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Project Plan Document

PowerEnjoy

Software Engineering 2
A.A. 2016-2017

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1. Introduction

1.1 Purpose and scope

The aim of this document is to analyse in detail which are the costs in terms of lines of code and time required to develop the PowerEnjoy application.

Previous documents on the topic have been created and we will use them as starting point of the estimation. Among them, the Design Document will be extensively used, the information needed will be retrieved and a proper schedule of activities, an estimation of the costs and so the organization of the resources will be appropriately described.

The first phase will deal with lines-of-code costs and the effort to effectively build the application, the main logic will follow the COCOMO and Function Points ones.

After having built an estimation of what really is the developing effort, we will give the precise idea of how to structure a suitable schedule with the specific aim of covering every step, from collecting and retrieving all the information and so the RAS Document to the actual realization.

As third step, there is the assignment of the various tasks to the different members of the group. Since our group sees only a couple of member, here a very delicate issue arises and later the discussion will vertex on this peculiarity.

Eventually, risks and the corresponding possible managements are faced; the discussion will follow every step of the project due to the unpredictability of the issue.

1.2 Definitions, Acronyms, Abbreviations

1.2.1 Definitions

1.2.2 Acronyms

- FP: Function Points
- ILF: Internal Logic File
- ELF: External Logic File
- EI: External Input
- EO: External Output
- EQ: External Inquiries
- API: Application Programming Interface
- RAS: Requirements Analysis and Specification phase
- RASD: Requirements Analysis and Specification Document

1.2.3 Abbreviations

1.3 Reference Documents

- Assignment Document
- Previous assignment documents: https://github.com/peempi/SWE2
- Slides from Lectures
- COCOMO II model definition manual: https://github.com/peempi/SWE2
- Project Plan document Sample by lecture presentation

2. Project size, cost and effort estimation

The aim of this chapter is trying to understand how many lines of code and time will require PowerEnjoy, and, as a natural consequence, an estimation of the costs.

To accomplish this aim two instruments will be used:

1. Function Points (FP) to estimate the size of the project. In practice, a level of difficulty will be assigned to every aspect to develop in the software to be, and they will be evaluated to receive a lower and an upper bound of the number of expected lines of code (LOC)
2. COCOMO, instead, will give the count and effort estimation, starting from the amount of LOCs calculated before and keeping in account al lot of different factor, as shown in the second section of this chapter.

2.1 Size estimation: function points

Function Points model expects the evaluation of the number of functionalities provided by the software to be. The estimation done is based on the following conversion tables:

- Internal and External Logic Files

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

- External Output and Inquiries

	Data Elements		
File Types	1-5	6-19	20+
0-1	Low	Low	Average
2-3	Low	Average	High
4+	Average	High	High

- For External Input

	Data Elements		
File Types	1-4	5-15	16+
0-1	Low	Low	Average
2-3	Low	Average	High
4+	Average	High	High

- UFP Complexity Weights

	Data Elements		
Function Type	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

2.1.1 Internal Logic Files (ILFs)

In order to work properly, PowerEnjoy must maintain all the necessary information it requires to have in a persistent copy.

The three main actor of the system, Clients, Operators and Cars, must have a dedicate table in the database. For the first there will be necessary store personal data such as name, surname, age and so on, username and password, to access the portal, and payment information. Particularly important data are the driving license id, and the user status, necessary to authorize a Customer to rent a vehicle.

Operators' table will contain, apart from their personal information, the ID and the password to access their dedicated platform.

Cars' table will be filled with their plaque number, status, QRcode value, their last position notified, as a couple of number, one for latitude and one for longitude, their status, and the percentage of battery charge.

Safe Areas will have a dedicated table with the coordinate couples of all of them;

For car reservation, there will be a table containing the user who generated it, the car booked, the timestamp of the reservation and a flag value to indicate whether it is still pending or not (whatever expired or interrupted for a rent).

Car rents will be stored in a table with the renting User, the car, the initial and final timestamp, the bill, calculated at the end of the rent, and whether the bill payment has been successful.

Damage form will inserted in a dedicated table, containing the data from the form, the timestamp of the form compilation, and a reference to the rent which generated the form. Through the last one, the system will be able to track down the User who compiled it and the subject car.

Maintenance jobs performed on the cars must be stored in another table. It will contain the operator who accomplishes the task, the id of the car he works on, and the data about the beginning and the end of the job. The maintenance form, containing structured data, won't be stored together but in a separate table, containing the collected data and the maintenance id it is referring to.

No one of the listed elements is particularly difficult to perform, except from the User table, which must preserve sensible information, such as payments method, in a secure way. For this reason we obtain the following FPs:

ILFs	Complexity	FPs
Clients	Average	10
Operators	Low	7
Cars	Low	7
Safe Areas	Low	7
Car Reservation	Low	7
Rents	Low	7
Damage Forms	Low	7
Maintenance Jobs	Low	7
Maintenance Forms	Low	7
Total		**66**

2.1.2 External Logic Files (ELFs)

PowerEnjoy has two main external data sources:

- The License validation APIs, which, given driving license parameters, return whether the document is valid or not;
- Map generation APIs, that construct the map with a car in each point indicated by a couple of coordinates contained in a list passed as parameter, the list will also contain the color to choose to color the pin, according to the car's status;
  The same APIs are used on the client side (both user and oprators) to convert their position of the research in a couple of coordinates

Therefore, we obtain the following FPs:

ELFs	Complexity	FPs
Driving license check	Low	7
Map generation	Average	10
Coordinates conversion	Low	7
Total		**31**

2.1.3 External Inputs (EIs)

Various types of external inputs are dealt by our application logic server; here we summarize them to point out the complexity of each of them.

Three kinds of external agents interact with Power Enjoy system: users, operators and cars. For every interaction they manage, we introduce a complexity level (c.lv.). This will lead us to a better estimation of the entire complexity. Every evaluation is based upon the Design Document, more particularly on the number of components used for the aim.

- Users:
  - ✓ Login/Logout: low c.lv. 2x3 FPs
  - ✓ Setting personal information/Password: average c.lv. 4.5 FPs
  - ✓ Request a Reservation: average c.lv. 4 FPs
  - ✓ Send QR/Start Rent: high c.lv. 6FPs
  - ✓ Finish Rent/Form average c.lv. 4.5 FPs
  - ✓ Total: 15 FPs

- Operators:
  - ✓ Login/Logout: low c.lv. 2x3 FPs
  - ✓ Lock specific car: low-average c.lv 3.5 FPs
  - ✓ Form/Unlock specific car: high c.lv. 6 FPs
  - ✓ Total: 15.5 FPs

- Cars:
  - ✓ Send information about car: low c.lv. 3 FPs
  - ✓ Safe Areas: low c.lc. 3 FPs
  - ✓ Total: 6 FPs

EIs	Medium Complexity	FPs
Users	Average	15
Operators	Average	15.5
Cars	Low	6
Total		**37.5**

2.1.4 External Inquiries (EQs)

This chapter is dedicated to analysis of those interaction that give to the agents just a snapshot of one or more data of the system. Few kinds of such interactions are supported by our application and here they are summarized.

- Users:
  - ✓ Search: average c.lv. 4 FPs
  - ✓ Total: 4 FPs

- Operators:
  - ✓ Look at the current situation: average c.lv 4 FPs
  - ✓ QR request: low c.lv. 3 FPs
  - ✓ Total: 7 FPs

EQs	Medium Complexity	FPs
Users	Average	4
Operators	Low-Average	7
Total		**11**

2.1.5 External Outputs (EOs)

This chapter is related to the communications performed by the logic server to the agents asynchronously with respect to their corresponding interactions. The outputs are those messages emitted from to server to the respective destination, which are not caused by a previous request by that agent, they are indeed a consequence of an interaction with another agent.

- To Users:
  - ✓ Timeout: low c.lv. 3 FPs
  - ✓ Total: 3 FPs

- To Cars:
  - ✓ Change Status Order: low c.lv 3 FPs
  - ✓ Maintenance orders: low c.lv. 3 FPs
  - ✓ Total: 6 FPs

EIs	Medium Complexity	FPs
To Users	Low	3
To Cars	Low	6
Total		**9**

2.1.6 Overall Estimation

Considering all the estimations done above, the result is displayed in the following table:

Function Type	
Internal Logic Files	66
External Logic Files	31
External Inputs	37,5
External Inquiries	11
External Outputs	9
Total	**154,5**

The user web application and both the mobile apps (Users and Operator's ones) are not appearing in the previous estimation because of there are to consider only as elements which only concern the User Experience.

Considering the choice of Lavarel as language the system is programmed brought some complications: neither PHP nor Laravel framework itself are considered in the QSM's conversion table, neither in ones by other authorities in that field. For this reason, here the values found in papers from 2 universities will be used as lower and upper bound for our estimation.

The two institution are University of Helsinki and Capstone Experience by University of New Jersey, who propose for php an average of respectively 67 and 53 lines of code. Since those are average estimation there will be differentiated, bringing them to 70 and 50 LOCs.

Following this approach, we obtain, as lower bound, the following value:

$$LOC_{lb} = 154.5 * 50 = 7725\ LOCs$$

In the same way, we can obtain as upper bound:

$$LOC_{ub} = 154.5 * 70 = 10815\ LOCs$$

2.2 Cost and Effort Estimation: COCOMO II

Once having calculated the size of the project, this section wants to understand the cost and the effort needed to realise PowerEnjoy, through the COCOMO II analysis.

The key for the conversion is the following equation:

$$PM = A * Size^{E} * \prod_{i=1}^{n} EM_i$$

Where:

- A= 2.94 is constant;
- Size is the amount of LOC calculated in the previous section, measured in "kilo-lines"; in particular:
  - $Size_{lb} = 7.725\ KLOC$
  - $Size_{ub} = 10.815\ KLOC$
- E is an aggregation of five Scale Factors, calculated in section 2.2.1;
- EM is the Effort Multiplier, calculated in section 2.2.2;

2.2.1 Scale Factors

The following table allows to calculate the value of *E*:

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

- PREC= Precedentedness, the similarity between PowerEnjoy application and several previously developed projects. The team has not wide knowledge of PHP and Laravel because of its extreme youth. For this reason, the coefficient is Low=4.96;
- FLEX= Development Flexibility. It is high if there are no specific constraints to conform to pre-established requirements and external interface specifications. Since PowerEnjoy only has to cope with Cars, because other external components don't require complicated interfaces, it will be Nominal= 3.04;
- RESL= Architecture / Risk Resolution, it describes the presence of a clear management plan, a clear definition of budget, a clear definition of budget and schedule and focus on architectural definition. Since the project has been analysed very in depth, it is High=2.83;
- TEAM= Team Cohesion, that is the capability of the stakeholders to work together. Since The developer team is very restricted (only two engineers), and has already worked together for several issues, it is Very High=1.1;
- PMAT= Process Maturity, refers to CMMI. For PowerEnjoy it is a Level 3, Defined=3.12;

Resuming:

Scale Factor	Factor	Value
PREC	Low	4.96
FLEX	Nominal	3.04
RESL	High	2.83
TEAM	Very High	1.1
PMAT	Level 3	3.12
Total		15.05

Therefore, applying the following equation, considering B=0.91

$$E = B + 0.01 * \sum_{j=1}^{5} SF_j = 0.91 + 0.01 * 15.5 = 0.91 + 0.155 = 1.065$$

2.2.2 Cost Drivers

In this section, all the costed drivers will be listed with the corresponding evaluation

1. Required Software Reliability (RELY):
   Since there are expensive very components relying on the software management, such as the cars it is set to High.

