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PowerEnJoy, Project Plan

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# Introduction

## Purpose and Scope

This Project Plan Document aims at:

* Estimating the overall project size;
* Thus, estimating the effort needed and the time required to project, develop and test the PowerEnjoy System;
* Defining project schedule and the division of tasks among team members;
* Identifying all the possible risks, and the related actions that should be taken.

## List of Definitions and Abbreviations

* BL: Business Logic
* ITPD: Integration Test Plan Document
* DD: Design document;
* RASD: Requirements Analysis and Specification Document;
* COCOMO II: COnstructive COst MOdel, version II.2000.0
* KSLOC: Kilo Source Line Of Code
* FP: Function Point
* UFP: Unadjusted Functional Point;
* ILF: Internal Logic File
* ELF: External Logic File
* PM: Person Month

## List of Reference Documents

* Specification Document: Assignments AA 2016-2017.pdf;
* RASD v1.1 Document;
* Design Document v1.1;
* ITPD Document v1.0;
* Example of Project Reporting Documents from previous years;

# Size estimation: Function Points

## Introduction

We use Functional Point approach in order to assess the final dimension of the project. It is based on the evaluation of the functionalities of the software to be, that have been taken from the RASD Document. It is also possible to convert Function Points to KSLOC, which will be used in COCOMO to evaluate the effort needed to accomplish the system.

The functionalities has been grouped in:

* Internal Logic File: it represents a set of homogeneous data handled by the system;
* External Interface File: it represents a set of homogeneous data used by the application but handled by external application;
* External Input: elementary operation that allows input of data in the system;
* External Output: elementary operation that creates a bitstream towards the outside of the application;
* External Inquiry: elementary operation that involves input and output operations.

The following table outline the number of Functional Points based on functionalities and relative complexity. The total number of FPs can be computed as the weighted sum of function types using the coefficient listed below:

|  |  |  |  |
| --- | --- | --- | --- |
| *Function Type* | *Complexity* | | |
| *Simple* | *Medium* | *Complex* |
| Internal Logic File | 7 | 10 | 15 |
| External Logic File | 5 | 7 | 10 |
| External Input | 3 | 4 | 6 |
| External Output | 4 | 5 | 7 |
| External Inquiry | 3 | 4 | 6 |

## Function Points Estimation

### Internal Logic Files

The system includes a number of ILFs that will be used to store the information about:

* Users: few simple information, such username, password, email;
* Cars: static information such as model of the car and seats, dynamic information such as battery level and availability. Because of the communication and the synchronization with the remote system of the car, we have considered this point as high complexity.
* Reservations: the system has to keep updated information about each reservation, with related start time and start area, car and user involved, and eventually final cost, obtained with the help of data from the car;
* Rides: information about starting and releasing time of a ride and release area;
* Safe Areas: information on location of a safe area, possibly the possibility of charging a car.

|  |  |  |
| --- | --- | --- |
| *ILF* | *Complexity* | *FPs* |
| User | Low | 7 |
| Car | High | 15 |
| Reservation | Medium | 10 |
| Ride | Low | 7 |
| Safe Area | Low | 7 |
| Total | | 46 |

### External Logic Files

The system has to interact with two external handlers:

* Payment Handler: the interaction is simple, because the more complex operations are all performed by the external handler, the system has only to receive and store information;
* Search-on-a-map Handler: interaction is more frequent and complex, the system possibly overlays information on received map;

|  |  |  |
| --- | --- | --- |
| *ELF* | *Complexity* | *FPs* |
| Payment | Simple | 5 |
| Map | Medium | 7 |
| Total | | 12 |

### External Inputs

The system interacts with the user to allow him/her to:

