 52.33PM \approx 52PM$$

2.2.4 Schedule Estimation

In terms of the schedule the following formulas will be need:

$$Duration = 3.67 * Effort^F$$

$$F = 0.28 + 0.2 * (E - B) = 0.28 + 0.2(1.0457 - 0.91) = 0.30714$$

The schedule considering the lower boud is:

$$Duration = 3.67 * 37.73^{0.30714} = 11.19months$$

and the schedule considering the higher bound is:

$$Duration = 3.67 * 52.33^{0.30714} = 12.37months$$

3 Project Plan Schedule

This section illustrate a high level view of the organization of the project schedule, showing the main phases of the production process. Should it be implemented, more detailed schedules for each of the phases and each of the sprints organized inside them will be defined during the project for better internal organization.

Due to the size of the Schedule Graph we separated in 4 different sections, RASD, DD, Development and Deployment.

Task Name	Oct 23							Oct 30							Nov 6							Nov 13						
	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
1 RASD																											RASD	
2 Meeting with Stakeholders								Meeting with Stakeholders																				
3 Identification of Requirements								Identification of Requirements																				
4 Goals Definition								Goals Definition																				
5 Scenarios Definition								Scenarios Definition																				
6 Use Cases Definition								Use Cases Definition																				
7 Meeting with Stakeholders								Meeting with Stakeholders																				
8 UML Diagrams Study								UML Diagrams Study																				
9 Sequence Diagrams								Sequence Diagrams																				
10 Class Definition								Class Definition																				
11 Initial UI Drafts								Initial UI Drafts																				
12 Function Definitions								Function Definitions																				
13 Initial Size and Cost Estimation								Initial Size and Cost Estimation																				
14 Meeting with Stakeholders								Meeting with Stakeholders																				
15 Document Refinement								Document Refinement																				
16 Document Approval by StakeHolders								Document Approval by StakeHolders																				
17 Project Presentation, Legal Confirmation								Project Presentation, Legal Confirmation																				

Task Name	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	S	M	T	W	T	F	S
DD																						DD
Meeting with Stakeholders									Meeting with Stakeholders													
High Level Component Architecture									High Level Component Architecture													
Main Components Definition									Main Components Definition													
External Tools Study									External Tools Study													
Component Overview									Component Overview													
Deployment View									Deployment View													
Runtime View									Runtime View													
Interfaces Definition									Interfaces Definition													
Architecture Review									Architecture Review													
Meeting with Stakeholders									Meeting with Stakeholders													
Refinement of Components									Refinement of Components													
Subsystems Definition									Subsystems Definition													
Algorithms Design									Algorithms Design													
UI Mockups Refinement									UI Mockups Refinement													
Meeting with Stakeholders									Meeting with Stakeholders													
Requirements Traceability									Requirements Traceability													
Final Architecture Design									Final Architecture Design													
Final Refinements									Final Refinements													
Design Approval by Stakeholders									Design Approval by Stakeholders													

Task Name	Oct 30	Nov 6	Nov 13	Nov 20	Nov 27	Dec 4	Dec 11	Dec 18	Dec 25	Jan 1	Jan 8	Jan 15	Jan 22
Development													
J2EE Study					J2EE Study								
Test Tools Study					Test Tools Study								
External Tools Acquisition						External Tools Acquisition							
Components Implementation						Components Implementation							
Location Helper						Location Helper							
Email Helper						Email Helper							
Car Controller						Car Controller							
Payment Controller						Payment Controller							
Ride Controller						Ride Controller							
Reservation Controller						Reservation Controller							
User Report Controller						User Report Controller							
User Controller						User Controller							
CRM Controller						CRM Controller							
User Component						User Component							
CRM Component						CRM Component							
Car Component						Car Component							
Chat Service						Chat Service							
Code Inspection													
Unit Testing													
Component Integration													
Integration Testing													
System Testing													
System Demonstration													
QC Refinement													
Stakeholders Presentation													
QC Refinement													
Document Revision													
Final Stakeholders Presentation													