RELY Descriptors:	slight inconven-ience	low, easily recoverable losses	moderate, easily recoverable losses	high financial loss	risk to human life	
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	0.82	0.92	1.00	1.10	1.26	n/a

2. Database Size (DATA):
   Since we estimate a database of 3.5 GB, and the software will be made of 7700 and 11000 lines of code, the DATA descriptor is:
   $$\frac{D}{P}_{lb} = \frac{3500000}{7700} = 454{,}55 \quad \frac{D}{P}_{ub} = \frac{3500000}{11000} = 318{,}18 \Rightarrow 318{,}18 < \frac{D}{P} < 454{,}55$$
   Therefore, DATA cost driver is to be considered High

DATA* Descriptors		Testing DB bytes/Pgm SLOC < 10	10 ≤ D/P < 100	100 ≤ D/P < 1000	D/P ≥ 1000	
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	n/a	0.90	1.00	1.14	1.28	n/a

3. Product Complexity(CPLX):
   According to COCOMO II evaluation, PowerEnjoy CPLX driver is to be considered as High.

Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	0.73	0.87	1.00	1.17	1.34	1.74

4. Developed for Reusability (RUSE):
   Since PowerEnjoy can be implemented in various different cities, RUSE cost driver is set as “Across Program”, thus High.

RUSE Descriptors:		none	across project	across program	across product line	across multiple product lines
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	n/a	0.95	1.00	1.07	1.15	1.24

5. Documentation Match to Life-Cycle Needs (DOCU)
   Every step of the life-cycle of PowerEnjoy has been documented as roperly, hence its driver is Nominal.

DOCU Descriptors:	Many life-cycle needs uncovered	Some life-cycle needs uncovered.	Right-sized to life-cycle needs	Excessive for life-cycle needs	Very excessive for life-cycle needs	
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	0.81	0.91	1.00	1.11	1.23	n/a

6. Execution Time Constraint (TIME):
   Since in PowerEnjoy business model gains are proportional to the time spent in rents, and since having a reliable service is a pillar for a customer experience which leads to customers' loyalty, a high percentage of execution time is necessary. For this reason, the driver is Very High.

TIME Descriptors:			≤ 50% use of available execution time	70% use of available execution time	85% use of available execution time	95% use of available execution time
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	n/a	n/a	1.00	1.11	1.29	1.63

7. Main Storage Constraint (STOR):
   Since PowerEnjoy won't deal with data particularly memory consuming but, more or less, with only textual data, or similar, a high percentage of memory unavailable can be easily prevented. Therefore, the driver is Nominal.

TIME Descriptors:			≤ 50% use of available execution time	70% use of available execution time	85% use of available execution time	95% use of available execution time
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	n/a	n/a	1.00	1.11	1.29	1.63

8. Platform Volatility (PVOL):
   The nature of PowerEnjoy doesn't implies frequent major changes, thus the rating level is Nominal. These will be used to adapt the platform to the modifications of the law concerning the viability, restrictions on driving licenses and similar.

PVOL Descriptors:		Major change every 12 mo.; Minor change every 1 mo.	Major: 6 mo.; Minor: 2 wk.	Major: 2 mo.;Minor: 1 wk.	Major: 2 wk.;Minor: 2 days	
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	n/a	0.87	1.00	1.15	1.30	n/a

9. Analyst Capability (ACAP):
   The analysis has already been developed in detail in the previous documents. For this reason the driver is High.

ACAP Descriptors:	15th percentile	35th percentile	55th percentile	75th percentile	90th percentile	
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	1.42	1.19	1.00	0.85	0.71	n/a

10. Programmer Capability (PCAP):
    Even if the young age of the team, it is very good in team-working and to communicate, therefore, considering the quite relevant lack of experience, the cost driver is Nominal.

PCAP Descriptors	15th percentile	35th percentile	55th percentile	75th percentile	90th percentile	
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	1.34	1.15	1.00	0.88	0.76	n/a

11. Personnel Continuity (PCON):
    Since the team has other project to follow the time it can dedicate to PowerEnjoy is limited. Therefore, the Driver is Very Low

PCON Descriptors:	48% / year	24% / year	12% / year	6% / year	3% / year	
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	1.29	1.12	1.00	0.90	0.81	

12. Applications Experience (APEX):
    The team has not a great experience in similar systems, in fact the driver is Very Low.

APEX Descriptors:	≤ 2 months	6 months	1 year	3 years	6 years	
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	1.22	1.10	1.00	0.88	0.81	n/a

13. Platform Experience (PLEX):
    Even if there is a lack of experience, the team is pretty interested in innovation of platforms in order to get a better result. For this reason, The Plex Driver is Nominal.

PLEX Descriptors:	≤ 2 months	6 months	1 year	3 years	6 year	
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	1.19	1.09	1.00	0.91	0.85	n/a

14. Language and Tool Experience (LTEX):
    The team has experience with several tools and applications for Software Development and analysis. Therefore, the driver is Nominal

LTEX Descriptors:	≤ 2 months	6 months	1 year	3 years	6 year	
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	1.20	1.09	1.00	0.91	0.84	

15. Use of Software Tools (TOOL):
    The team experienced with powerful tool for programming and debugging, with some useful application for the lifecycle of the program, but these are not well integrated each pther. For this reason, the Driver considered will be Nominal.

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

16. Multisite Development (SITE):
    The driver is Extra-high, since the team entirely works in the same stable.

SITE: Collocation Descriptors:	Inter-national	Multi-city and Multi-company	Multi-city or Multi-company	Same city or metro. area	Same building or complex	Fully collocated
SITE: Communications Descriptors:	Some phone, mail	Individual phone, FAX	Narrow band email	Wideband electronic communication.	Wideband elect. comm., occasional video conf.	Interactive multimedia
Rating Levels	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multipliers	1.22	1.09	1.00	0.93	0.86	0.80

17. Required Development Schedule (SCED):
    In the first phases of the project there has been a lot of Schedule compression. In the latter ones less and the team hopes to maintain a similar rhythm in order to cope with their others projects. Thus, the driver is High

SCED Descriptors	75% of nominal	85% of nominal	100% of nominal	130% of nominal	160% of nominal	
Rating Level	Very Low	Low	Nominal	High	Very High	Extra High
Effort Multiplier	1.43	1.14	1.00	1.00	1.00	n/a

Summarizing, the following table lists the result obtained with the detailed COCOMO II analysis:

Cost Driver	**Factor**	**Value**
RELY	High	1.10
DATA	High	1.14
CPLX	High	1.17
RUSE	High	1.07
DOCU	Nominal	1.00
TIME	Very High	1.29
STOR	Nominal	1.00
PVOL	Nominal	1.00
ACAP	High	0.85
PCAP	Nominal	1.00
PCON	Very Low	1.29
APEX	Very Low	1.22
PLEX	Nominal	1.00
LTEX	Nominal	1.00
TOOL	Nominal	1.00
SITE	Extra High	0.80
SCED	High	1.00
Total		**2,167**

2.2.3 Effort equation

Having calculated everything is necessary, the effort estimation, measured in Person/Month (PM) becomes:

$$PM_{lb} = A * Size_{lb}^{E} * \prod_{i=1}^{n} EM_i = 2.94 * 7.725^{1.065} * 2.167 = 56.21$$

$$PM_{ub} = A * Size_{ub}^{E} * \prod_{i=1}^{n} EM_i = 2.94 * 10.815^{1.065} * 2,167 = 80.43$$

2.2.4 Schedule Estimation

To estimate the Schedule Estimation there will be used the following formula:

$$Duration = 3.67 * PM^F \; where \; F = 0.28 + 0.2 * (E - B)$$

With E, B, calculated above.

Thus, $F = 0.28 + 0.2(1{,}065 - 0.91) = 0.311$

Therefore, the lower bound will be

$$Duration_{lb} = 3.67 * PM_{lb}^F = 3.67 * 56.21^{0.311} = 12.84 \, months$$

And the upper one

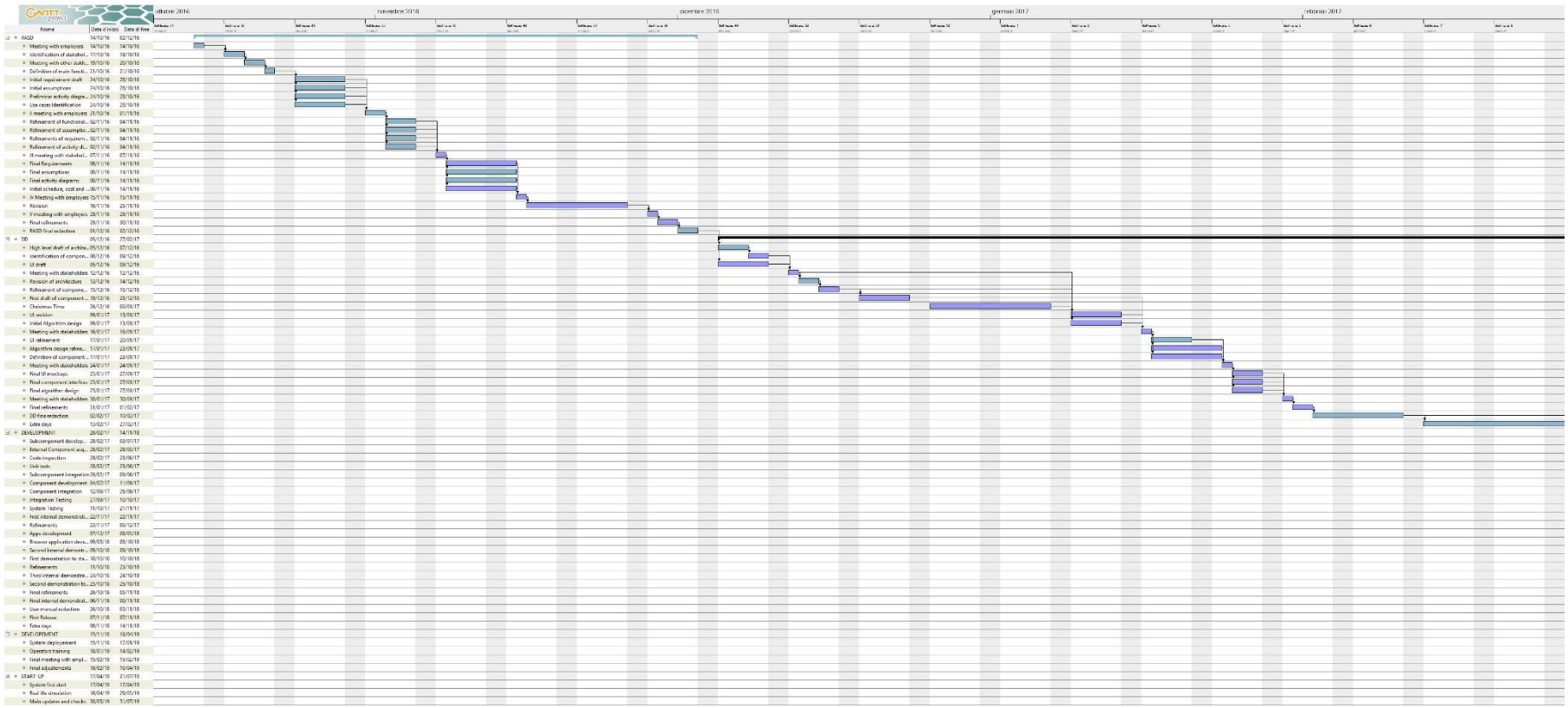
$$Duration_{ub} = 3.67 * PM_{ub}^F = 3.67 * 80.43^{0.311} = \; 14.36 \, months$$

3. Schedule

In this section, there is a first draft of the Schedule for the realization of the project. Even if the schedule estimation through COCOMO II resulted as between 12 and 14 months, the effort calculated above is between 56 and months. This gap is due to the fact the schedule estimation don't keep in consideration factors such as the effective number of resources available, when the team that will develop PowerEnjoy in made by only 2 engineers. For this reason, this chapter will consider a duration of the project of around 33 months, considering an average value between the two boundaries. There has been the choice of follow as much as possible the waterfall model, scheduling an activity only before the end of the previous one. This choice is to highlight the dependences between consecutive tasks. Whereas the end of the various assignments must be considered as a deadline, the beginning can be anticipated as soon as the needed prerequisites are completed.