* Login/logout: these are simple operations, so we can adopt the simple weight for them;
* Sign-up: validation of payment is performed of external handler, we can adopt the simple weight for this operation;
* Change Payment Info: as above, we have considered it as a simple operation;
* Search for an address: the user insert an address manually and the system shows a map centred on that address. Both the manual insertion and the GPS position are managed maintaining simple interaction between components;
* Show information about a Safe Area: after the user has selected a safe area, the system shows information about available cars in that area and possibly power grids status. Since it implies interaction of multiple entities, we have considered it as medium complexity;
* Reserve an available car: The user select one car to be reserved among the available ones. This operation implies multiple interaction: for example, the car has to be marked as unavailable, a reservation code has to be shown in the car dashboard and the expiration of the reservation has to be checked.
* Unlock a car: the user insert the code shown on the car dashboard in order to unlock the car he/she has just reserved, we have considered it as medium complexity because it implies synchronization between multiple components;

|  |  |  |
| --- | --- | --- |
| *Ext. Input* | *Complexity* | *FPs* |
| Login/logout | Low | 3 |
| Sign-up | Low | 3 |
| Payment Info | Low | 3 |
| Search for an address | Medium | 4 |
| Reserve an available car | High | 6 |
| Unlock a car | Medium | 4 |
| Total | | 23 |

### External Outputs

* Ride Conclusion: after that the user has concluded a ride, the system updates ride and reservation entities and calculates the final discharged cost that the user has automatically payed. These data are saved and stored in order to allow the user to consult order history.

|  |  |  |
| --- | --- | --- |
| *Ext. Output* | *Complexity* | *FPs* |
| Ride Conclusion | Medium | 5 |
| Total | | 5 |

### External Inquiries

* Search of near available Cars: the user can search for Safe Areas with almost one available car that are near a certain address. The process of this request involves fairly complex algorithm in order to optimize the search performance.
* Reservation History: each user can consult his/her personal reservation history. This process does not implies complex algorithms.

|  |  |  |
| --- | --- | --- |
| *Ext. Inquiry* | *Complexity* | *FPs* |
| Near Cars | High | 6 |
| Reservation History | Low | 3 |
| Total | | 9 |

## Total FP number and summary

|  |  |
| --- | --- |
| *Function Type* | *Unadjusted Functional Points* |
| Internal Logic File | 46 |
| External Logic File | 23 |
| External Input | 12 |
| External Output | 5 |
| External Inquiry | 9 |
| Total | 95 |

By summing up all these numerical values we get a total estimation of 95 UFP.

It is possible to estimate a number of line of code from the number of functional points.

We have used the value present in the table found at this URL: <http://www.qsm.com/resources/function-point-languages-table>

***[KSLOC/UFP] J2EE: 46***

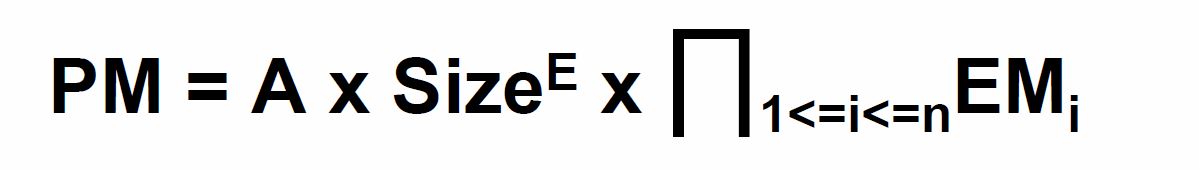
The total estimated number of KSLOC is 46\*95= **4370** **KSLOC**

# Effort and cost estimation: COCOMO II

## Introduction

Thanks to COCOMO, we can estimate the number of effort needed to accomplish the finished system.

This estimation, whose unit of measure in the Person Month, is achieved through a complex, non-linear model that takes in account the characteristics of the product but also of people and process.