Task Name													
	Jan 29	Feb 5	Feb 12	Feb 19	Feb 26	Mar 5	Mar 12	Mar 19	Mar 26	Apr 2	Apr 9	Apr 16	Apr 23
38 Development													Development
39 J2EE Study													
40 Test Tools Study													
41 External Tools Acquisition													
42 Components Implementation													
43 Location Helper													
44 Email Helper													
45 Car Controller													
46 Payment Controller													
47 Ride Controller													
48 Reservation Controller													
49 User Report Controller													
50 User Controller													
51 CRM Controller													
52 User Component													
53 CRM Component													
54 Car Component													
55 Chat Service													
56 Code Inspection		Code Inspection											
57 Unit Testing			Unit Testing										
58 Component Integration				Component Integration									
59 Integration Testing					Integration Testing								
60 System Testing						System Testing							
61 System Demonstration							System Demonstration						
62 QC Refinement								QC Refinement					
63 Stakeholders Presentation									Stakeholders Presentation				
64 QC Refinement										QC Refinement			
65 Document Revision											Document Revis		
66 Final Stakeholders Presentation												Final Stakehol	

Task Name													
	Apr 2	Apr 9	Apr 16	Apr 23	Apr 30	May 7	May 14	May 21	May 28	Jun 4	Jun 11	Jun 18	Jun 25
67 Deployment													Deployment
68 System Deployment				System Deployment									
69 CRM Demo and Training					CRM Demo and Training								
70 Car Systems Distribution						Car Systems Distribution							
71 Re-Charging Station Registration							Re-Charging Station Registration						
72 Field Testing								Field Testing					
73 Field Preparations									Field Preparations				
74 System Start										System Start			

4 Resource Allocation



Task Name	Dec												Jan						Feb						Mar					
	Dec 4	Dec 11	Dec 18	Dec 25	Jan 1	Jan 8	Jan 15	Jan 22	Jan 29	Feb 5	Feb 12	Feb 19	Feb 26	Mar 5	Mar 12	Mar 19	Mar 26													
1 RASD																														
18 DD																														
38 Development																														
67 Deployment																														
74 System Start																														
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76 Matheus Fin																														
77 Meeting with Stakeholders																														
78 Identification of Requirements																														
79 Goals Definition																														
80 Scenarios Definition																														
81 Use Cases Definition																														
82 Meeting with Stakeholders																														
83 UML Diagrams Study																														
84 Sequence Diagrams																														
85 Class Definition																														
86 Initial UI Drafts																														
87 Function Definitions																														
88 Initial Size and Cost Estimation																														
89 Meeting with Stakeholders																														
90 Document Refinement																														
91 Project Presentation, Legal Confirmation																														
92 Meeting with Stakeholders																														
93 High Level Component Architecture																														
94 Main Components Definition																														
95 External Tools Study																														
96 Component Overview																														
97 Deployment View																														
98 Runtime View																														
99 Interfaces Definition																														
100 Architecture Review																														
101 Meeting with Stakeholders																														
102 Refinement of Components																														
103 Subsystems Definition																														
104 Algorithms Design																														
105 UI Mockups Refinement																														
106 Meeting with Stakeholders																														
107 Requirements Traceability																														
108 Final Architecture Design																														
109 Final Refinements																														
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111 Test Tools Study																														
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114 Car Controller																														
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117 Reservation Controller																														
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124 Chat Service																														
125 Code Inspection																														
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128 Integration Testing																														
129 System Testing																														
130 System Demonstration																														
131 QC Refinement																														
132 Stakeholders Presentation																														
133 QC Refinement																														
134 Document Revision																														
135 Final Stakeholders Presentation																														
136 System Deployment																														
137 CRM Demo and Training																														
138 Re-Charging Station Registration																														
139 Field Testing																														
140 Field Preparations																														

