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PowerEnJoy

Electric Car-sharing Service

PROJECT PLAN DOCUMENT

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1. Introduction

1.1 Purpose

The purpose of this document is to provide an estimate of the main attributes of the PEMS

This is a fundamental document for all those aspects of the software that are not technical and strictly related to the product.

It may also play a very important role in the feasibility study.

1.2 Scope

This document is the basic reference for everything concerning the planning of the project.

In particular, using the COCOMO II we are able to estimate the required effort in terms of months, from which then the Gantt has been studied.

1.3 Glossary

In this document the following acronyms and definitions have been used

- **PowerEnJoy Management System (PEMS):** It's the software system to be developed.
- **User:** The user of the software. He can register as a new user or access to the car sharing service via login and becoming an Authenticated User.
- **Suspended User:** User who has an account but cannot reserve a car because his driving license or payment information are found not be valid.
- **Authenticated User (AU):** User who has an account and it can use the service.
- **Money Saving Option (MSO):** Option for the AU to ask for a reduction. The system will suggest the user a SPA near the destination and suitable for a discount, according to the CT.
- **Integration Test Plan (ITP):** Plan for testing the integration of the modules of the PEMS.
- **Onroad Service (OS):** People, provided by an external system but at the disposal of the PEMS, which provide autonomous support for exceptional situations directly on site. The OS also provides an emergency call center where the user may directly communicate with an operator.
- **Payment System:** Any generic external system through which a payment to PowerEnJoy happens.
- **National Transport System (NTS):** AU's country state agency that stores all driving licenses information to be validated by external users.

1.4 Reference Documents

- Assignments AA 2016-2017.pdf
- PowerEnJoy Requirement Analysis and Specifications Document – Version 2
- PowerEnJoy Design Document – Version 2
- Gantt Chart – BACKUP.pdf
- http://alvinalexander.com/FunctionPoints/FunctionPoints.shtml
- COCOMO II Model Definition Manual

1.5 Overview

The present document describes the testing process for the PEMS project.
It contains both a high level view of the testing approach and a more detailed focus on the type of tests required.

The document is organized in the following sections:

1. **Introduction**
   This section introduces the purpose, the scope, clarify the terminology and the acronyms and explain the general aspects of the project.
2. **Size, Cost and Effort Estimation**
   This section in specifically focused on providing some estimations of the expected size, cost and required effort of PEMS.
3. **Tasks Identification and Resource Allocation**
   In this chapter the project is decomposed into tasks and the dependencies between them are pointed out. The distribution of tasks between the team member is also considered.
4. **Risk Management**
   This section describes the risk of the project and the associated recovery actions.
5. **Effort Spent**
   This section contains the hour of work and the distribution of task between the group members.
6. **Appendix:** Reference tables.

2. Size, Cost and Effort Estimation

2.1 Size Estimation

To estimate the size of the PEMS project the Function Point approach has been chosen. This system provides a good estimation of the Source Lines of Code to be written for the project.

The calculations have been performed accordingly to the reference tables (Appendix 7.1)

Internal Logic Files

"An ILF is a user-identifiable group of logically related data or control information maintained within the boundary of the application. The primary intent of an ILF is to hold data maintained through one or more elementary processes of the application being counted."

PEMS relies on several ILFs to store the information it needs to offer the required functionalities.

First of all, the system has to store information about the geographical area. These data are stored in a single table into the database with the name and the id to identify it. The Safe area are stored with the reference of the geographical area and a list of pairs <Latitude, Longitude> that define the extension of the area. The recharging area are stored like a particular type of safe area.

The system also needs a list of car, stored in another table of the database. For each car we need to know the position, the current battery level and if the car is online or offline.

The system has also to store information about the users. These data are considered in a single table that holds the first name, last name, birthdate, driver license number, payment information, email, password, phone number and a personal code to start the car. Another entity keeps track of payments.

The reservation is stored as a relationship between user and car. It has to store the date when it is made, the MSO option and the ride time.
Another entity keep track and store the car sensors state.

Finally, the system keeps a list of Emergency.

ILF	Complexity	FPs
Geographical Area	Low	7
Safe Area	Average	10
Car	Low	7
User	High	15
Reservation	High	15
Sensors	Low	7
Emergency	Low	7
TOTAL		68

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External Logic Files

"An external logic file (ELF) is a user identifiable group of logically related data or control information referenced by the application, but maintained within the boundary of another application. The primary intent of an ELF is to hold data referenced through one or more elementary processes within the boundary of the application counted. This means an ELF counted for an application must be in an ILF in another application."

National Transport system: The correctness of the driver license number is checked with a query on an external database.

ELF	Complexity	FPs
National Transport System	Low	5
TOTAL		5

External Logic Files

"An external input (EI) is an elementary process that processes data or control information that comes from outside the application boundary. The primary intent of an EI is to maintain one or more ILFs and/or to alter the behavior of the system."