The general equation that calculates the effort needed is:

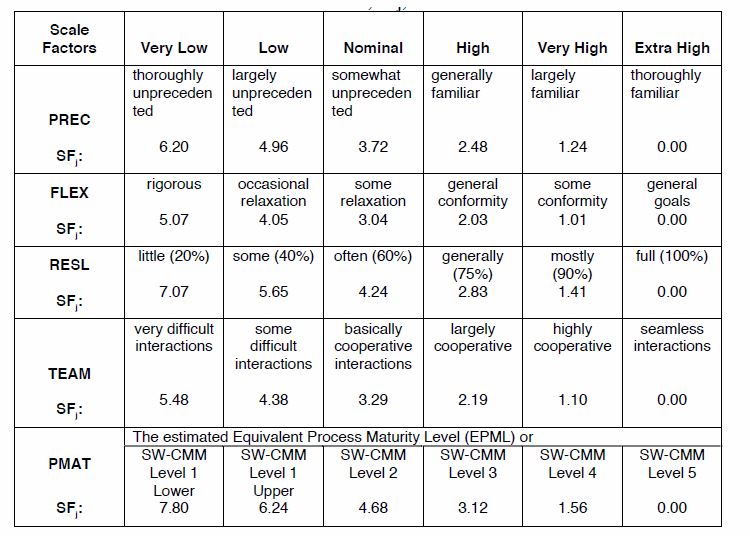
We have already found the Size parameter thank to the UFP.

Now we have to found the value of the parameter E, which is an aggregation of five Scale Factors, and the parameter EM, which are the Effort Multiplier.

All the tables used in this analysis have been taken from COCOMO II, Model Definition

Manual at: <http://csse.usc.edu/csse/research/COCOMOII/cocomo2000.0/CII_modelman2000.0.pdf>

## Scale Factors



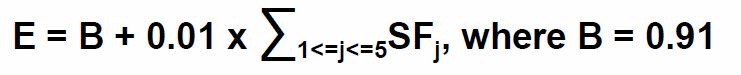
These are the five Scale Factors with our evaluation for this project:

* Precedentedness: It reflects the previous experience that we have with this kind of projects. We have different past experience, but generally this is the first experience using this framework and these development methodologies, this value will be Low;
* Development Flexibility: It reflects the degree of flexibility in the development process. We have only some clear general goals, so it is possible to classify the factor as High;
* Risk Resolution: Reflects the extent of risk analysis carried out. Thanks to Risk and Recovery Actions analysis carried out in the following chapters of this document, this factor can be considered as High;
* Team Cohesion: Team members know each other very well, thus the cooperation can be proactive. All the stakeholders seems to have the same vision, so we have evaluated this factor as Very High;
* Process Maturity: We have analysed the process maturity and we have concluded that this factor can be evaluated as Nominal.

Results are summarized in the following table:

|  |  |  |
| --- | --- | --- |
| *Scale Factor* | *Evaluation* | *Value* |
| Precedentedness | Low | 4,96 |
| Development flexibility | High | 2,03 |
| Risk resolution | High | 2,83 |
| Team cohesion | Very High | 2,19 |
| Process maturity | Nominal | 4,68 |
| Total | | 16,69 |

It is now possible to calculate the parameter E of the Effort Formula, using the following:



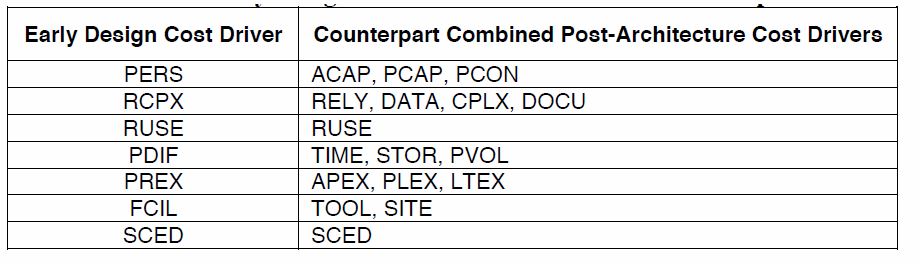
, where B=0,91 .

Hence **E = 1,0769 .**

## Cost Drivers

We have to consider Cost Drivers for an Early Design System, because the PowerEnjoy system has to be built from the ground up.