Task Name	Feb	Mar 5	Mar 12	Mar 19	Mar 26	Apr 2	Apr 9	Apr 16	Apr 23	Apr 30	May 7	May 14	May 21	May 28	Jun 4	Jun 11	Jun 18	Jun 25
1 RASD																		
18 DD																		
38 Development																		
67 Deployment																		
74 System Start																		
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76 Matheus Fim																		
77 Meeting with Stakeholders																		
78 Identification of Requirements																		
79 Goals Definition																		
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83 UML Diagrams Study																		
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86 Initial UI Drafts																		
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88 Initial Size and Cost Estimation																		
89 Meeting with Stakeholders																		
90 Document Refinement																		
91 Project Presentation, Legal Confirmation																		
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93 High Level Component Architecture																		
94 Main Components Definition																		
95 External Tools Study																		
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99 Interfaces Definition																		
100 Architecture Review																		
101 Meeting with Stakeholders																		
102 Refinement of Components																		
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106 Meeting with Stakeholders																		
107 Requirements Traceability																		
108 Final Architecture Design																		
109 Final Refinements																		
110 J2EE Study																		
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122 CRM Component																		
123 Car Component																		
124 Chat Service																		
125 Code Inspection																		
126 Unit Testing																		
127 Component Integration																		
128 Integration Testing																		
129 System Testing																		
130 System Demonstration																		
131 QC Refinement																		
132 Stakeholders Presentation																		
133 QC Refinement																		
134 Document Revision																		
135 Final Stakeholders Presentation																		
136 System Deployment																		
137 CRM Demo and Training																		
138 Re-Charging Station Registration																		
139 Field Testing																		
140 Field Preparations																		

Task Name	Oct	Oct	Oct	Oct	Oct	Nov	Nov	Nov	Nov	Dec	Dec	Dec	Jan	Jan	Jan	Jan	Jan
	Oct 2	Oct 9	Oct 16	Oct 23	Oct 30	Nov 6	Nov 13	Nov 20	Nov 27	Dec 4	Dec 11	Dec 18	Dec 25	Jan 1	Jan 8	Jan 15	Jan 22
141 Caio Zuliani																	
142 Meeting with Stakeholders						Meeting with Stakeholders											
143 Identification of Requirements						Identification of Requirements											
144 Goals Definition						Goals Definition											
145 Scenarios Definition						Scenarios Definition											
146 Use Cases Definition						Use Cases Definition											
147 Meeting with Stakeholders						Meeting with Stakeholders											
148 UML Diagrams Study						UML Diagrams Study											
149 Sequence Diagrams						Sequence Diagrams											
150 Class Definition						Class Definition											
151 Initial UI Drafts						Initial UI Drafts											
152 Function Definitions						Function Definitions											
153 Initial Size and Cost Estimation						Initial Size and Cost Estimation											
154 Meeting with Stakeholders						Meeting with Stakeholders											
155 Document Refinement						Document Refinement											
156 Project Presentation, Legal Confirmation						Project Presentation, Legal Confirmation											
157 Meeting with Stakeholders						Meeting with Stakeholders											
158 High Level Component Architecture						High Level Component Architecture											
159 Main Components Definition						Main Components Definition											
160 External Tools Study						External Tools Study											
161 Component Overview						Component Overview											
162 Deployment View						Deployment View											
163 Runtime View						Runtime View											
164 Interfaces Definition						Interfaces Definition											
165 Architecture Review						Architecture Review											
166 Meeting with Stakeholders						Meeting with Stakeholders											
167 Refinement of Components						Refinement of Components											
168 Subsystems Definition						Subsystems Definition											
169 Algorithms Design						Algorithms Design											
170 UI Mockups Refinement						UI Mockups Refinement											
171 Meeting with Stakeholders						Meeting with Stakeholders											
172 Requirements Traceability						Requirements Traceability											
173 Final Architecture Design						Final Architecture Design											
174 Final Refinements						Final Refinements											
175 J2EE Study						J2EE Study											
176 Test Tools Study						Test Tools Study											
177 External Tools Acquisition						External Tools Acquisition											
178 Location Helper						Location Helper											
179 Email Helper						Email Helper											
180 Car Controller						Car Controller											
181 Payment Controller						Payment Controller											
182 Ride Controller						Ride Controller											
183 Reservation Controller						Reservation Controller											
184 User Report Controller						User Report Controller											
185 User Controller						User Controller											
186 CRM Controller						CRM Controller											
187 User Component						User Component											
188 CRM Component						CRM Component											
189 Car Component						Car Component											
190 Chat Service						Chat Service											
191 Code Inspection																	
192 Unit Testing																	
193 Component Integration																	
194 Integration Testing																	
195 System Testing																	
196 System Demonstration																	
197 QC Refinement																	
198 Stakeholders Presentation																	
199 QC Refinement																	
200 Document Revision																	
201 Final Stakeholders Presentation																	
202 System Deployment																	
203 Car Systems Distribution																	
204 Re-Charging Station Registration																	