In the plan, there are also a break in Christmas time and one in August. These are to be considered also to recover potential delay due to particularly critical problems.

Due to the big size of the schedule table, which compromises the readability, the schedule source file is also available for the download at this link, in the folder of the project:
https://github.com/peempi/SWE2/blob/master/schedule.gan


ottobre 2016
novembre 2016
dicembre 2016
gennaio 2017
febbraio 2017
Nome
Data d'inizio
Data di fine
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Meeting with employees 14/10/16 14/10/16
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DD fina redaction 02/02/17 10/02/17
Extra days 13/02/17 27/02/17
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Subcomponent develop... 28/02/17 03/07/17
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Subcomponent integration 26/03/17 09/06/17
Component development 04/07/17 11/09/17
Component integration 12/09/17 25/09/17
Integration Testing 27/09/17 10/10/17
System Testing 11/10/17 27/11/17
First internal demonstrati... 22/11/17 22/11/17
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Apps development 07/12/17 08/05/18
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Third internal demonstra... 24/10/18 24/10/18
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Final refinements 26/10/18 03/11/18
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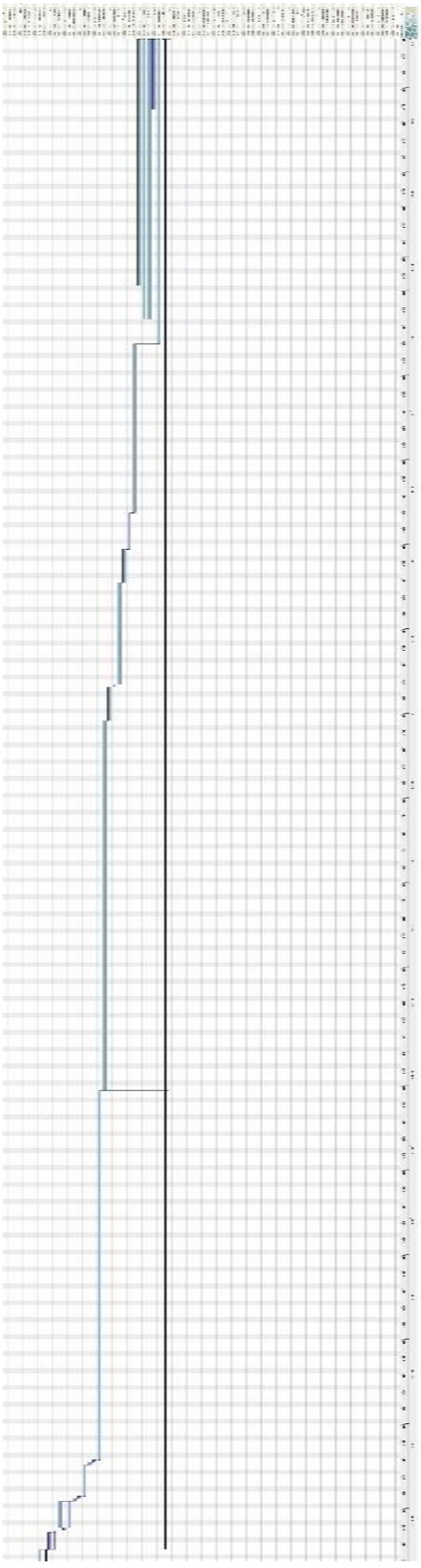
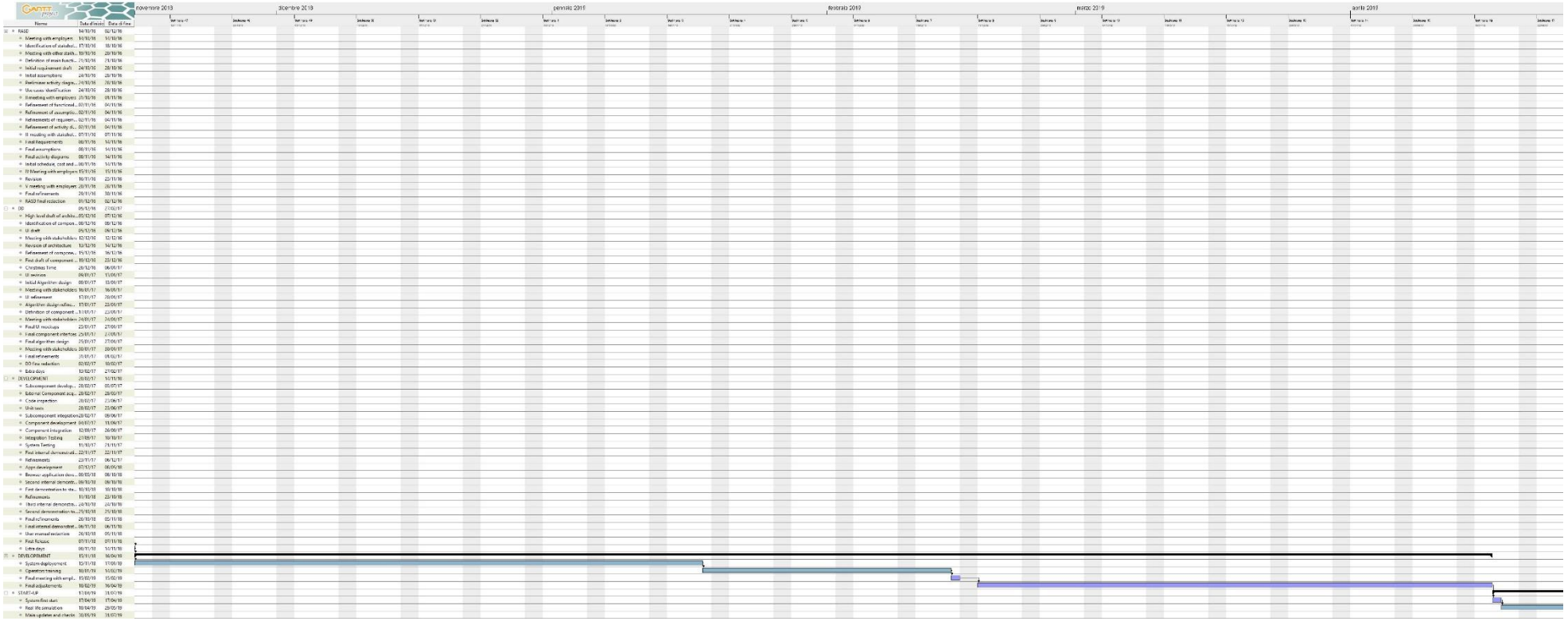
User manual redaction 26/10/18 05/11/18
Fist Release 07/11/18 07/11/18
Extra days 08/11/18 14/11/18
DEVELOPMENT 15/11/18 15/04/19
System deployment 15/11/18 17/01/19
Operator training 18/01/19 14/02/19
Final meeting with empl... 15/02/19 15/02/19
Final adjustments 18/02/19 15/04/19
START-UP 17/04/19 31/07/19
System first start 17/04/19 17/04/19
Real life simulation 18/04/19 29/05/19
Main updates and checks 30/05/19 31/07/19

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novembre 2015
dicembre 2015
gennaio 2016
febbraio 2016
marzo 2016
aprile 2016
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Data di fine
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Meeting with employers 14/10/16 14/10/16
Identification of stakehol... 17/10/16 18/10/16
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Initial assumptions 24/10/16 28/10/16
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Use cases identification 24/10/16 28/10/16
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Refinement of activity di... 02/11/16 04/11/16
III meeting with stakehol... 07/11/16 07/11/16
Final Requirements 08/11/16 14/11/16
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Final activity diagrams 08/11/16 14/11/16
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Revision 16/11/16 22/11/16
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Final refinements 29/11/16 30/11/16
RASD Final redaction 01/12/16 02/12/16
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UI draft 09/12/16 09/12/16
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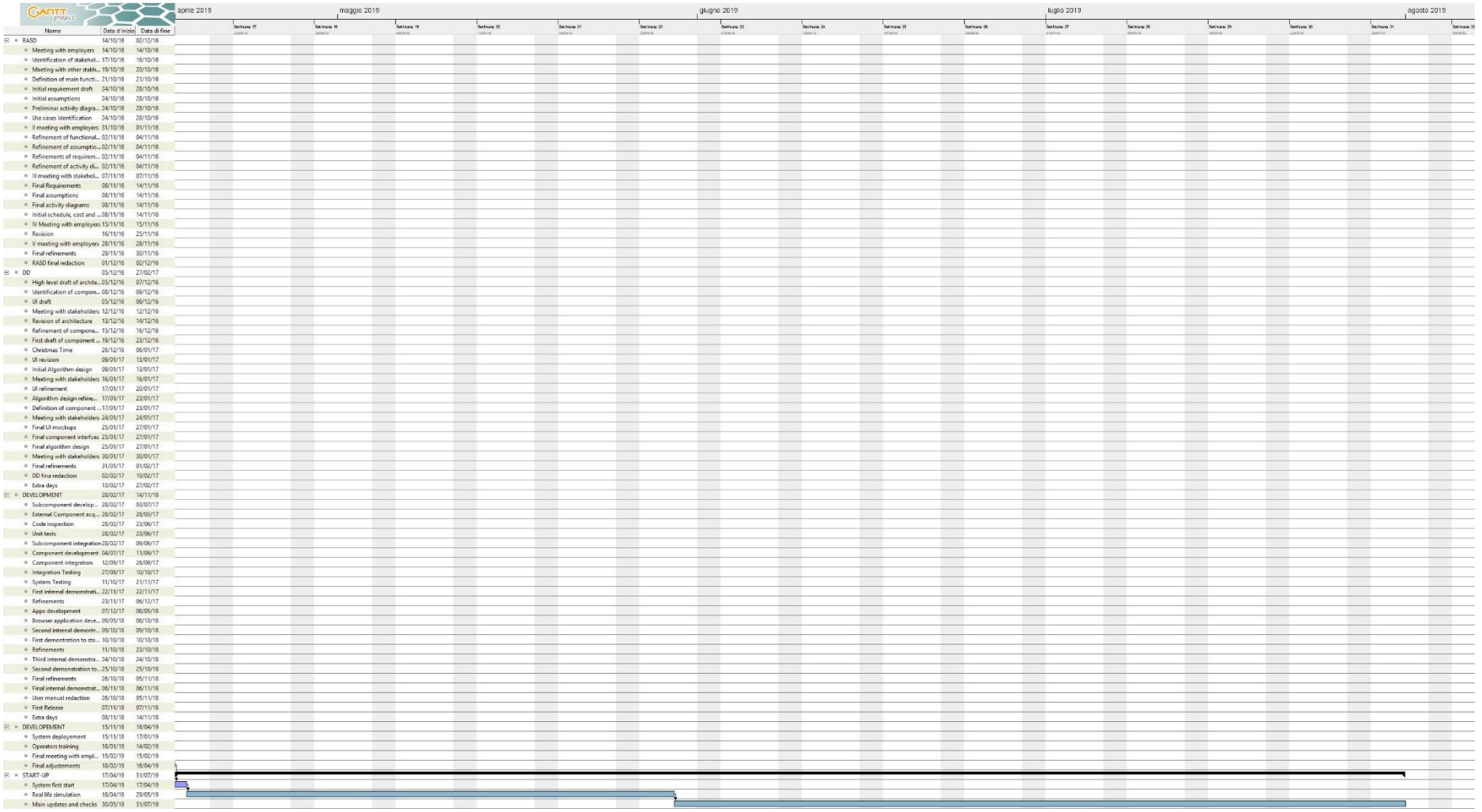

