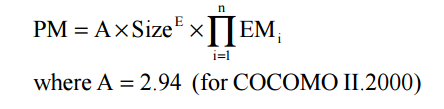
**1.qualcosa Effort and Duration Estimation with COCOMO II Method**

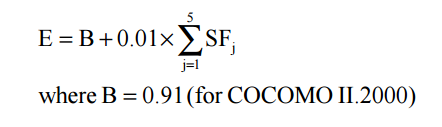
Once estimated the dimensions of the system-to-be, it is possible to make a first prevision of the software cost in terms of time spent and people allocated to the project.

The COCOMO (Constructive Cost MOdel) approach is based on effort and duration estimation using ad-hoc formulae that consider many parameters derived from previous projects data and future previsions.

The formula used for effort calculation is the following:

The effort is calculated in Persons-Month; in this case, the parameter Size is derived from the Function Points evaluation done before, E and EM are factors derived from respectively scale factors and cost drivers, i.e. elements that let the project manager consider the system necessities and have a preview of what the team needs to deal with.

The exponent E is obtained from the following expression:

SF are the mentioned scale factors, consider elements like developers experience, team cohesion, and project specifications.

Their value is decided with the help of the dedicated table.

Let’s analyse them in detail:

Precedentedness:

It reflects the previous experiences related to this kind of projects. In this case the team had already developed similar systems so the nominal value will be reflecting the actual situation.

Development flexibility:

It reflects the flexibility of costraints in the development process. The stakeholders set

precise specifications but without letting the development team free to choose the majority of implementation details, for this reason this value will be nominal.

Risk resolution:

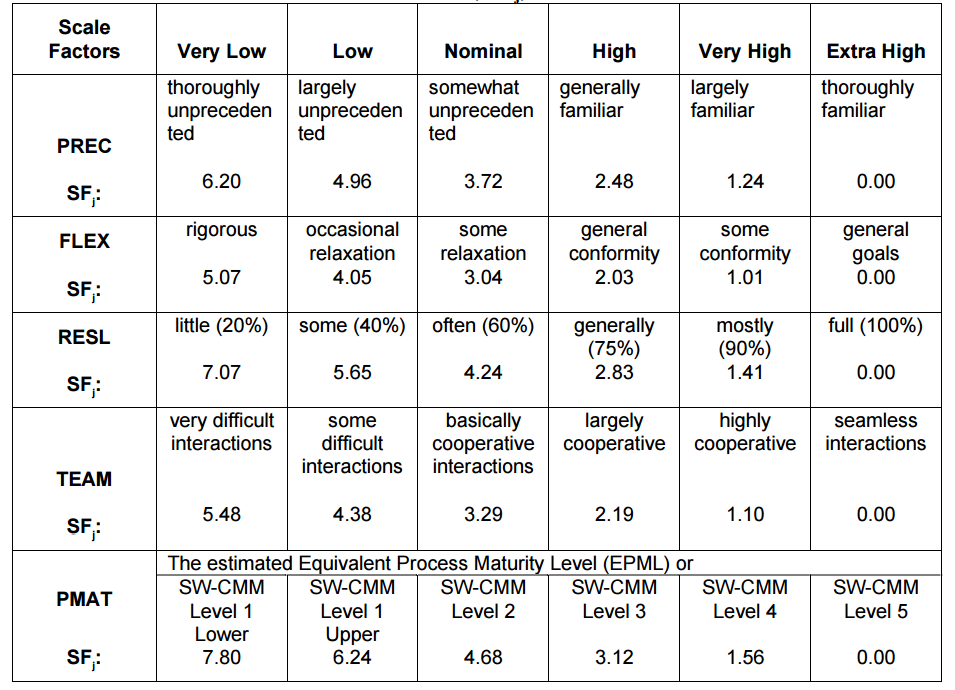
Reflects the extent of risk analysis. A well developed risk management plan corresponds to a high value in the table. In this case the value considered is nominal.

Team cohesion:

Reflects how the development team know each other and cooperate. In this case the team is united; people communicate and cooperate in an efficient way, so it is possible to consider a high value for this parameter.

Process maturity:

Reflects team maturity regarding project development management. Organization and adopted techniques influence this factor. For this project, the correct value is the nominal one since the project is developed under standard conditions.