Two main kinds of actor send information to the PEMS system. We are going to summarize the impact of the offered features, grouping by user:

- User
  - **Login and Logout:** they contribute 3 FPs each.
  - **Registration:** in operation that can be divided in three steps: the first save the personal information, the second the driving license and the third the payment method. they contribute with 4 FPs each.
- Authenticated User
  - **Search car and reserve car:** it can be done with GPS potion or by writing an address. it involves a complex number of operations, 6 FPs each.
  - **Cancel the reservation:** it is a simple operation, 3 FPs.
  - **Unlock:** The user can send to the system a request for unlocking the car. it contributes with 3 FPs.
- Car
  - **Set MSO option:** it is not a complex operation but it is divided in two step, 3 FPs each.
  - **Car Sensors:** it is a bit complex operation but there are a lot of sensors (door, ignition, battery, GPS, passengers). 4 FPs each is reasonable
  - **Emergency Alert:** It is another input from the cars to the PEMS where system receive information about car emergency. 3 FPs.
  - **Car starting code:** it is not a complex operation, 3 FPs

EI	Complexity	FPs
Login / Logout	Low	3x2
Registration	Average	4x3
Search Car	Average	6x2
Reserve Car	Average	6
Cancel the Reservation	Low	3
Unlock via Mobile	Low	3
Set MSO	Low	3x2
Car Sensors	Average	4x5
Emergency Alert	Low	3
Starting Code	Low	3
TOTAL		74

External Inquiries

"An External Inquiry (EQ) is an elementary process that sends data or control information outside the application boundary. The primary intent of an external inquiry is to present information to a user through the retrieval of data or control information from an ILF of EIF."

The processing logic contains no mathematical formulas or calculations, and creates no derived data. No ILF is maintained during the processing, nor is the behavior of the system altered. PEMS supports:

- **Payments:**
  - We make payments with an external interface.
- **Car:**
  - PEMS sends to the car system an unlocking code to unlock the car my NFC.
- **Emergency alert:**
  - PEMS sends a message to Onroad service control to manage the emergency.

EI	Complexity	FPs
Payments	Low	3
Driver License	Average	4
Unlocking Car	Low	3
Emergency Alert	Low	3
TOTAL		13

External Outputs

"An external output (EO) is an elementary process that sends data or control information outside the application boundary. The primary intent of an external output is to present information to a user through processing logic other than, or in addition to, the retrieval of data or control information. The processing logic must contain at least one mathematical formula or calculation, create derived data maintain one or more ILFs or alter the behavior of the system."

As a part of its normal behavior, PEMS needs to communicate information with the user outside the context of an inquiry:

- **Authenticated users:**
  - Notify a list of available cars.
  - Notify user that the car is correctly reserved and the reservation time.
  - Notify the final charge of the ride and the payment history.
- **Car:**
  - Notify the car a list of recharging area in money saving option mode.
  - Notify the car the information about the ride
- **Emergency alert:**
  - The system sends a notification when an emergency occurs.

EO	Complexity	FPs
List of the Available Cars	Average	5
Reservation Time	Low	4
Payment Information	Low	4
MSO	Average	5
Ride Information	Low	4
Emergency Alert	Low	4
TOTAL		26

Overall Estimation

Overall Estimation	FPs
Internal Logic Files	68
External Logic Files	5
External Inputs	74
External Outputs	26
External Inquiries	13
TOTAL	186

Considering Java Enterprise Edition as a development platform we can estimate the total number of lines of code, depending on the conversion rate:

$$SLOC = \begin{cases} 186 \times 46 = 12'462 & \text{Upper Bound} \\ 186 \times 67 = 8'556 & \text{Lower Bound} \end{cases}$$

It does not include the graphics interface of mobile application and website.

2.2 Cost and Effort Estimation

To estimate the cost and effort of the PEMS project the COCOMO II has been chosen.

Scale Factors

The scale factors are computed according to the standard COCOMO II table.

Scale Factors	Very Low	Low	Nominal	High	Very High	Extra High
PREC SF	Thoroughly Unprecedented 6.20	Largely Unprecedented 4.96	Somewhat Unprecedent 3.72	Generally Familiar 2.48	Largely Familiar 1.24	Thoroughly Familiar 0.00
FLEX SF	Rigorous 5.07	Occasional Relaxation 4.05	Some Relaxation 3.04	General Conformity 2.03	Some Conformity 1.01	General Goals 0.00
RESL SF	Little (20%) 7.07	Some (40%) 5.65	Often (60%) 4.24	Generally(70%) 2.83	Mostly(90%) 1.41	Full (100%) 0.00
TEAM SF	Very Difficult Interactions 5.48	Some Difficult Interactions 4.38	Basically Cooperative 3.29	Largely Cooperative 2.19	Highly Cooperative 1.10	Seamless Interactions 0.00
P.MAT SF	Lower Level 1 7.80	Upper Level 1 6.24	Level 2 4.68	Level 3 3.12	Level 4 1.56	Level 5 0.00

Referencing the table, the following values have been chosen:

- **Precedentness:** Represents the previous experience of the team with the development of a large scale project.
  We are no expert but since we already made the Software Engineering 1 project together the value that best fits is Low.
- **Development Flexibility:** Represents the flexibility allowed by the provided requirements and specifications.
  The Assignment has very specific requirements regarding the documents to be produced, but the actual requirement for the product to be developed allow for some "free" interpretation. Consequently, the value that best fits is Low.
- **Risk Resolution:** Represents the quality of the planning. In particular, it considers risk management plan and clear definition of budget and schedule.
  The project had no information regarding budget. Deadlines were only provided for each full document, but as a team we managed to define a good schedule and properly distribute tasks. Risk management was a big part of the project, it is likely though, that given our little experience some issues have been left out.
  Overall we chose the Nominal value for this factor.
- **Team Cohesion:** Represents how well the team members manage to work together.
  In our case, we already had the experience of the previous project and have learned to work together in a seamless way. Confrontation comes easy and is always constructing. We share a common "frame of mind" that allows us to share ideas in an immediate and friendly manner. For this factor then the value chosen is Very High.