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Refinements of requirem...	02/11/16	04/11/16
Refinement of activity di...	02/11/16	04/11/16
III meeting with stakehol...	07/11/16	07/11/16
Final Requirements	08/11/16	14/11/16
Final assumptions	08/11/16	14/11/16
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IV Meeting with employers	15/11/16	15/11/16
Revision	16/11/16	25/11/16
V meeting with employers	28/11/16	28/11/16
Final refinements	29/11/16	30/11/16
RASD final redaction	01/12/16	02/12/16
DD	05/12/16	27/02/17
High level draft of archite...	05/12/16	07/12/16
Identification of compon...	08/12/16	09/12/16
UI draft	05/12/16	09/12/16
Meeting with stakeholders	12/12/16	12/12/16
Revision of architecture	13/12/16	14/12/16
Refinement of componen...	15/12/16	16/12/16
First draft of component ...	19/12/16	23/12/16
Christmas Time	26/12/16	06/01/17
UI revision	09/01/17	13/01/17
Initial Algorithm design	09/01/17	13/01/17
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UI refinement	17/01/17	20/01/17
Algorithm design refine...	17/01/17	23/01/17
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Final algorithm design	25/01/17	27/01/17
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DEVELOPMENT	28/02/17	14/11/18
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Component development	04/07/17	11/09/17
Component integration	12/09/17	26/09/17
Integration Testing	27/09/17	10/10/17
System Testing	11/10/17	21/11/17
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Refinements	23/11/17	06/12/17
Apps development	07/12/17	08/05/18
Browser application deve...	09/05/18	08/10/18
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First demontration to sta...	10/10/18	10/10/18
Refinements	11/10/18	23/10/18
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Second demonstration to...	25/10/18	25/10/18
Final refinements	26/10/18	05/11/18
Final internal demonstrat...	06/11/18	06/11/18
User manual redaction	26/10/18	05/11/18
First Release	07/11/18	07/11/18
Extra days	08/11/18	14/11/18
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System deployement	15/11/18	17/01/19
Operators training	18/01/19	14/02/19
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4. Resource allocation

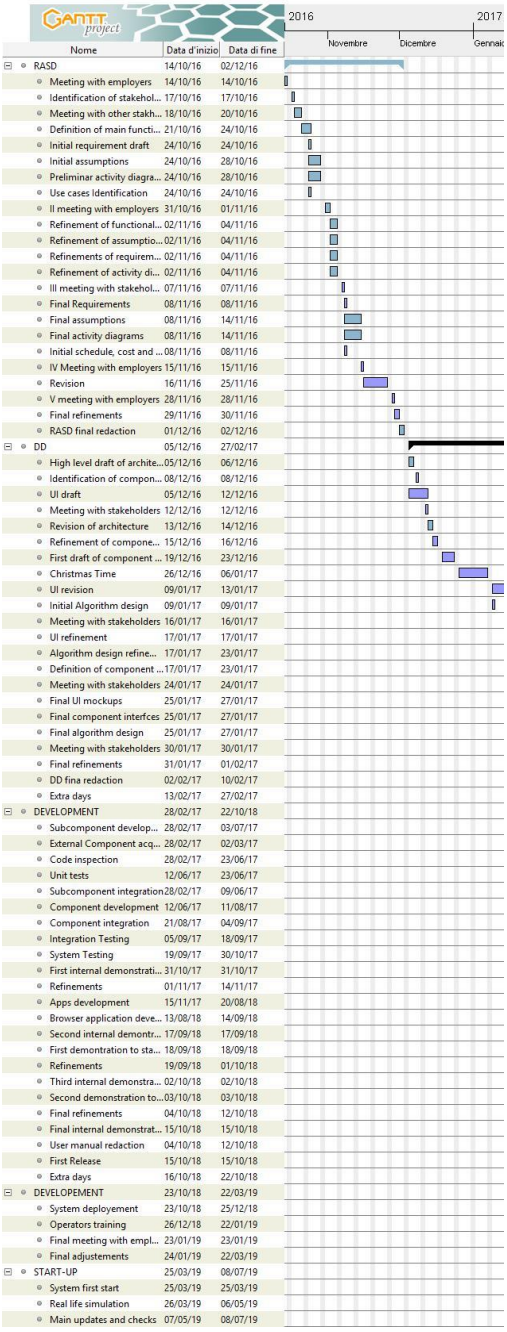
In this section of the document a picture of the loads of the two members of the team is provided. The activities chosen for both, reflect the personal skills or interests in order to obtain a better result; furthermore, we decided to include also meetings with stakeholders or employers because of the reasons that will be furtherly detailed in the Risk Management chapter: we consider the people involved one of the possible sources of extra issues with respect to PowerEnjoy system. From that point of view, a clear schedule and workload with that people is mandatory and it will certainly improve performances.

However, this chapter is not to be taken as if it was definitive, that's not the meaning we want to give. Indeed, we think that the actual schedule will consider changes due to unpredicted necessities or delays; this is merely an overview, as precise as possible though.

Lastly, we would like to underline the fact that we had to split the whole into sub-pictures due to the large costs in terms of time that our application needs, anyway, you can find the original schedules source files at the following links:

- https://github.com/peempi/SWE2/blob/master/resourceGnecco.gan
- https://github.com/peempi/SWE2/blob/master/resourceCrovari.gan

4.1 Crovari



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Refinements of requirem...	02/11/16	04/11/16
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III meeting with stakehol...	07/11/16	07/11/16
Final Requirements	08/11/16	08/11/16
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Initial schedule, cost and ...	08/11/16	08/11/16
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Revision	16/11/16	25/11/16
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RASD final redaction	01/12/16	02/12/16
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High level draft of archite...	05/12/16	06/12/16
Identification of compon...	08/12/16	08/12/16
UI draft	05/12/16	12/12/16
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Revision of architecture	13/12/16	14/12/16
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First draft of component ...	19/12/16	23/12/16
Christmas Time	26/12/16	06/01/17
UI revision	09/01/17	13/01/17
Initial Algorithm design	09/01/17	09/01/17
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Algorithm design refine...	17/01/17	23/01/17
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Second internal demontr...	17/09/18	17/09/18
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Final adjustements	24/01/19	22/03/19
START-UP	25/03/19	08/07/19
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Real life simulation	26/03/19	06/05/19
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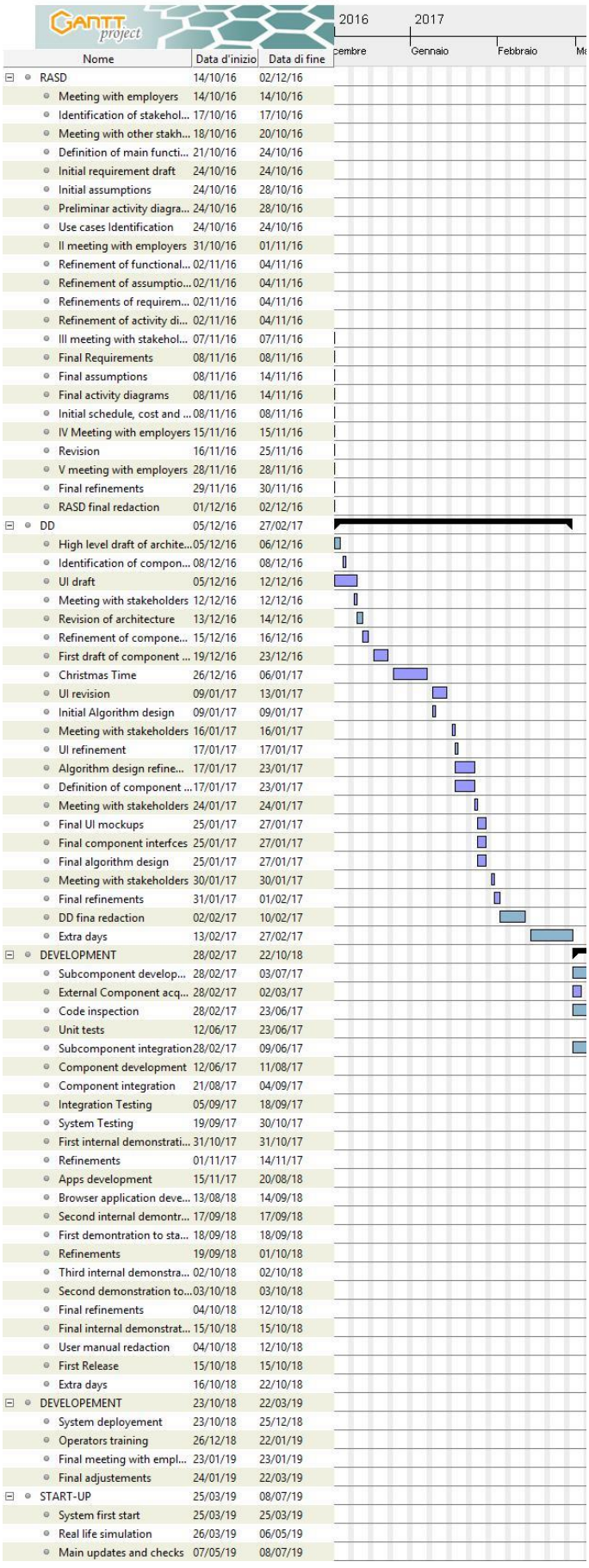