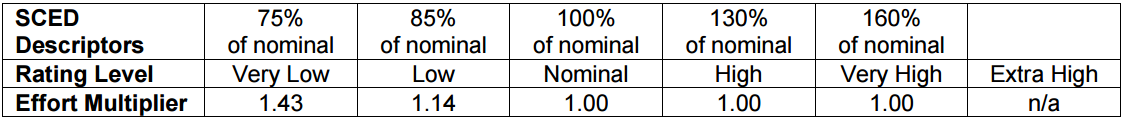
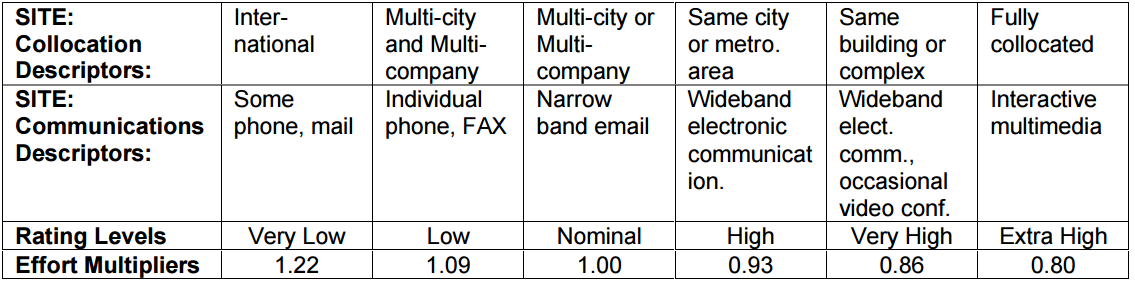
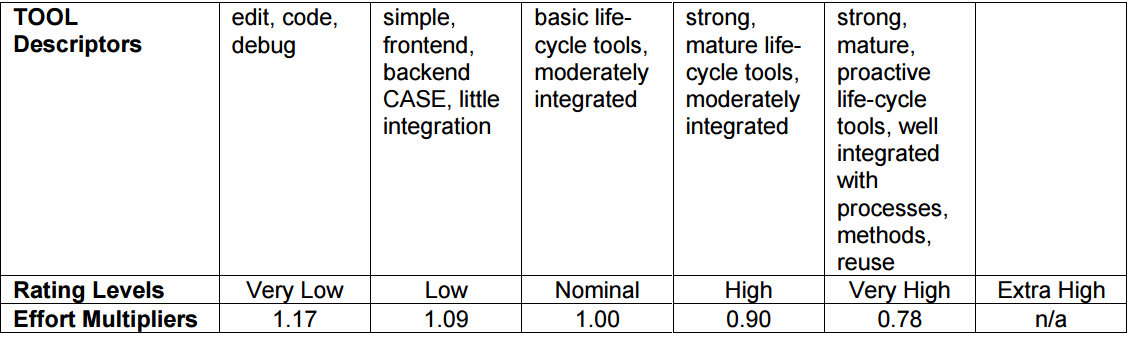
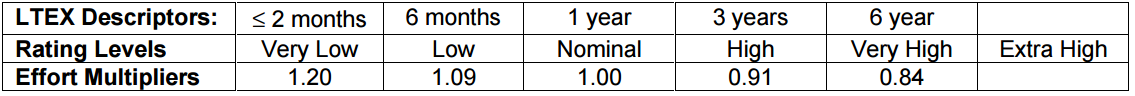
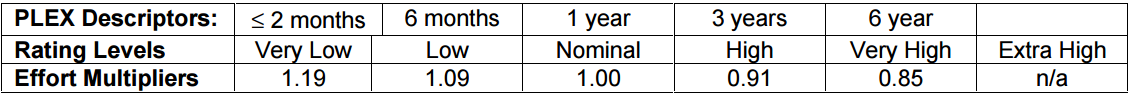
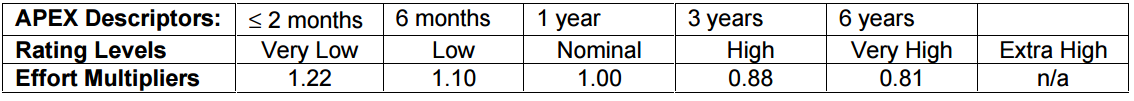
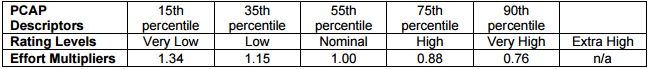
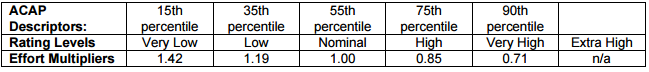
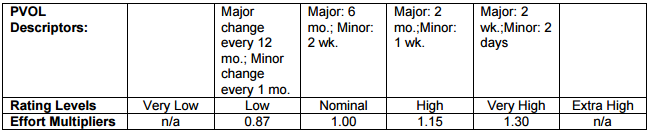
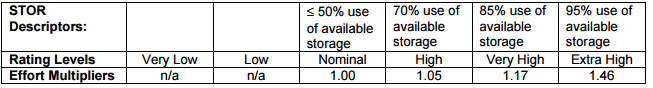
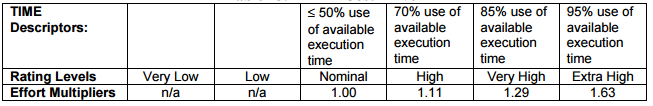
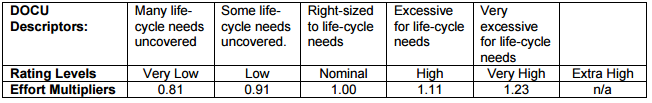
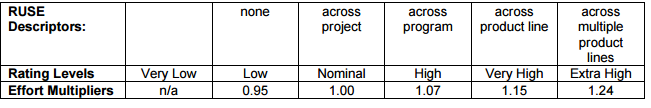
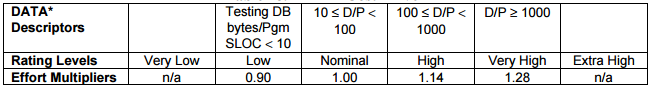
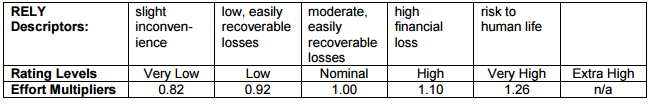