- **Process Maturity:** Represents the maturity of the project organization according to the industry standard CMM.
  In our case we have reached a good level in the managing of a project. Since we do not have fixed working hours though, man-hours cannot be easily translated into time, and consequently we cannot give a good metric for scheduling and deadlines. Consequently we identify in the Level 3 of CMM or value High.

The scale factors are summarized in the following table:

Scale Factor	Level	Value
Precedentness	Low	4.96
Development Flexibility	Low	4.05
Risk Resolution	Nominal	4.24
Team Cohesion	Very High	1.10
Process Maturity	High	3.12
TOTAL		17.47

Cost Drivers

Our system is not based on any previously existing software, suggesting the use of an “Early Design” approach. Since though we are computing the cost after the design of the architecture we have enough knowledge of the project to properly estimate the cost drivers according to the “Post-Architecture” approach.

Required Software Reliability

Represents the extent to which the software must perform its intended function over a period of time and the effects caused by failures.

Since the car-sharing service can only work if the system is running, high financial loss is an obvious consequence of a failure. While, given the type of service offered, there will be no risk to human lives. Consequently, the level that best fits is High.

RELY Cost Driver Table				
Very Low	**Low**	**Nominal**	**High**	**Very High**
Slightly Inconvenience	Easily Recoverable Losses	Moderate Recoverable Losses	High Financial Losses	Risk to Human Life
0.82	0.92	1.00	1.10	1.26

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Database Size

Represents the ratio between the size of a large test database over the number of source lines of code (measured in SLOC).

Since we do not already have the real database, an estimate has been made using the following parameters.

- C = 1'000 cars.
- $R_{C,D}$ = 10 Reservation per car per day.
- H = 365 Days of reservation history.
- U = 20'000 users.
- B_T = 100 bytes per DB tuple.

We obtain a DB size $D = B_T \times \left(U + C + C \cdot R_{C,D} \cdot H\right) = 300$ MB.

Considering an average of 10'000 lines of code we get a $\frac{D}{P} = 30$ corresponding to the Nominal value.

DATA Cost Driver Table			
Low	**Nominal**	**High**	**Very High**
$\frac{D}{P} < 10$	$10 \leq \frac{D}{P} \leq 100$	$100 \leq \frac{D}{P} \leq 1000$	$\frac{D}{P} > 1000$
0.90	1.00	1.14	1.28

Product Complexity

Represents the complexity of the system to be developed.

According to the COCOMO II rating scale we find the best fitting value to be Nominal.

CPLX Cost Driver Table					
Very Low	**Low**	**Nominal**	**High**	**Very High**	**Extra High**
0.73	0.87	1.00	1.17	1.34	1.74

Developed for Reusability

The system was designed without any consideration regarding reusability. Thus no additional effort was spent on designing components for reusability. The values chosen is then Low.

RUSE Cost Driver Table				
Low	**Nominal**	**High**	**Very High**	**Extra High**
None	Across Project	Across Program	Across Product Line	Across Multiple Product Lines
0.95	1.00	1.07	1.15	1.24

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Documentation Match to Life-Cycle Needs

Represents how much of the life-cycle needs are covered in the documentation.

In our case the documentation covers most of the life-cycle needs, leaving out maintenance and details on possible future releases. We found this to be quite the right amount for our project, thus the chosen value is Nominal.

DOCU Cost Driver Table				
Very Low	**Low**	**Nominal**	**High**	**Very High**
Many LC Needs Uncovered	Some LC Needs Uncovered	Right-sized for LC needs	Excessive for LC Needs	Very excessive for LC Needs
0.81	0.91	1.00	1.11	1.23

Execution Time Constraint

Represents the expected CPU usage with respect to the computational capabilities of the hardware.
PEMS is not a particularly complicated software. It does not need to perform complicated computations and a little latency time is accepted. Thus the chosen value is Nominal.

TIME Cost Driver Table			
Nominal	**High**	**Very High**	**Extra High**
<50% CPU	70% CPU	85% CPU	95% CPU
1.00	1.11	1.29	1.63

Main Storage Constraint

Represents how much of the available storage is used

Since PEMS will take advantage of cloud server and DB service, we can fill our DB to nearly full and expand at ease every time it is needed.
It is then reasonable to choose the value Extra High.

STOR Cost Driver Table			
Nominal	**High**	**Very High**	**Extra High**
<50% Storage	70% Storage	85% Storage	95% Storage
1.00	1.05	1.17	1.46

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Platform Volatility

Represents how often the software needs to be updated to follow platform changes.

In this case the main constraint is set by the mobile devices for the Mobile Application. Given the current rate of advance it is realistic to expect a new version every 12 months with monthly minor fixes. The chosen value is then Low.

PVOL Cost Driver Table			
Low	**Nominal**	**High**	**Very High**
Major: 12 months Minor: 1 month	Major: 6 months Minor: 2 weeks	Major: 2 months Minor: 1 week	Major: 2 weeks Minor: 2 days
0.87	1.00	1.15	1.30

Analyst Capability

Represents the design and communication capabilities of the people who work on requirements and the design. Experience should not be considered as it is included in the APEX, LTEX and PLEX drivers.