Task Name	Dec				Jan				Feb				Mar				
	Dec 4	Dec 11	Dec 18	Dec 25	Jan 1	Jan 8	Jan 15	Jan 22	Jan 29	Feb 5	Feb 12	Feb 19	Feb 26	Mar 5	Mar 12	Mar 19	Mar 26
141 Calo Zuliani																	
142 Meeting with Stakeholders																	
143 Identification of Requirements																	
144 Goals Definition																	
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158 High Level Component Architecture																	
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160 External Tools Study																	
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162 Deployment View																	
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164 Interfaces Definition	Interfaces Definition																
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166 Meeting with Stakeholders	Meeting with Stakeholders																
167 Refinement of Components	Refinement of Components																
168 Subsystems Definition	Subsystems Definition																
169 Algorithms Design	Algorithms Design																
170 UI Mockups Refinement	UI Mockups Refinement																
171 Meeting with Stakeholders	Meeting with Stakeholders																
172 Requirements Traceability	Requirements Traceability																
173 Final Architecture Design	Final Architecture Design																
174 Final Refinements	Final Refinements																
175 J2EE Study																	
176 Test Tools Study																	
177 External Tools Acquisition	External Tools Acquisition																
178 Location Helper	Location Helper																
179 Email Helper	Email Helper																
180 Car Controller	Car Controller																
181 Payment Controller	Payment Controller																
182 Ride Controller	Ride Controller																
183 Reservation Controller	Reservation Controller																
184 User Report Controller	User Report Controller																
185 User Controller	User Controller																
186 CRM Controller	CRM Controller																
187 User Component	User Component																
188 CRM Component	CRM Component																
189 Car Component	Car Component																
190 Chat Service	Chat Service																
191 Code Inspection	Code Inspection																
192 Unit Testing	Unit Testing																
193 Component Integration	Component Integration																
194 Integration Testing	Integration Testing																
195 System Testing																	
196 System Demonstration																	
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198 Stakeholders Presentation																	
199 QC Refinement																	
200 Document Revision																	

Task Name	Timeline														Owner			
	Feb	Mar 5	Mar 12	Mar 19	Mar 26	Apr 2	Apr 9	Apr 16	Apr 23	Apr 30	May 7	May 14	May 21	May 28	Jun 4	Jun 11	Jun 18	Jun 25
141 [Caio Zuliani]															Caio Zuliani			
142 Meeting with Stakeholders																		
143 Identification of Requirements																		
144 Goals Definition																		
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148 UML Diagrams Study																		
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201 Final Stakeholders Presentation																		
202 System Deployment																		
203 Car Systems Distribution																		
204 Re-Charging Station Registration																		
205 Field Testing																		
206 Field Preparations																		