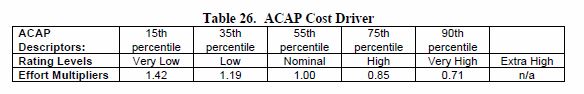
Early design evaluation implies the combination of multiple cost drivers arising from Post Architecture Estimation, following this table:



We will now calculate the value of each early design cost driver by evaluating the corresponding post-architecture cost drivers. Each of these has a rating scale from Very Low (=1) to Very High (=5). Adding up their numerical ratings produces a value, that corresponds to a certain Rating Level with related Effort Multiplyer.

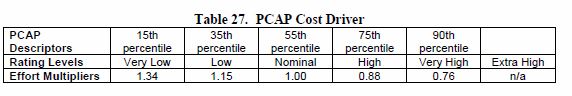
### Personnel Capability (PERS)

* Analyst Capability (ACAP) – High:



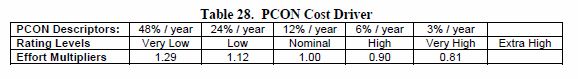
Design and analysis abilities should be set to high, since a lot of effort will be dedicated in analysing the problem specification and requirements, drafting the RASD Document, and designing the hardware and software architecture, drafting the Design Document. Moreover, most of the ambiguities present in the initial description will be detailed and resolved in RASD, document that all the stockholders has to approve.

* Programmer Capability (PCAP) – High:



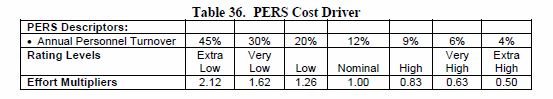
This parameter is evaluated according to our degree of cooperation, which is run in. Thus, the value is set to high.

* Personnel Continuity (PCON)– Low:



This parameter is relevant in particular since in the current case our available time is less than half a year. For this reason, we have set it to low.

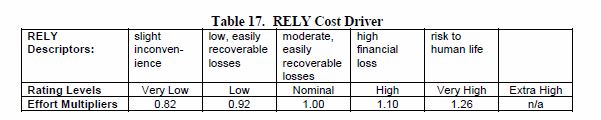
The total numeric value is 4+4+2=10.



This corresponds to a High Rating Level, and its related effort multiplier is **0.83** .

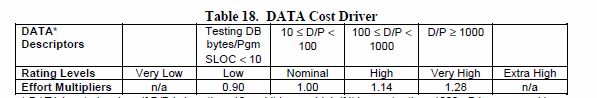
### Product Reliability and Complexity (RCPX)

* Required software reliability (RELY) – Nominal:



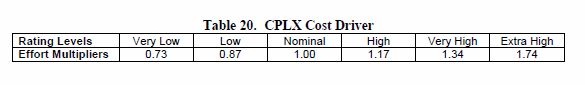
A software failure would not cause risks to human life, but would probably cause some financial problems.

* Database size (DATA) – High:



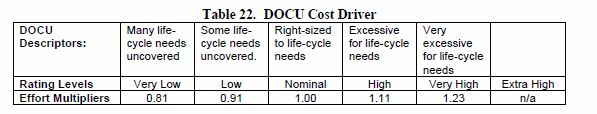
The size of data contained in the database will be probably quite big compared to the number of line of code. Thus, we have set this parameter as High.

* Product complexity (CPLX) – Nominal:

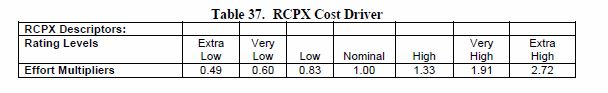


We have evaluated the complexity of control operations, computational operations, device-dependent operations, data management operations and user interface management operations, using the table provided in the COCOMO definition manual. We have evaluated the overall complexity as Nominal.

* Documentation match to life-cycle needs (DOCU) – High:



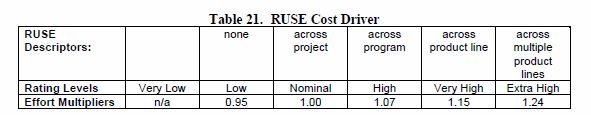
The completeness of documents that will be produced is high, but also the time and efforts required for drawing up them. Although this choice will reduce time and effort needed in other part of the project such as maintenance, because of the better understanding of project and software that all the documents guarantee.