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UI draft	05/12/16	12/12/16
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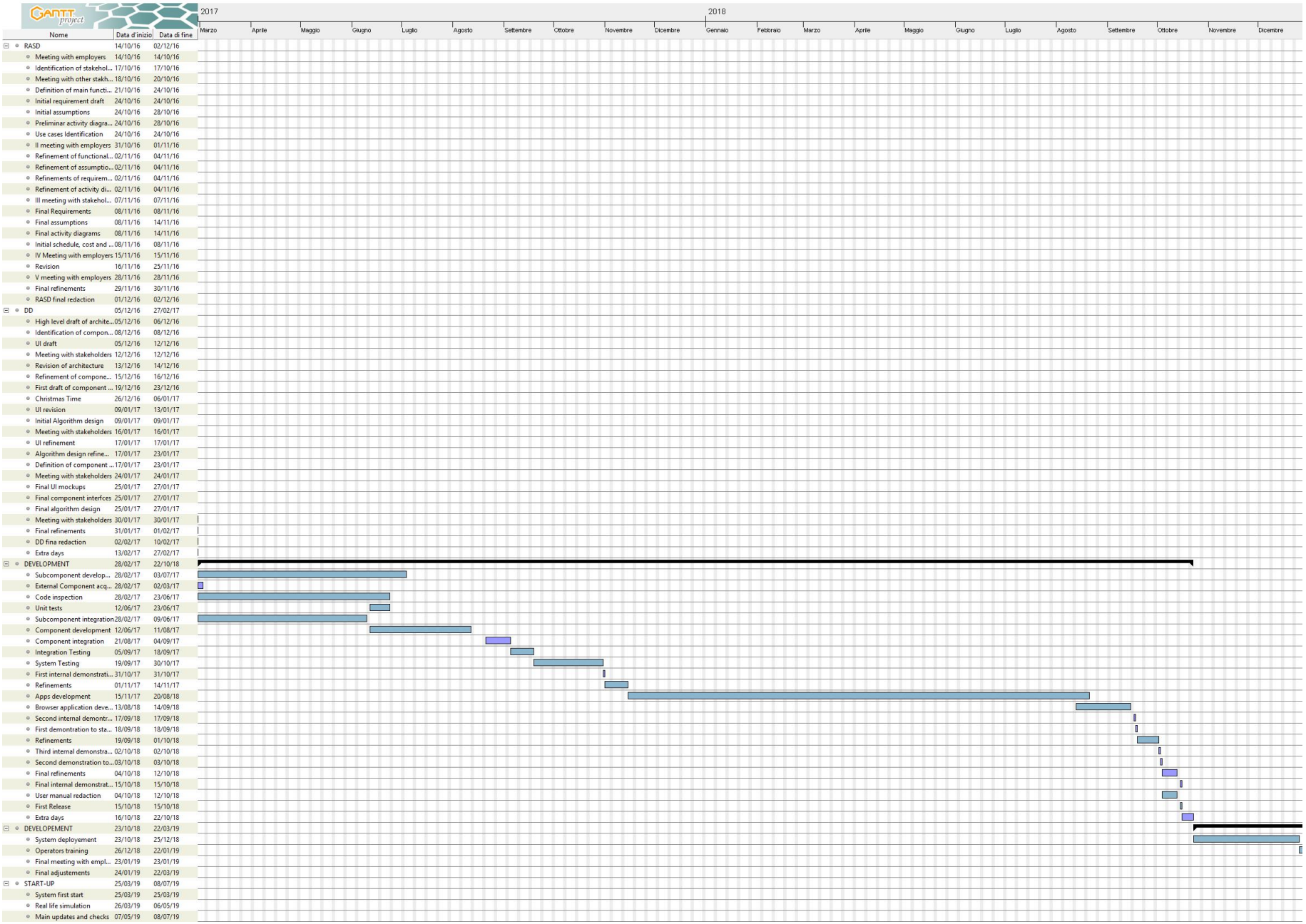

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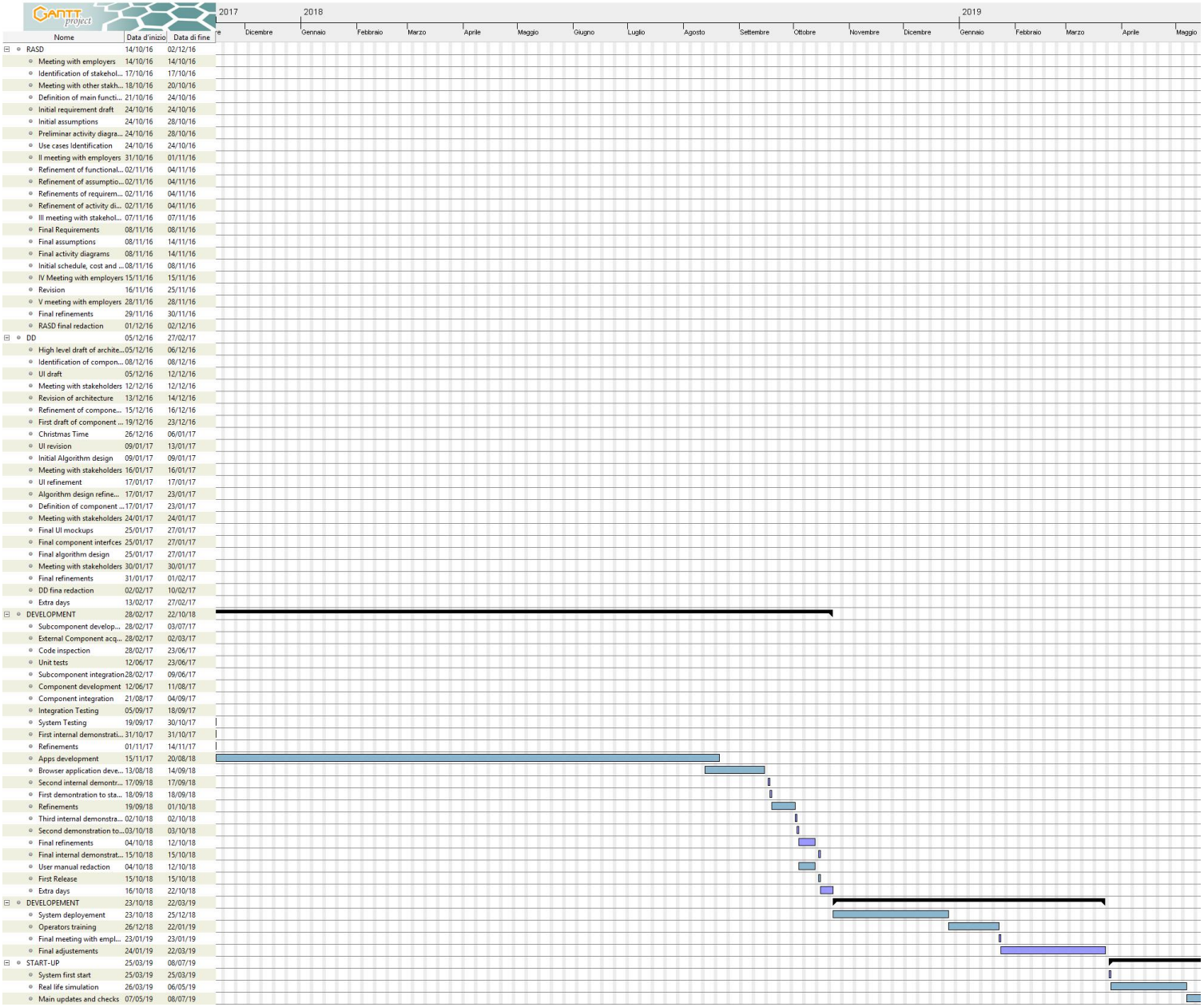
Extra days	13/02/17	27/02/17
DEVELOPMENT	28/02/17	22/10/18
Subcomponent develop...	28/02/17	03/07/17
External Component acq...	28/02/17	02/03/17
Code inspection	28/02/17	23/06/17
Unit tests	12/06/17	23/06/17
Subcomponent integration	28/02/17	09/06/17
Component development	12/06/17	11/08/17
Component integration	21/08/17	04/09/17
Integration Testing	05/09/17	18/09/17
System Testing	19/09/17	30/10/17
First internal demonstrati...	31/10/17	31/10/17
Refinements	01/11/17	14/11/17
Apps development	15/11/17	20/08/18
Browser application deve...	13/08/18	14/09/18
Second internal demontr...	17/09/18	17/09/18
First demontration to sta...	18/09/18	18/09/18
Refinements	19/09/18	01/10/18
Third internal demonstra...	02/10/18	02/10/18
Second demonstration to...	03/10/18	03/10/18
Final refinements	04/10/18	12/10/18
Final internal demonstrat...	15/10/18	15/10/18
User manual redaction	04/10/18	12/10/18
First Release	15/10/18	15/10/18
Extra days	16/10/18	22/10/18
DEVELOPEMENT	23/10/18	22/03/19
System deployement	23/10/18	25/12/18
Operators training	26/12/18	22/01/19
Final meeting with empl...	23/01/19	23/01/19
Final adjustements	24/01/19	22/03/19
START-UP	25/03/19	08/07/19
System first start	25/03/19	25/03/19
Real life simulation	26/03/19	06/05/19
Main updates and checks	07/05/19	08/07/19