Task Name	Oct 2	Oct 9	Oct 16	Oct 23	Oct 30	Nov 6	Nov 13	Nov 20	Nov 27	Dec 4	Dec 11	Dec 18	Dec 25	Jan 1	Jan 8	Jan 15	Jan 22	Ja
207 Domenico Favaro																		
208 Meeting with Stakeholders						Meeting with Stakeholders												
209 Identification of Requirements						Identification of Requirements												
210 Goals Definition						Goals Definition												
211 Scenarios Definition						Scenarios Definition												
212 Use Cases Definition						Use Cases Definition												
213 Meeting with Stakeholders						Meeting with Stakeholders												
214 UML Diagrams Study						UML Diagrams Study												
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216 Class Definition						Class Definition												
217 Initial UI Drafts						Initial UI Drafts												
218 Function Definitions						Function Definitions												
219 Initial Size and Cost Estimation						Initial Size and Cost Estimation												
220 Meeting with Stakeholders						Meeting with Stakeholders												
221 Document Refinement						Document Refinement												
222 Project Presentation, Legal Confirmation						Project Presentation, Legal Confirmation												
223 Meeting with Stakeholders						Meeting with Stakeholders												
224 High Level Component Architecture						High Level Component Architecture												
225 Main Components Definition						Main Components Definition												
226 External Tools Study						External Tools Study												
227 Component Overview						Component Overview												
228 Deployment View						Deployment View												
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230 Interfaces Definition						Interfaces Definition												
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233 Refinement of Components						Refinement of Components												
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236 UI Mockups Refinement						UI Mockups Refinement												
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239 Final Architecture Design						Final Architecture Design												
240 Final Refinements						Final Refinements												
241 J2EE Study						J2EE Study												
242 Test Tools Study						Test Tools Study												
243 External Tools Acquisition						External Tools Acquisition												
244 Location Helper						Location Helper												
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248 Ride Controller						Ride Controller												
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250 User Report Controller						User Report Controller												
251 User Controller						User Controller												
252 CRM Controller						CRM Controller												
253 User Component						User Component												
254 CRM Component						CRM Component												
255 Car Component						Car Component												
256 Chat Service						Chat Service												
257 Code Inspection						Code Inspection												
258 Unit Testing						Unit Testing												
259 Component Integration						Component Integration												
260 Integration Testing						Integration Testing												
261 System Testing						System Testing												
262 System Demonstration						System Demonstration												
263 QC Refinement						QC Refinement												
264 Stakeholders Presentation						Stakeholders Presentation												
265 CC Refinement						CC Refinement												
266 Document Revision						Document Revision												
267 Final Stakeholders Presentation						Final Stakeholders Presentation												
268 System Deployment						System Deployment												
269 CRM Demo and Training						CRM Demo and Training												
270 Car Systems Distribution						Car Systems Distribution												
271 Re-Charging Station Registration						Re-Charging Station Registration												
272 Field Testing						Field Testing												
273 Field Preparations						Field Preparations												

Task Name	Dec	Jan	Feb	Mar													
	Dec 4	Dec 11	Dec 18	Dec 25	Jan 1	Jan 8	Jan 15	Jan 22	Jan 29	Feb 5	Feb 12	Feb 19	Feb 26	Mar 5	Mar 12	Mar 19	Mar 26
207 [em] Domenico Favaro																	
208 Meeting with Stakeholders																	
209 Identification of Requirements																	
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232 Meeting with Stakeholders	Meeting with Stakeholders																
233 Refinement of Components	Refinement of Components																
234 Subsystems Definition	Subsystems Definition																
235 Algorithms Design	Algorithms Design																
236 UI Mockups Refinement	UI Mockups Refinement																
237 Meeting with Stakeholders	Meeting with Stakeholders																
238 Requirements Traceability	Requirements Traceability																
239 Final Architecture Design	Final Architecture Design																
240 Final Refinements	Final Refinements																
241 J2EE Study																	
242 Test Tools Study																	
243 External Tools Acquisition	External Tools Acquisition																
244 Location Helper	Location Helper																
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248 Ride Controller	Ride Controller																
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258 Unit Testing	Unit Testing																
259 Integration Testing	Integration Testing																
260 System Testing	System Testing																
261 System Demonstration	System Demonstration																
262 QC Refinement	QC Refinement																
263 Stakeholders Presentation	Stakeholders Presentation																
264 QC Refinement	QC Refinement																
265 Document Revision	Document Revision																
266 Final Stakeholders Presentation	Final Stakeholders Presentation																
267 System Deployment	System Deployment																
268 CRM Demo and Training	CRM Demo and Training																
269 Car Systems Distribution	Car Systems Distribution																
270 Re-Charging Station Registration	Re-Charging Station Registration																
271 Field Testing	Field Testing																
272 Field Preparations	Field Preparations																

Task Name													Domenico Favaro						
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207 Domenico Favaro																			
208 Meeting with Stakeholders																			
209 Identification of Requirements																			
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256 Chat Service																			
257 Code Inspection																			
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259 Component Integration																			
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266 Document Revision																			
267 Final Stakeholders Presentation																			
268 System Deployment																			
269 CRM Demo and Training																			
270 Car Systems Distribution																			
271 Re-Charging Station Registration																			
272 Field Testing																			
273 Field Preparations																			

5 Risk Management

This section aims at defining at an early stage what are the risks regarding this project, and by doing so, define what are the indicators of a risk materializing itself and the actions that should be taken. The risk management is a continuous process. Therefore, the following are guidelines that should be upgraded as the project progresses.