Since the rating is in percentile, thus related to other teams, the best indicator of this driver is the final vote. Given that no vote has yet been issued we chose the value Nominal as it best represent the statistical value.

Having said that it is our belief that both singularly and as a team we performed very well.

ACAP Cost Driver Table				
Very Low	**Low**	**Nominal**	**High**	**Very High**
15th Percentile	35th Percentile	55th Percentile	75th Percentile	90th Percentile
1.42	1.19	1.00	0.85	0.71

Programmer Capability

Represents the capability of the programming team. Experience should not be considered as it is included in the APEX, LTEX and PLEX drivers.

Since the rating is in percentile, thus related to other teams, a good indicator could be the vote of the 3rd year Software Engineering project.

Our team achieved a vote of 30 thanks to our ability to share tasks and work effectively together. The chosen value is thus High.

PCAP Cost Driver Table				
Very Low	**Low**	**Nominal**	**High**	**Very High**
15th Percentile	35th Percentile	55th Percentile	75th Percentile	90th Percentile
1.34	1.15	1.00	0.88	0.76

Personnel Continuity

Represents the project's annual personnel turnover.

Since there has been no turnover we chose the value Very High.

PCON Cost Driver Table				
Very Low	**Low**	**Nominal**	**High**	**Very High**
48% Year	24% Year	12% Year	6% Year	3% Year
1.29	1.12	1.00	0.90	0.81

Application Experience

Represents the level of application experience of the project team.

Since our experience is very short (1 project) the value Very Low has been chosen.

APEX Cost Driver Table				
Very Low	**Low**	**Nominal**	**High**	**Very High**
≤ 2 Months	6 Months	1 Year	3 Years	6 Years
1.22	1.10	1.00	0.88	0.81

Platform Experience

Represent the level of experience with the development platforms of the project team.

The team has no previous experience of Java EE and very little experience with databases and web applications. Thus the chosen value is Very Low.

PLEX Cost Driver Table				
Very Low	**Low**	**Nominal**	**High**	**Very High**
≤ 2 Months	6 Months	1 Year	3 Years	6 Years
1.19	1.09	1.00	0.91	0.85

Language and Tool Experience

Represents the level of experience with the development programming languages and software tools.

The team has some experience with Java and SQL, together with some related tools. The chosen value is then Low.

LTEX Cost Driver Table				
Very Low	**Low**	**Nominal**	**High**	**Very High**
≤ 2 Months	6 Months	1 Year	3 Years	6 Years
1.20	1.09	1.00	0.91	0.84

Use of Software Tools

Represents how well and how extensively the software tools have been used in the project.

The project was developed in a formal way aiming more towards good integration and structure rather than getting the application ready as soon as possible.
The chosen value is Very High.

TOOL Cost Driver Table				
Very Low	**Low**	**Nominal**	**High**	**Very High**
Edit, Code, Debug	Simple Frontend, Backend, Little Integration	Basic life-cycle tools, moderately integrated	Mature life-cycle tools, moderately integrated	Proactive life-cycle tools, well integrated with process, methods reuse
1.17	1.09	1.00	0.90	0.78

Multisite Development

Represents the difficulties in communication due to distance and communication supports available.

We live in difference location around the same city, but since most of project has been made together at Politecnico or using video call the value chosen is Very High.

SITE Cost Driver Table					
Very Low	**Low**	**Nominal**	**High**	**Very High**	**Extra High**
International	Multi-city and Multi-company	Multi-city or Multi-company	Same city or metrop. area	Same building or complex	Fully collocated
Some phone, mail	Individual phone, FAX	Narrow band email	Wideband electronic communication	WB communic. Occasional video conf.	Interactive Multimedia
1.22	1.09	1.00	0.93	0.86	0.80

Required Development Schedule

Represents the schedule constraints imposed on the project team.

The deadlines provided to us were specific and definitive. Schedule stretches are not allowed and schedule compressions are not considered.
The chosen value is then Nominal.

SCED Cost Driver Table				
Very Low	**Low**	**Nominal**	**High**	**Very High**
75% Nominal	85% Nominal	100% Nominal	130% Nominal	160% Nominal
1.43	1.14	1.00	1.00	1.00

The cost driver factors are summarized in the table below:

CD ID	Cost Driver	Level	Value
RELY	Required Software Reliability	High	1.10
DATA	Database Size	Nominal	1.00
CPLX	Product Complexity	Nominal	1.00
RUSE	Developed for Reusability	Low	0.95
TIME	Execution Time Constraint	Nominal	1.00
STOR	Main Storage Constraint	Extra High	1.46
PVOL	Platform Volatility	Low	0.87
ACAP	Analyst Capability	Nominal	1.00
PCAP	Programmer Capability	High	0.88
PCON	Personnel Continuity	Very High	0.81
APEX	Application Experience	Very Low	1.22
PLEX	Platform Experience	Very Low	1.19
LTEX	Language and Tool Experience	Low	1.09
TOOL	Use of Software Tools	Very High	0.78
SITE	Multisite Development	Very High	0.80
SCED	Required Development Schedule	Nominal	1.00
TOTAL (Multiplication)			**0.93427**