Nome	Data d'inizio	Data di fine
RASD	14/10/16	02/12/16
Meeting with employers	14/10/16	14/10/16
Identification of stakehol...	17/10/16	17/10/16
Meeting with other stakh...	18/10/16	20/10/16
Definition of main functi...	21/10/16	24/10/16
Initial requirement draft	24/10/16	24/10/16
Initial assumptions	24/10/16	28/10/16
Preliminar activity diagra...	24/10/16	28/10/16
Use cases Identification	24/10/16	24/10/16
II meeting with employers	31/10/16	01/11/16
Refinement of functional...	02/11/16	04/11/16
Refinement of assumptio...	02/11/16	04/11/16
Refinements of requirem...	02/11/16	04/11/16
Refinement of activity di...	02/11/16	04/11/16
III meeting with stakehol...	07/11/16	07/11/16
Final Requirements	08/11/16	08/11/16
Final assumptions	08/11/16	14/11/16
Final activity diagrams	08/11/16	14/11/16
Initial schedule, cost and ...	08/11/16	08/11/16
IV Meeting with employers	15/11/16	15/11/16
Revision	16/11/16	25/11/16
V meeting with employers	28/11/16	28/11/16
Final refinements	29/11/16	30/11/16
RASD final redaction	01/12/16	02/12/16
DD	05/12/16	27/02/17
High level draft of archite...	05/12/16	06/12/16
Identification of compon...	08/12/16	08/12/16
UI draft	05/12/16	12/12/16
Meeting with stakeholders	12/12/16	12/12/16
Revision of architecture	13/12/16	14/12/16
Refinement of compone...	15/12/16	16/12/16
First draft of component ...	19/12/16	23/12/16
Christmas Time	26/12/16	06/01/17
UI revision	09/01/17	13/01/17
Initial Algorithm design	09/01/17	09/01/17
Meeting with stakeholders	16/01/17	16/01/17
UI refinement	17/01/17	17/01/17
Algorithm design refine...	17/01/17	23/01/17
Definition of component ...	17/01/17	23/01/17
Meeting with stakeholders	24/01/17	24/01/17
Final UI mockups	25/01/17	27/01/17
Final component interfces	25/01/17	27/01/17
Final algorithm design	25/01/17	27/01/17
Meeting with stakeholders	30/01/17	30/01/17
Final refinements	31/01/17	01/02/17
DD fina redaction	02/02/17	10/02/17
Extra days	13/02/17	27/02/17
DEVELOPMENT	28/02/17	22/10/18
Subcomponent develop...	28/02/17	03/07/17
External Component acq...	28/02/17	02/03/17
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First internal demonstrati...	31/10/17	31/10/17
Refinements	01/11/17	14/11/17
Apps development	15/11/17	20/08/18
Browser application deve...	13/08/18	14/09/18
Second internal demontr...	17/09/18	17/09/18
First demontration to sta...	18/09/18	18/09/18
Refinements	19/09/18	01/10/18
Third internal demonstra...	02/10/18	02/10/18
Second demonstration to...	03/10/18	03/10/18
Final refinements	04/10/18	12/10/18
Final internal demonstrat...	15/10/18	15/10/18
User manual redaction	04/10/18	12/10/18
First Release	15/10/18	15/10/18
Extra days	16/10/18	22/10/18
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System deployement	23/10/18	25/12/18
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Final meeting with empl...	23/01/19	23/01/19
Final adjustements	24/01/19	22/03/19
START-UP	25/03/19	08/07/19
System first start	25/03/19	25/03/19
Real life simulation	26/03/19	06/05/19
Main updates and checks	07/05/19	08/07/19

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Preliminar activity diagra...	24/10/16	28/10/16
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Refinements of requirem...	02/11/16	04/11/16
Refinement of activity di...	02/11/16	04/11/16
III meeting with stakehol...	07/11/16	07/11/16
Final Requirements	08/11/16	08/11/16
Final assumptions	08/11/16	14/11/16
Final activity diagrams	08/11/16	14/11/16
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High level draft of archite...	05/12/16	06/12/16
Identification of compon...	08/12/16	08/12/16
UI draft	05/12/16	12/12/16
Meeting with stakeholders	12/12/16	12/12/16
Revision of architecture	13/12/16	14/12/16
Refinement of compone...	15/12/16	16/12/16
First draft of component ...	19/12/16	23/12/16
Christmas Time	26/12/16	06/01/17
UI revision	09/01/17	13/01/17
Initial Algorithm design	09/01/17	09/01/17
Meeting with stakeholders	16/01/17	16/01/17
UI refinement	17/01/17	17/01/17
Algorithm design refine...	17/01/17	23/01/17
Definition of component ...	17/01/17	23/01/17
Meeting with stakeholders	24/01/17	24/01/17
Final UI mockups	25/01/17	27/01/17
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Final algorithm design	25/01/17	27/01/17
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Third internal demonstra...	02/10/18	02/10/18
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Final refinements	04/10/18	12/10/18
Final internal demonstrat...	15/10/18	15/10/18
User manual redaction	04/10/18	12/10/18
First Release	15/10/18	15/10/18
Extra days	16/10/18	22/10/18
DEVELOPEMENT	23/10/18	22/03/19
System deployement	23/10/18	25/12/18
Operators training	26/12/18	22/01/19
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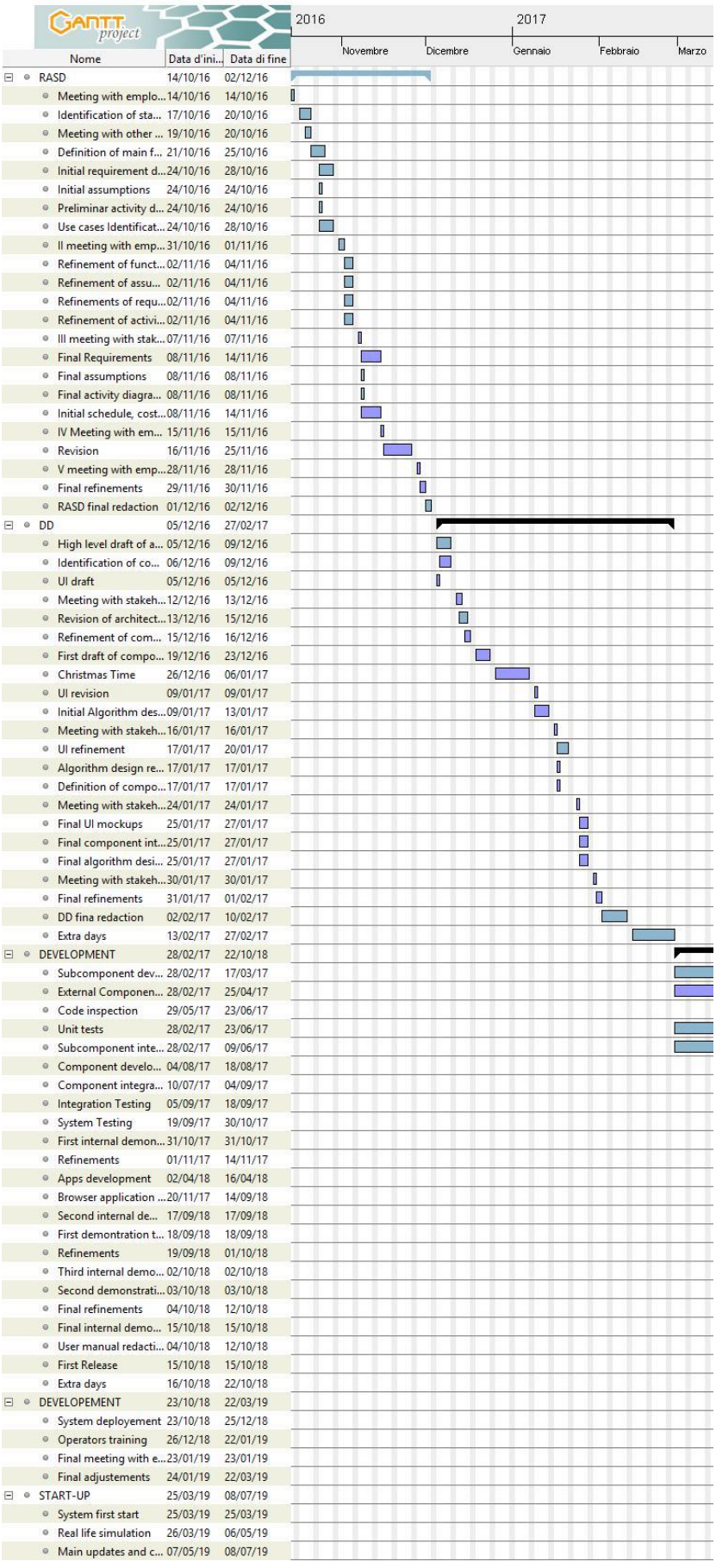
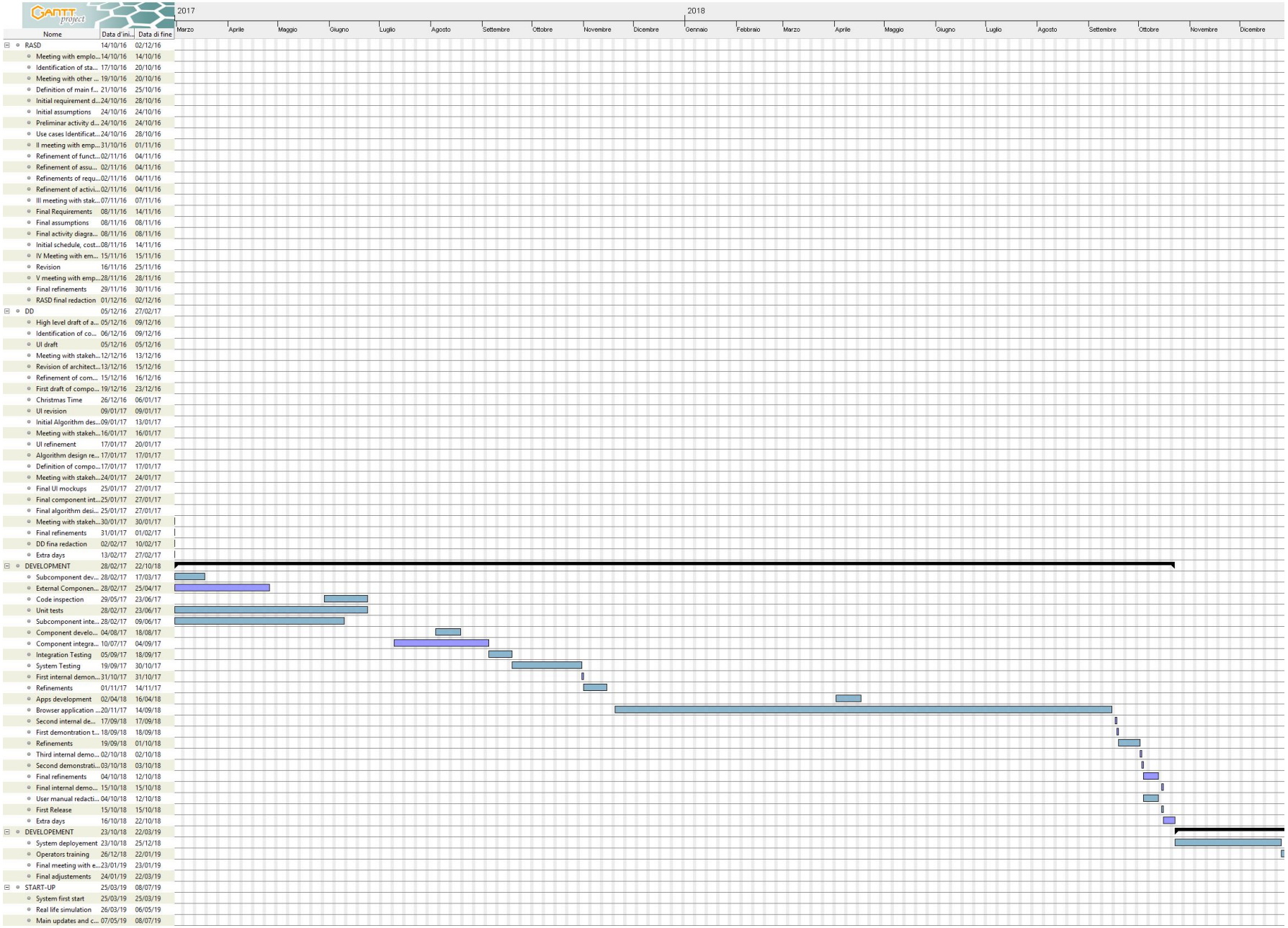
Final adjustements	24/01/19	22/03/19
START-UP	25/03/19	08/07/19
System first start	25/03/19	25/03/19
Real life simulation	26/03/19	06/05/19
Main updates and checks	07/05/19	08/07/19