A common risks computer softwares face are that the delivered product is not in total accordance with the vision the client had, and thus does not fully attend the functionalities proposed. Or it may happen that the users and CRM staff are not pleased with the final version, resulting in some resistance to use the product and bad public acceptance. This type of risks are managed by involving both the client and the users into early stages of development. The client should participate in the requirement analysis, design, and be presented with constant reports and demonstrations of new functionalities, while the users need to be brought to test functionalities and interfaces every time it is possible, especially before they are final versions. The same is the case for the CRM team, apart from bringing them closer to the development, it is important to also provide training on how to use the final system, to ensure a low resistance to the software and increase the quality of the deployed service.

A predictable risk is a turnover in the client situation, demanding the decrease of resources or the project to be completed in less time. Such scenario may arise for different reason, as example, a competitor company announces that will release a similar service before PowerEnjoy or a financial crisis is causing the client to invest less money than expected. Those are completely different problems, but the overall guidelines are the same: promote a negotiation with the client, explaining the consequences of this action. If, however, it is really necessary to do such change, establish a plan of incremental deployments, being the first one on the date set or using the money provided with limited functionalities, and make incremental deliveries as time or money become available.

There are risks that represent greater problems as they cannot have clear contingency plans beforehand, such are the cases of legislation changes regarding the car sharing service in Italy. New laws concerning the parking spots and other traffic rules can cause significantly changes in the product. And, although this scenario is hard to predict, such changes don't come unnoticed, and by maintaining a good relationship with the city hall is possible to be aware with enough antecedence to adapt the service.

The deployed system, inevitably will depend on external solutions, as the cloud infrastructure and the mapping service. For the first, it is necessary to do a complete market research before choosing the company that will

provide the service, some key points are: a clear contract, defining what are the changes that can happen in the cloud infrastructure and binding them to send a notice before doing so; the structure used should be as generic as possible, predicting that in case of having to migrate, the damage is minimized; the line between price and quality here should be pending to the quality side. As for the second, the used solution is well-known and widely accepted, Google maps. For this reason, instability or changes in the service are not a high concern, nonetheless, in case it does not meet the company needs anymore, a replacement should already be kept in background, with some preliminary tests on migration.

Also the database, payment and e-mail are factor of risks, they have a serious effects but low probability and are easily fixed due to the fact they are relatively standardized. Backup routines should be established and followed rigorously, with redundant copies in different medias. Still regarding data loss, the source code needs to be included in the backups and the developers should be constantly reminded to keep the quality of the GIT repository, following the specifications for the commits.

Some internal problems may be summarized as the unavailability of a staff member. To ensure that no functionality is left undone, no member is single handed responsible for a specific part, or in other words, the work distributions overlaps themselves. But, as this is a small team, it may result in overload of work for the remaining members. This may be a difficult point to solve, as the period of absence is unsure, one of the management technique adopted that helps this and almost most issues in the development phase is to include extra time in the ending of major tasks.

A final predicted risk, is the failure of the screen inside the car, as it is a hardware piece it is subjected multiple malfunctions. As for the quality of the product, extensive testing with different hardwares was predicted in the testing phase, so, in case of the hardware proves to be insufficient to the needs of the system, there are other tested options. And for punctual failures, the company is advised to keep spare screens in stock for a fast change. Of course, the later a problem is detected here, the more expensive is to fix it. As an example, if on development it is discovered that the first option for the screen breaks easily after little use, there are only a few to be replaced, but if the system was already deployed, this may result in huge losses for the company.

The above consideration (the later a risk presents itself the more expensive it is to fix it) tends to be true for most cases, hence it is why is crucial to keep reviewing the contingency plans and monitoring the signals that a risk, predicted or non predicted, may arise.

6 Effort Spent

Date	Domenico	Caio	Matheus
15/01/17	2h	2h	2h
16/01/17	-	-	-
17/01/17	4h	-	-
18/01/17	4h	-	-
19/01/17	-	6h	-
20/01/17	-	6h	1h
21/01/17	-	1h	6h
22/01/17	-	1h	-

7 Changelog

As the project and design decisions may change during the development this document is also prone to change. We'll document every version in this part.

- **Version 1.1:** 22/01/2017