Effort Equation

Given the following formulas defined for COCOMO II

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

$$EAF = \prod Cost\ Drivers = 0.93427$$

$$E = B + 0.01 \times \sum_i SF_i = 1.0847$$

$$F = 0.28 + 0.2 \times (E - B) = 0.31494$$

The effort estimation in Person-Months (PM) is given by the equation

$$\text{Effort} = A \times EAF \times KSLOC^E = \begin{cases} 28.19 \approx 28 \text{ PM} & \text{for } KSLOC = 8.8556 \\ 42.38 \approx 42 \text{ PM} & \text{for } KSLOC = 12.462 \end{cases}$$

The Final Schedule estimation is given by the equation

$$\text{Duration} = 3.67 \times \text{Effort}^F = \begin{cases} 10.50 \text{ Months} & \text{for } KSLOC = 8.8556 \\ 11.9 \text{ Months} & \text{for } KSLOC = 12.462 \end{cases}$$

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3. Tasks Identification and Resource Allocation

3.1 Task Identification

The project has been divided in phases from the initial documentation to test and debugging.

1. Project Setup Documentation

Every Document is composed by a writing phase and a revision phase.

- **RASD:** Requirement and Specification Document.
- **DD:** Design Document based on the RASD.
- **ITPD:** Integration Test Plan Document, partially based on the DD.
- **PP:** Project Plan Document, based on all the previous.

2. Development

Every task is given a D tag followed by a number. Modules hierarchy is shown in parenthesis.

- D1 - DMBS
- D2 - Model (Application Server).
- D3 - DataAccess (Application Server).
- D4 - ChargeUser (UserManager, Application Server).
- D5 - SubscribeUser (UserManager, Application Server).
- D6 - CheckUser (UserManager, Application Server).
- D7 - ReserveCar (Reservation, Application Server).
- D8 - MSOManager (Reservation, Application Server).
- D9 - LockCar (Reservation, Application Server).
- D10 - UnlockCar (Reservation, Application Server).
- D11 - MSOCalculator (Application Server).
- D12 - CarController (Application Server).
- D13 - EmergencyController (Application Server).
- D14 - SubscribeManager (Application Server).
- D15 - ReservationManager (Application Server).
- D16 - CarsManager (Application Server).
- D17 - OnRoadServiceManager (Application Server).
- D18 - UserVisitor (ServerVisitor, Application Server).
- D19 - FindCarVisitor (ServerVisitor, Application Server).
- D20 - ReservationVisitor (ServerVisitor, Application Server).
- D21 - LockVisitor (ServerVisitor, Application Server).

- D22 - UnlockVisitor (ServerVisitor, Application Server).
- D23 - EmergencyVisitor (ServerVisitor, Application Server).
- D24 - ClientService.
- D25 - CarService.
- D26 - Website (Client Application).
- D27 - MobileApp (Client Application).
- D28 - Login (UserApplication, Client Application).
- D29 - Registration (UserApplication, Client Application).
- D30 - FindCars (UserApplication, Client Application).
- D31 - Reservation (UserApplication, Client Application).
- D32 - Car Proprietary System Gateway (Car System).
- D33 - UI (CarSystem, Car System).
- D34 - UnlockCar (CarSystem, Car System).
- D35 - LockCar (CarSystem, Car System).
- D36 - MSO (CarSystem, Car System).
- D37 - EmergencyController (CarSystem, Car System).

In order to make the document more readable the D Tasks are joined in Macro Development Tasks, with the MD tag. The MD are composed of tasks in the same Integration Test.

- MD1: D1, D2, D3.
- MD2: D14, **...** , D17 (Managers) D18, **...** , D23 (ServerVisitor).
- MD3: D4, D5, D6 (UserManager).
- MD4: D7, **...** , D10 (Reservation).
- MD5: D24, D25.
- MD6: D28, **...** , D31 (UserApplication).

3. Testing

Unit Testing

Unit testing is executed at the completion of the corresponding module. Every task in this group is composed by a code inspection, a testing and correction phase.
Every task is given a UT(D) tag, associated to the corresponding D task.

- UT(D1).
- UT(D2)
- ...
- UT(D37).

Integration Testing

Integration testing is executed as described in the ITP document. Every task is associated with the corresponding IT tag.

- IT1.1 - Requires UT(MD1).
- IT1.2 - Requires UT(MD1), UT(D6).
- IT1.3 - Requires UT(MD1), UT(D5).
- IT1.4 - Requires UT(MD1), UT(D4).
- IT1.5 - Requires UT(MD1), UT(D12).
- IT1.6 - Requires UT(MD1), UT(D7).
- IT1.7 - Requires UT(MD1), UT(D9).
- IT1.8 - Requires UT(MD1), UT(D8).
- IT1.9 - Requires UT(MD1), UT(D13).
- IT2.1 - Requires UT(D4), UT(D7).
- IT2.2 - Requires UT(D4), UT(D9).
- IT2.3 - Requires UT(D4), UT(D13).
- IT2.4 - Requires UT(D4), UT(D5).
- IT2.5 - Requires UT(D6), UT(D7).
- IT3.1 - Requires UT(MD2), UT(MD3) UT(MD4), UT(D11), UT(D12), UT(D13).
- IT3.2 - Requires UT(MD2), UT(MD5), UT(MD6).
- IT4.1 - Requires UT(MD4), UT(D22).
- IT4.2 - Requires UT(D7), UT(D11).
- IT5.1 - Requires UT(D22), UT(D34).
- IT5.2 - Requires UT(D22), UT(D34).
- IT5.3 - Requires UT(D27), UT(D34).
- IT5.4 - Requires UT(D21), UT(D35).
- IT5.5 - Requires UT(D20), UT(D36).
- IT5.6 - Requires UT(D23), UT(D37).