The total numeric value is 3+4+3+4=14.

This corresponds to a High RCPX Rating Level, and its related effort multiplier is **1.33** .

### Developed for Reusability (RUSE)



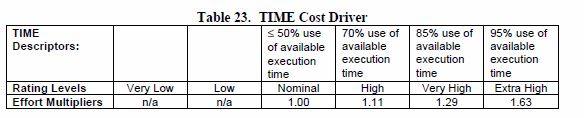
This Early Design model cost driver is the same as its Post-Architecture counterpart.

Thanks to the design that follows common software engineering principles, that enhance the reusability of code, we have set this parameter as High. This value fits also the constraints imposed by the value of Reliability and Database Size.

The High Rating Level corresponds to an effort multiplier of **1.07** .

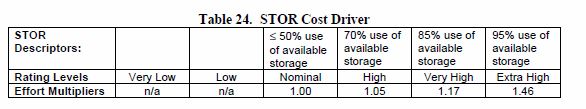
### Platform Difficulty (PDIF)

* Execution time constraint (TIME) – Nominal:



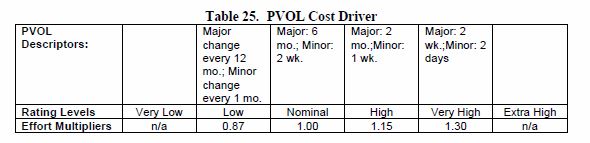
We have evaluated the execution time expected to be used by the system, consuming the total execution time resource, as Nominal. This because the the remarkable increase in available processor execution efficiency of modern CPUs.

* Main storage constraint (STOR) – Nominal:

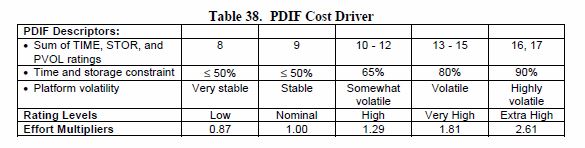


As for the Time constraint, also the storage constraint is subject to the same considerations. Our system has not any particular storage-angry feature, so it is quite simple to get hardware that will not give concerns about space occupation.

* Platform volatility (PVOL) – Nominal:



Changes in Mobile Systems are frequent, anyway a certain degree of backward compatibility is given. Thus, we have set the platform volatility as Nominal.

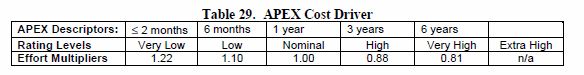


The total numeric value is 3+3+3=9.

This corresponds to a Nominal PDIF Rating Level, and its related effort multiplier is **1.00** .

### Personnel Experience (PREX)

* Application experience (APEX) – Low:



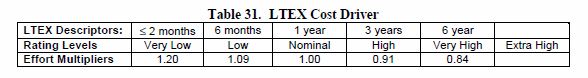
Our project experience is evaluated according to our previous experience in web

projects and also according to our abilities in programming in Java and most

importantly in the Java EE framework.

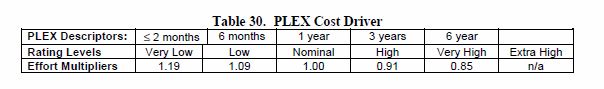
We have different past experiences, but, since we are still students, we can evaluate our experience as a Low value.