4.2 Gnecco



Nome	Data d'ini...	Data di fine
RASD	14/10/16	02/12/16
Meeting with emplo...	14/10/16	14/10/16
Identification of sta...	17/10/16	20/10/16
Meeting with other ...	19/10/16	20/10/16
Definition of main f...	21/10/16	25/10/16
Initial requirement d...	24/10/16	28/10/16
Initial assumptions	24/10/16	24/10/16
Preliminar activity d...	24/10/16	24/10/16
Use cases Identificat...	24/10/16	28/10/16
II meeting with emp...	31/10/16	01/11/16
Refinement of funct...	02/11/16	04/11/16
Refinement of assu...	02/11/16	04/11/16
Refinements of requ...	02/11/16	04/11/16
Refinement of activi...	02/11/16	04/11/16
III meeting with stak...	07/11/16	07/11/16
Final Requirements	08/11/16	14/11/16
Final assumptions	08/11/16	08/11/16
Final activity diagra...	08/11/16	08/11/16
Initial schedule, cost...	08/11/16	14/11/16
IV Meeting with em...	15/11/16	15/11/16
Revision	16/11/16	25/11/16
V meeting with emp...	28/11/16	28/11/16
Final refinements	29/11/16	30/11/16
RASD final redaction	01/12/16	02/12/16
DD	05/12/16	27/02/17
High level draft of a...	05/12/16	09/12/16
Identification of co...	06/12/16	09/12/16
UI draft	05/12/16	05/12/16
Meeting with stakeh...	12/12/16	13/12/16
Revision of architect...	13/12/16	15/12/16
Refinement of com...	15/12/16	16/12/16
First draft of compo...	19/12/16	23/12/16
Christmas Time	26/12/16	06/01/17
UI revision	09/01/17	09/01/17
Initial Algorithm des...	09/01/17	13/01/17
Meeting with stakeh...	16/01/17	16/01/17
UI refinement	17/01/17	20/01/17
Algorithm design re...	17/01/17	17/01/17
Definition of compo...	17/01/17	17/01/17
Meeting with stakeh...	24/01/17	24/01/17
Final UI mockups	25/01/17	27/01/17
Final component int...	25/01/17	27/01/17
Final algorithm desi...	25/01/17	27/01/17
Meeting with stakeh...	30/01/17	30/01/17
Final refinements	31/01/17	01/02/17
DD fina redaction	02/02/17	10/02/17
Extra days	13/02/17	27/02/17
DEVELOPMENT	28/02/17	22/10/18
Subcomponent dev...	28/02/17	17/03/17
External Componen...	28/02/17	25/04/17
Code inspection	29/05/17	23/06/17
Unit tests	28/02/17	23/06/17
Subcomponent inte...	28/02/17	09/06/17
Component develo...	04/08/17	18/08/17
Component integra...	10/07/17	04/09/17
Integration Testing	05/09/17	18/09/17
System Testing	19/09/17	30/10/17
First internal demon...	31/10/17	31/10/17
Refinements	01/11/17	14/11/17
Apps development	02/04/18	16/04/18
Browser application ...	20/11/17	14/09/18
Second internal de...	17/09/18	17/09/18
First demontration t...	18/09/18	18/09/18
Refinements	19/09/18	01/10/18
Third internal demo...	02/10/18	02/10/18
Second demonstrati...	03/10/18	03/10/18
Final refinements	04/10/18	12/10/18
Final internal demo...	15/10/18	15/10/18
User manual redacti...	04/10/18	12/10/18
First Release	15/10/18	15/10/18
Extra days	16/10/18	22/10/18
DEVELOPEMENT	23/10/18	22/03/19
System deployement	23/10/18	25/12/18
Operators training	26/12/18	22/01/19
Final meeting with e...	23/01/19	23/01/19
Final adjustements	24/01/19	22/03/19
START-UP	25/03/19	08/07/19
System first start	25/03/19	25/03/19
Real life simulation	26/03/19	06/05/19
Main updates and c...	07/05/19	08/07/19



Nome	Data d'ini...	Data di fine
RASD	14/10/16	02/12/16
Meeting with emplo...	14/10/16	14/10/16
Identification of sta...	17/10/16	20/10/16
Meeting with other ...	19/10/16	20/10/16
Definition of main f...	21/10/16	25/10/16
Initial requirement d...	24/10/16	28/10/16
Initial assumptions	24/10/16	24/10/16
Preliminar activity d...	24/10/16	24/10/16
Use cases Identificat...	24/10/16	28/10/16
II meeting with emp...	31/10/16	01/11/16
Refinement of funct...	02/11/16	04/11/16
Refinement of assu...	02/11/16	04/11/16
Refinements of requ...	02/11/16	04/11/16
Refinement of activi...	02/11/16	04/11/16
III meeting with stak...	07/11/16	07/11/16
Final Requirements	08/11/16	14/11/16
Final assumptions	08/11/16	08/11/16
Final activity diagra...	08/11/16	08/11/16
Initial schedule, cost...	08/11/16	14/11/16
IV Meeting with em...	15/11/16	15/11/16
Revision	16/11/16	25/11/16
V meeting with emp...	28/11/16	28/11/16
Final refinements	29/11/16	30/11/16
RASD final redaction	01/12/16	02/12/16
DD	05/12/16	27/02/17
High level draft of a...	05/12/16	09/12/16
Identification of co...	06/12/16	09/12/16
UI draft	05/12/16	05/12/16
Meeting with stakeh...	12/12/16	13/12/16
Revision of architect...	13/12/16	15/12/16
Refinement of com...	15/12/16	16/12/16
First draft of compo...	19/12/16	23/12/16
Christmas Time	26/12/16	06/01/17
UI revision	09/01/17	09/01/17
Initial Algorithm des...	09/01/17	13/01/17
Meeting with stakeh...	16/01/17	16/01/17
UI refinement	17/01/17	20/01/17
Algorithm design re...	17/01/17	17/01/17
Definition of compo...	17/01/17	17/01/17
Meeting with stakeh...	24/01/17	24/01/17
Final UI mockups	25/01/17	27/01/17
Final component int...	25/01/17	27/01/17
Final algorithm desi...	25/01/17	27/01/17
Meeting with stakeh...	30/01/17	30/01/17
Final refinements	31/01/17	01/02/17
DD fina redaction	02/02/17	10/02/17
Extra days	13/02/17	27/02/17
DEVELOPMENT	28/02/17	22/10/18
Subcomponent dev...	28/02/17	17/03/17
External Componen...	28/02/17	25/04/17
Code inspection	29/05/17	23/06/17
Unit tests	28/02/17	23/06/17
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Component integra...	10/07/17	04/09/17
Integration Testing	05/09/17	18/09/17
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First internal demon...	31/10/17	31/10/17
Refinements	01/11/17	14/11/17
Apps development	02/04/18	16/04/18
Browser application ...	20/11/17	14/09/18
Second internal de...	17/09/18	17/09/18
First demontration t...	18/09/18	18/09/18
Refinements	19/09/18	01/10/18
Third internal demo...	02/10/18	02/10/18
Second demonstrati...	03/10/18	03/10/18
Final refinements	04/10/18	12/10/18
Final internal demo...	15/10/18	15/10/18
User manual redacti...	04/10/18	12/10/18
First Release	15/10/18	15/10/18
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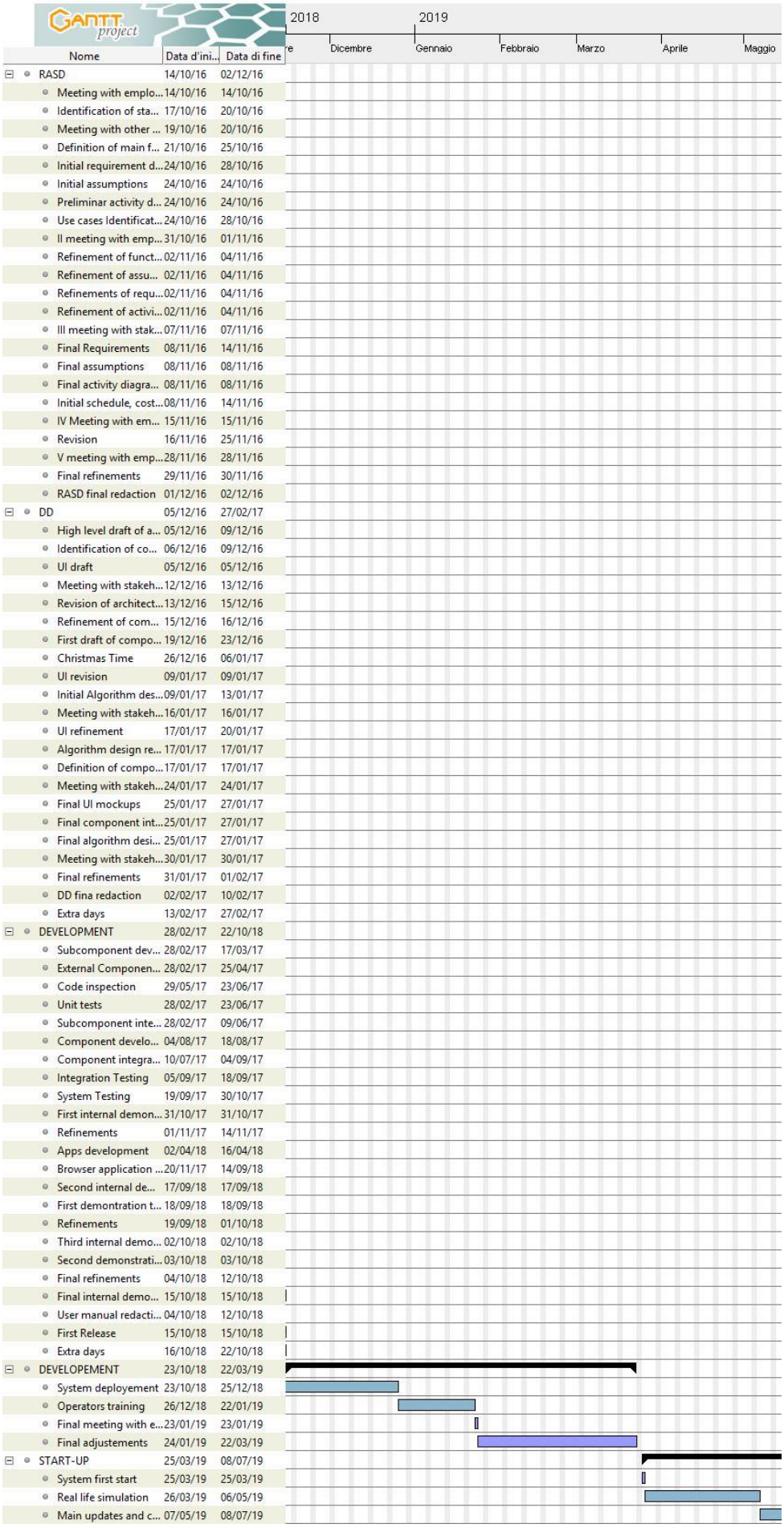
GANTT project
2018
2019
Nome
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Data di fine
Dicembre
Gennaio
Febbraio
Marzo
Aprile
Maggio
RASD 14/10/16 02/12/16
Meeting with emplo... 14/10/16 14/10/16
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Refinement of assu... 02/11/16 04/11/16
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Refinement of activi... 02/11/16 04/11/16
III meeting with stak... 07/11/16 07/11/16
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Final assumptions 08/11/16 08/11/16
Final activity diagra... 08/11/16 08/11/16
Initial schedule, cost... 08/11/16 14/11/16
IV Meeting with em... 15/11/16 15/11/16
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RASD final redaction 01/12/16 02/12/16
DD 05/12/16 27/02/17
High level draft of a... 05/12/16 09/12/16
Identification of co... 06/12/16 09/12/16
UI draft 05/12/16 05/12/16
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Revision of architect... 13/12/16 15/12/16
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Christmas Time 26/12/16 06/01/17
UI revision 09/01/17 09/01/17
Initial Algorithm des... 09/01/17 13/01/17
Meeting with stakeh... 16/01/17 16/01/17
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Algorithm design re... 17/01/17 17/01/17
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Final refinements 04/10/18 12/10/18
Final internal demo... 15/10/18 15/10/18
User manual redacti... 04/10/18 12/10/18
First Release 15/10/18 15/10/18
Extra days 16/10/18 22/10/18
DEVELOPEMENT 23/10/18 22/03/19
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START-UP 25/03/19 08/07/19
System first start 25/03/19 25/03/19
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Nome	Data d'ini...	Data di fine
RASD	14/10/16	02/12/16
Meeting with emplo...	14/10/16	14/10/16
Identification of sta...	17/10/16	20/10/16
Meeting with other ...	19/10/16	20/10/16
Definition of main f...	21/10/16	25/10/16
Initial requirement d...	24/10/16	28/10/16
Initial assumptions	24/10/16	24/10/16
Preliminar activity d...	24/10/16	24/10/16
Use cases Identificat...	24/10/16	28/10/16
II meeting with emp...	31/10/16	01/11/16
Refinement of funct...	02/11/16	04/11/16
Refinement of assu...	02/11/16	04/11/16
Refinements of requ...	02/11/16	04/11/16
Refinement of activi...	02/11/16	04/11/16
III meeting with stak...	07/11/16	07/11/16
Final Requirements	08/11/16	14/11/16
Final assumptions	08/11/16	08/11/16
Final activity diagra...	08/11/16	08/11/16
Initial schedule, cost...	08/11/16	14/11/16
IV Meeting with em...	15/11/16	15/11/16
Revision	16/11/16	25/11/16
V meeting with emp...	28/11/16	28/11/16
Final refinements	29/11/16	30/11/16
RASD final redaction	01/12/16	02/12/16
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High level draft of a...	05/12/16	09/12/16
Identification of co...	06/12/16	09/12/16
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Meeting with stakeh...	12/12/16	13/12/16
Revision of architect...	13/12/16	15/12/16
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First draft of compo...	19/12/16	23/12/16
Christmas Time	26/12/16	06/01/17
UI revision	09/01/17	09/01/17
Initial Algorithm des...	09/01/17	13/01/17
Meeting with stakeh...	16/01/17	16/01/17
UI refinement	17/01/17	20/01/17
Algorithm design re...	17/01/17	17/01/17
Definition of compo...	17/01/17	17/01/17
Meeting with stakeh...	24/01/17	24/01/17
Final UI mockups	25/01/17	27/01/17
Final component int...	25/01/17	27/01/17
Final algorithm desi...	25/01/17	27/01/17
Meeting with stakeh...	30/01/17	30/01/17
Final refinements	31/01/17	01/02/17
DD fina redaction	02/02/17	10/02/17
Extra days	13/02/17	27/02/17
DEVELOPMENT	28/02/17	22/10/18
Subcomponent dev...	28/02/17	17/03/17
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Code inspection	29/05/17	23/06/17
Unit tests	28/02/17	23/06/17
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Integration Testing	05/09/17	18/09/17
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First internal demon...	31/10/17	31/10/17
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Apps development	02/04/18	16/04/18
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Second internal de...	17/09/18	17/09/18
First demontration t...	18/09/18	18/09/18
Refinements	19/09/18	01/10/18
Third internal demo...	02/10/18	02/10/18
Second demonstrati...	03/10/18	03/10/18
Final refinements	04/10/18	12/10/18
Final internal demo...	15/10/18	15/10/18
User manual redacti...	04/10/18	12/10/18
First Release	15/10/18	15/10/18
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5. Risk Management