System Testing and Debugging

The system testing it’s a main test on all the functionalities of the application, the main scope of this test are to run the system in different scenarios, even simulating problems and heavy loads and to detect possible vulnerabilities.
After the testing some extra time is allocated for correcting eventual problems.

Deployment

The system is finally installed on all that required platform: The fleet of cars and the servers

Beta Testing and Debugging

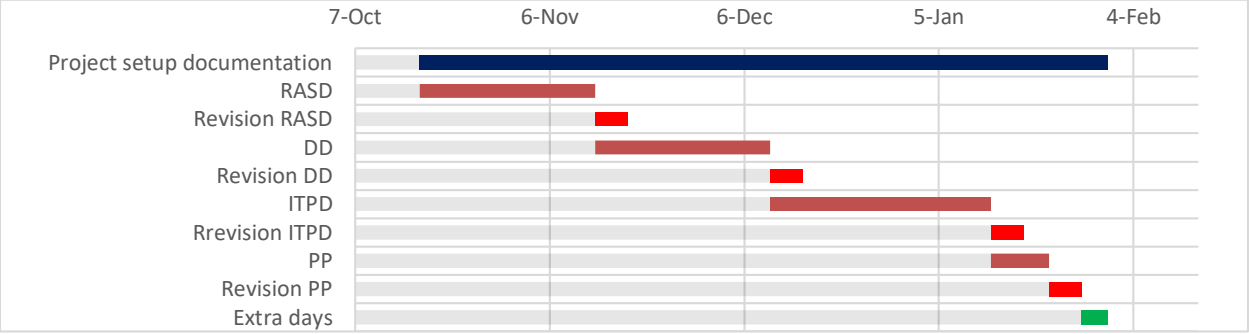
The system is tested on a real scenario. Some additional time is allocated for correcting eventual problems.

3.2 Gantt and Resource Allocation

The following graphs describes the task distribution over time and personnel.

Note that tasks are divided between personnel only in the DD Chart, as it goes into the most details.
Also take notice that the 3 workers, represented by the 3 colors (blue, orange, green) are not univocally assigned to any group member. This is because we are all pretty much at the same level and thus are equally capable of dealing with any task.

Project Setup Documentation



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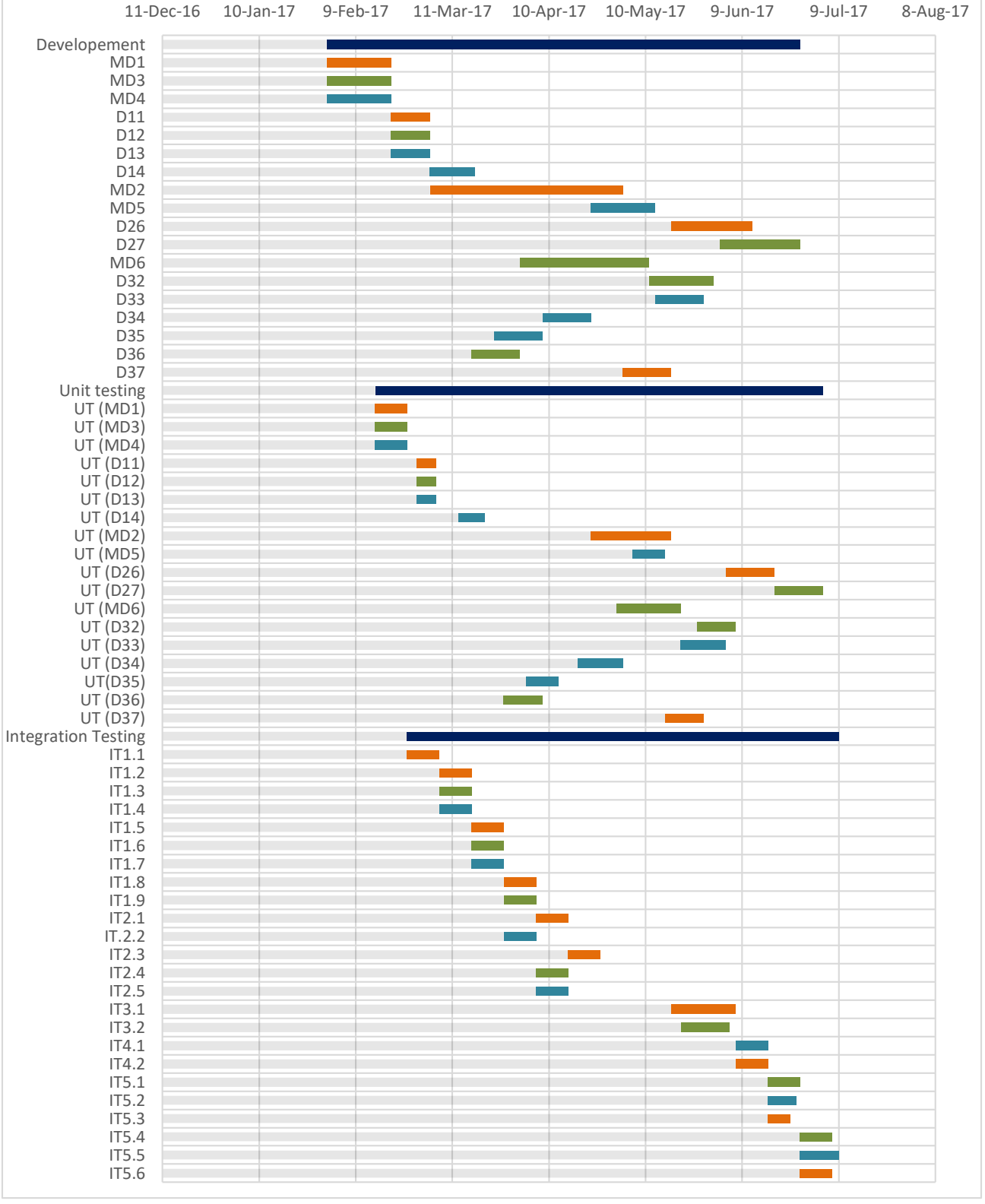
Development