* Language and tool experience (LTEX) – Nominal:

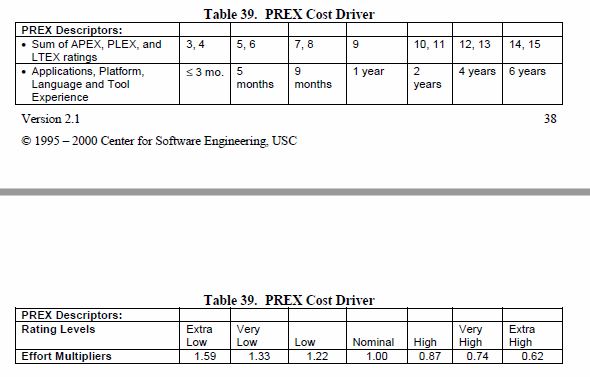


We have started using tools tools involved in software engeneering, such as ones that perform requirements and design representation and analysis, about one years ago. The best level that represents our language and tool experience is Nominal.

* Platform experience (PLEX) - Nominal:



Also our average knowledges about platforms, such as databases, user interfaces and server side development, are around one year.

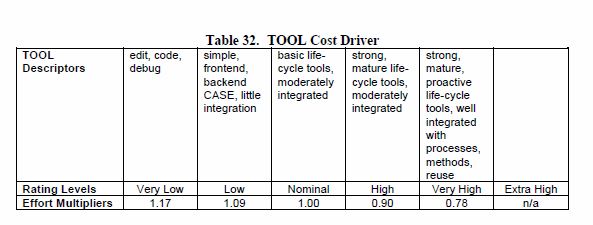


The total numeric value is 2+3+3=8.

This corresponds to a Low PREX Rating Level, and its related effort multiplier is **1.22** .

### Facilities (FCIL)

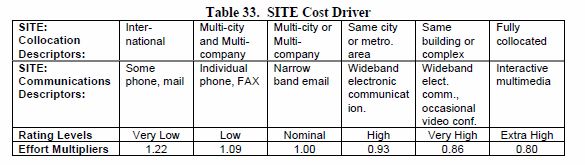
* Use of software tools (TOOL) – Nominal:



Tools that we will use during the project are, for example, Git, NetBeans, Maven and SonarQube, and others that will be mentioned in the other Documents.

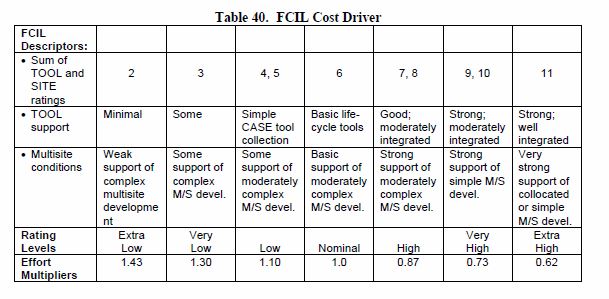
We think that the best level for this cost driver is Nominal, because tools mentioned above are simple basic lifecycle tools that are moderately integrated.

* Multisite development (SITE) – High:



This parameter reflects how we handled the distribution of development over distance and multiple platforms.

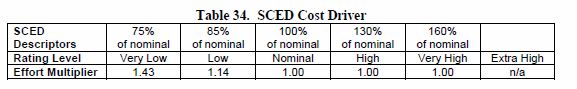
We think that the best value for our situation is High.



The total numeric value is 3+4=7.

This corresponds to a High FCIL Rating Level, and its related effort multiplier is **0.87** .

### Required Development Schedule (SCED)



Also this Early Design model cost driver is the same as its Post-Architecture counterpart.

We plan to distribute our efforts well over the available development time. We have selected the Nominal value for this cost driver.

The Nominal Rating Level corresponds to an effort multiplier of **1.00** .

### Summary

|  |  |  |
| --- | --- | --- |
| *Scale Driver* | *Factor* | *Value* |
| Personnel Capability | High | 0,83 |
| Product Reliability and Complexity | High | 1,33 |
| Developed for Reusability | High | 1,07 |
| Platform Difficulty | Nominal | 1,00 |
| Personnel Experience | Low | 1,22 |
| Facilities | High | 0,87 |
| Required Development Schedule | Nominal | 1,00 |
| Product | | 1,25 |

## Effort Equation

This final equation gives us the effort estimation measured in Person-Months (PM):

**Effort = A \* EAF \* KSLOC E**

Where:

* **A = 2,94** (for COCOMO.2000)
* **EAF = 1,25**: product of all the cost drivers;
* **E =** **1,0769**:exponent derived from Scale Factors. Is calculated as:

B + 0,01 \* sum{i} SF[i] = B + 0,01 \*16,69 = 0,91 + 0,1669 = 1,0769 and

in which B is equal to: 0,91 for COCOMO.2000;

* **KSLOC = 4370**: estimated lines of code using the FP analysis;

With this parameters we can compute the Effort value, that is equal to:

**Effort = 2,94 \* 1,25 \* 4370 1,0769 = 30.598 PM**

# Resource Allocation

# Risks and recovery actions

## Introduction

Risk management is an important phase of project planning, but it is often underestimated. Taking into account risks in advance means being proactive towards them. Primary objective of risk management is to avoid risks and to have a contingency plan in place to handle unavoidable risks in a controlled and effective manner.

There are some principles that we have always to follow:

* Encourage all stakeholders and users to point out risks at any time:

It is important to have an open communication, the whole project can only benefit if no one try to hide information and risks;

* Modify identified risks as more becomes known and add new risks as better insight is achieved;
* Develop a shared product vision, because a shared vision by all stakeholders facilitates better risk identification and assessment.

In next paragraphs, we have analysed some risks, ranking them by probability and impact. We have then developed a contingency plan for those that are not negligible.

## Risk Analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *ID* | *Type* | *Risk Description* | *Probability* | *Impact* |
| 1 | Project | Project size and complexity grow more than expected | High | Critical |
| 2 | Business | Customer not fully aware of project progress | High | Moderate |
| 3 | Business | Financial problems force reductions in the project budget | Moderate | Critical |
| 4 | Project | The development time is underestimated | Moderate | Critical |
| 5 | Project | Deadlines too close when drafting project documents | Moderate | Critical |
| 6 | Project | Key staff are ill at critical times in the project | Moderate | Serious |
| 7 | Project | Staff experience with used tools is not adequate | Moderate | Serious |
| 8 | Project | Changes to requirements that require major design rework are proposed | Moderate | Serious |
| 9 | Technical | The database used in the system cannot process as many transactions per second as expected | Moderate | Serious |
| 10 | Project | Integration tests shows that design of system has to be improved | Low | Critical |
| 11 | Technical | Car subsystem does not maintain an high level of reliability | Low | Critical |
| 12 | Technical | Database size grows more than expected | Low | Serious |
| 13 | Technical | An external handler changes its interface with the system | Low | Serious |

## Recovery Action

|  |  |
| --- | --- |
| *ID* | *Strategy* |
| 1 | Have a meeting with other team members, where have to be analysed what are the functions, components, interfaces or other piece of software which complexity is higher than expected. Then, check all the possible alternatives that try to simplify the design and the implementation. At the end, a document with all the taken design choices has to be drafted and has to be delivered to all the stakeholders involved. |
| 3 | Draft a briefing document for customers showing progress of the development, showing how the project is making a very important contribution to the goals of the business and presenting reasons why cuts to the project budget would not be cost effective. |
| 4 | Have a meeting with other team members, where point out problems during development that lengthened the schedule. Try to identify tools that would facilitate the development, or try to identify tasks that can be switched between team members. If the situation does not improve, take actions listed for risk 1. |
| 5 | Have a meeting with other team members, where point out what sections of document can be simplified in order to draft in time a simpler, but clear, document. |
| 6 | Try to identify tasks that can be switched between team members, what tasks can be delayed. If the situation does not improve, take actions listed for risk 4. |
| 7 | Have a meeting in which each team member explain what are key features that he knows for each tool. Try to identify documents, material or example on the web that can improve the knowledge. |
| 8 | Alert customer to potential difficulties and the possibility of delays because of changes in already approved RASD; investigate possibly buying-in or simplifying components to be developed. |
| 9 | Investigate the possibility of buying a higher-performance database; investigate the possibility to build more efficient algorithms, which interface with database. |

# Effort spent