The following content is dedicated to the analysis of risks and the corresponding management; risks are various, they will be faced in detail, but they can be categorized into three main classes: technical, financial and human-related. Clearly, the first kind is possibly caused by a technical issue, the second one by a bad evaluation from a certain point of view, and the third one is the class of possible troubles arising from the particular situation our group has to face: the team is made only of two elements and every kind of inoperability, due to illnesses or whatever, can propagate a great impact on the scheduling and the project. The topics will be faced in detail.
However, a part from the previous categorization, risks will be listed from the first steps of Power Enjoy application to the end; in other words, we will start from contextual risks, such as workers' unions or "bad" stakeholders, to the already mentioned human-related issues, causing a possible great delay in our original plan.

First risk that can afflict our project consists in the workers' unions; they are not manageable or avoidable from our point of view, they would cause a block of part of the system; it wouldn't cause an immediate impact of the incomes but, after a certain period, the lack of available cars is absolutely a very important problem for Power Enjoy system. Due to this peculiarity, we considered these unions as part of the main stakeholders, this could represent a solution: mitigating on short-term problems, preserving long-term efficiency. This is considerable as a personnel shortfall as far as human-related risks.

Secondly, it has to be noticed how related risks can emerge: workers' unions are part of the stakeholders, but they aren't neither the principle component; from this consideration, many important issues can derive: lack of budget, change of government, competitions with other service providers, as for example bus or metro dealers, may definitely determine whether our project will be developed or not. Fortunately, all these kinds of risks can be dealt, but not ensured to be resolved, applying the same idea: a more active participation of stakeholders, increasing the number of the meetings and keeping track of all the changes, trying to stay as independent as possible with respect to the internal organization of groups involved.

Thirdly, a possible source of risk is the legislative point of view of the entire application. We kept track of every ride to deal with assurances and mitigate problems related to incidents, however that will not solve other possible issues. Our project doesn't consider the method through which safe areas are distributed in the city, but a possible problem would surely arise if a new legislation went to change those location, for example to create more green areas in the city, or pedestrian ones. That can be partially solved as the second point; there are several more sophisticated cases though, that must be managed at a higher level possibly changing the RAS or the scheduling, for example due to a cut of the budget or of the possible inducements from the government.

Another important issue arises from the RAS examination: the possibility of being told wrong instructions or to misunderstand the requirements given. Generalizing the concept, we could enlarge this set of risks including all the possible human errors deriving from unformal, unprecise situations. A proper meeting schedule and a clear way of communication would solve this risk, however imprecision is a part of the human being, we won't be able to create the perfect system and we know that, anyway, we can minimize the error between the actual realization and the idea of our clients. There remains the possibility that our clients don't know precisely what they want, or how they want, giving us a certain degree of freedom; however, as we said, a proper meeting schedule will hopefully solve this kind of problems.

Lastly from the RAS view, there is the possible risk of having too many fresh requirements, the need of a malleable structure from the clients' point of view, that however remains incompatible with PowerEnjoy capabilities. Fortunately, we consider this kind of problem less frequent with respect to the previous ones: the reason is found in the nature of our stakeholders, indeed, we consider them as "stable" ones; in other words, we think that their ideas can't change so frequently to overload our capabilities of adapting.

Now, approaching the Design possible issues, we can't avoid to underline the correlation between a wrong requirement analysis and its consequent design realization. This is fundamental, we don't want a cascade of unprecise, or even wrong, actions which would only lead to a loss of money and time. This is the main reason of so much attention to the previous step.

However, other possible issues can be here identified: risks and weak points of the design are strongly correlated, this is the key concept of our analysis. The first dependency of our system is based on external services and APIs: if they go down, the entire application could consequently fall. The avoidance of such case is organized considering separately those services depending on the providers. So, those whose providers are stakeholders, for example the case of the police APIs, are managed as described in the previous section. There remains still an important class of service providers anyway, they are the Google and the bank ones. In both cases the management consists in contacting them and creating a reliable contract for the usage of the respective APIs. That can be a source of costs and possibly a loss of customers, for example if a certain kind of payment or a specific credit card is not supported. A dedicated amount of time and attentions is recommended to face these problems while designing the application.

As we said, key points where to start are the weak ones of the application: possible risk arises from a non-reliable set of databases. Data must be valid and always ready. There can't be any other case. But, if it happened, our reaction would be to stop clients' interactions and fix as soon as possible the issue. However, this delay could cause a great amount of money lost. The idea is to improve the technologies through the new database and increase the number of mirroring disks and channels to a better and more reliable communication with the old one.

Other aspects of the component risks are: reliability of the connection between server and devices, free possibility of giving suitable devices to the operators and the affordability of the cars; these aspects are to be satisfied as far as we can, unfortunately there isn't a possible Boolean evaluation: they can be up or down, but the range of possible values lies between those boundaries, for instance we can imagine a car partially damaged but still working, the outcome behaviour will depend only on which components are seriously damaged.
A sort of fuzzy logic should be involved or a proper analysis based on the environmental statistics and on the probabilistic frequency of failures could give us an idea of the magnitude of the problem and so the reaction to be taken. However, we assumed in the RAS Document that these won't be a source of risks, a possible solution is to decrease the number of hardware and cars needed or to increase the dedicated budget.

Risks related to the software can be various: we classify them into two different sets. The first set is the one dedicated to the logic, here bugs and other issues are dealt through exceptions or other method, closer to the analysis seen in previous documents. For what concerns the human interfaces, the problem is mainly how the customers interact with the application; for this reason, statistical tools can be adopted to understand the behaviour of the customers and so to improve our service. However, the chosen approach here was to maintain as simple as possible the interface, following the paradigm "less is more". Furthermore, we will perform UI tests before the release of the application. In conclusion, maintainability and improvements are encouraged by our choices and way of thinking the application, ad hoc solutions will be latterly adopted in an easier way.

Finally, the last considerations regard the planning phase: those risks related to a bad time or resource allocation. A bad schedule or evaluation will lead to extra demands or possibly to the loss of the client because of a too expensive request. The method to handle this problem is to properly detailing the costs for each subcomponent and functionality; that's also the aim of the first part of this document.
Also, there is the risk of delays due to human-related problems, as we previously introduced; in other terms, that possible issue is generated by the fact that our group is composed of two people and therefore

if one of the two gets ill, or unable to work, all the corresponding load must be processed by the other member. This is a very important problem and the only feasible solution is to increase as much as possible the number of meetings and exchanges between the two members of the team.

6. Changelog

6. Hours of work

- Enrico Gnecco: 16 hours;
- Pietro Crovari: 16 Hours;