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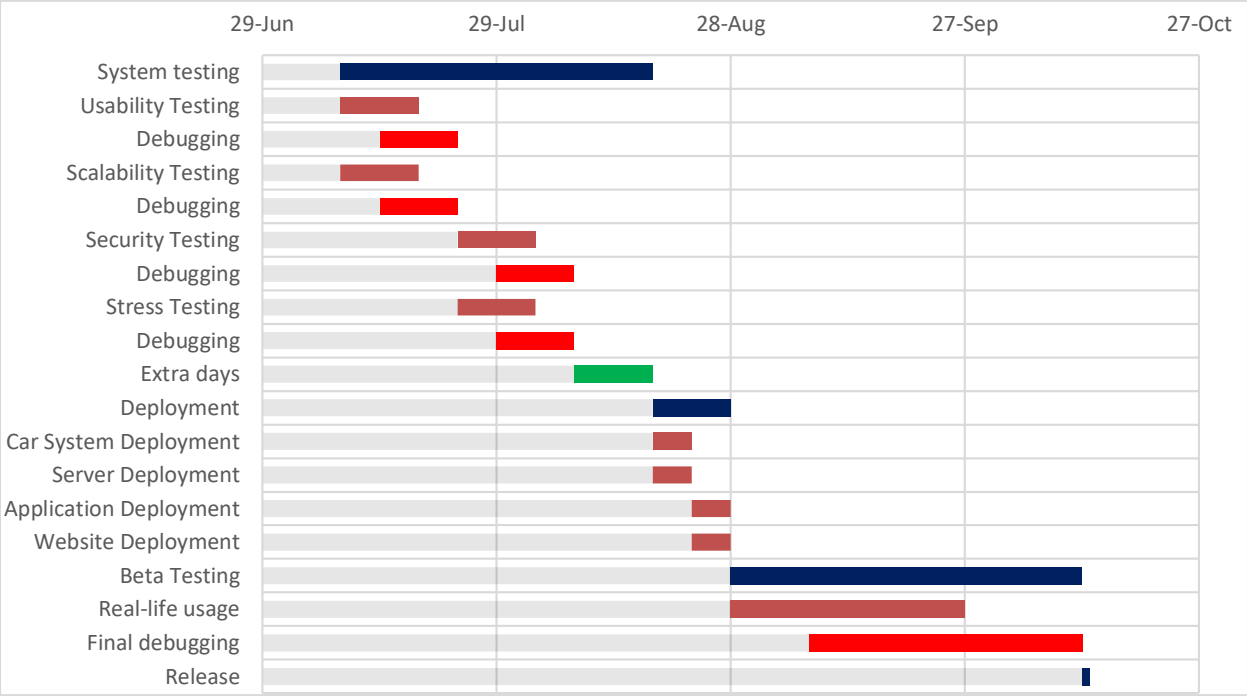
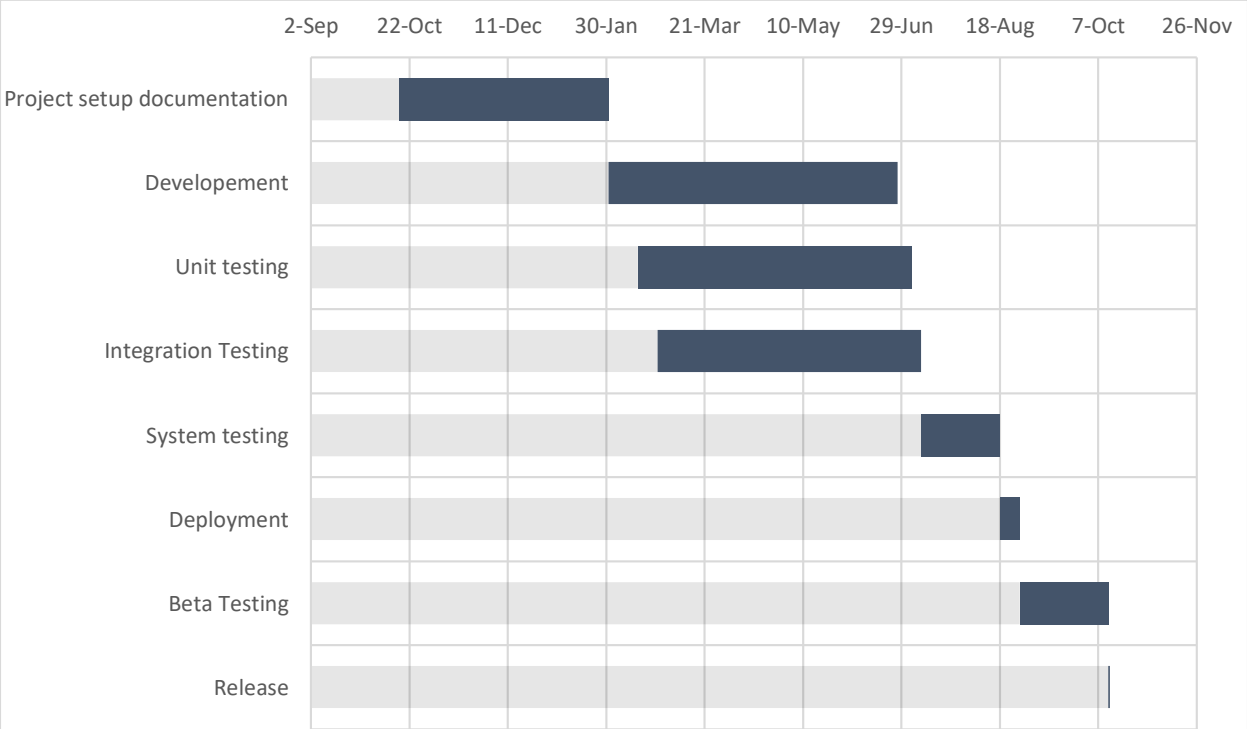
Final Testing and Release



Overview



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4. Risk Management

In this chapter are listed the major risks individuated by the team for the project. They are separated in Internal Risks, whose causes are inherent to the team members or to the technical part, and External Risks, which are caused by entities outside the team and not properly controllable. Each risk is given a probability value: Low - Average - High; and an impact value: Low - Moderate - Serious - Catastrophic.

4.1 Internal Project risks

Limited size of the team

The team is composed of only 3 people. This means that illness and others unexpected accidents can cause a sensible delay of the project schedule. For further reducing this possible delay, it's advised to document the code and the task that the team member is working on, thus making it possible for another member to temporarily take his place. The team should also be encouraged to increase the communication on the project aspects. Probability: Average; Impact: Serious

Expertise of the team

The team is composed by recently graduated people. Their experience can be easily overestimated: new situations can be taken with an inexperienced approach, leading to waste of time and delays to the project schedule. For reducing this risk it's possible to enlist a consulting firm that can help the team with experience and practical knowledge. Probability: High; Impact: Moderate

Defective components

The team is composed of recently graduated people. It is possible that they will be contacted by others companies with a greater appeal. The defection of a team member in an advanced phase of the development can have a really serious impact on the schedule, making necessary to search and hire a new staff member and to introduce him in the project. Keeping the team united and motivated and giving them a competitive salary and contract conditions can avoid this problem. Probability: Low; Impact: Serious.

4.2 External Risks

Changing of the external components.

The system relies, for its functions, on some external components, like the map service or the payment service. The changing of this components can have different effects: a slight change in the function can provoke a delay on the project, while a massive change (like disable some services or modify the interfaces) can cause a review of the design of the system, causing a big delay and resources waste.
Changing in the policies of this services (like from freeware to payware) can cause an increase of the project costs. Probability: Low; Impact: Low-Serious (depending of the size of the change).

5. Effort Spent

Work Division

section	Paragraph	author	revisioned by
Introduction		Milanta	Gianola
Size, Cost and Effort Estimation			
	Size Estimation	Gianola	Milanta
	Cost and Effort Estimation	Milanta	Gianola
Tasks Identification and Resource Allocation		Facchini	Gianola
Risk management		Milanta	Facchini
Effort Spent		Gianola	Facchini

Working Hours

	Week I							Week IV							Totale
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
Antonio Gianola						1	1				2	2		2	7
Andrea Facchini						1		1		2		4			8
Andrea Milanta				1				1		2		4		2	9

6. Appendices

6.1 Function Points Reference Tables

The following tables have been used as the reference to assign the Function Points for the size estimation.

Internal Logic Files and External Logic Files

File Types	Data Element Types		
	1 — 19	**20 — 50**	**51+**
1	Low	Low	Average
2 to 5	Low	Average	High
6 or more	Average	High	High

External Outputs and External Inquiries

File Types	Data Element Types		
	1 — 5	**6 — 19**	**20+**
0 to 1	Low	Low	Average
2 to 3	Low	Average	High
4 or more	Average	High	High

External Inputs

File Types	Data Element Types		
	1 — 4	**5 — 15**	**16+**
0 to 1	Low	Low	Average
2 to 3	Low	Average	High
4 or more	Average	High	High

Complexity Weights

Complexity Weight			
	Low	**Average**	**High**
Internal Logic Files	7	10	15
External Logic Files	5	7	10
External Inputs	3	4	6
External Outputs	4	5	7
External Inquiries	3	4	6

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