In this particular project the values considered are often the ones in the “Nominal” column, since the project conditions are standard and often idealized. The only higher value is the one regarding Team Cohesion.

With the chosen factors, we can calculate the exponent E with the already presented formula.

E = 0.91 + 0.01 x (3.72 + 3.04 + 4.24 + 2.19 + 4.68) = 0.91 + 0.01 x 17.87 = 0.91 + 0.1787 ≈ 1.08

Now it is necessary to calculate effort multipliers, and it is done in the same way used for scale factors, using the dedicated tables.



**RELY**: The measure of how much reliable the software must be. Since this is a taxi management application, the malfunctioning of the system will cause an easily recoverable loss, so the chosen value is the low one.

**DATA**: This measures the effects of data dimensions on project development. It represents the effort needed to assemble and maintain the required data. Since the amount of data is acceptable, the nominal value is considered for this multiplier.

**CPLX**: This factor represents the required complexity of the system, in terms of operation, code, data management. The product needs to interact with external components and with a notification system, so it is considered of nominal complexity.

**RUSE**: This cost driver represents the additional effort needed to project thinking about reusing components on current or future projects. The intention here is to have reusable components inside the system, but without the necessity to make them available for future products, so the chosen value is nominal.

**DOCU**: The level of required documentation. Since standard documentation is requested, the considered value is nominal.

**TIME**: Measure of the execution time constraints imposed upon the system. No particular constraints are imposed upon this project, o the value chosen is the nominal one.

**STOR**: Measure of data occupation constraint imposed upon the system. No particular constraints are imposed in this case, the chosen value is nominal.

**PVOL**: Measure of the necessary changes ratio on the system to keep it up-to-date with platform and functions. Not many major modifications are expected, so it is fine to consider a nominal value for this cost driver.

**ACAP**: The capability of the analysts who work on high-level design. The value is decided basing on the percentile in which they fall. In this case this is a supposed nominal value since the analysts team is not present.

**PCAP**: The programmers ability to deal with new technologies. This value do not consider the programmers experience. It is measured considering the percentile in which the programmers fall. It is assumed as nominal for the current project.

**PCON**: Represents the personnel continuity. Since the project team remains unchanged for the whole project duration, it is possible to consider a high value for this driver.

**APEX**: This factor considers the programmers team experience in developing the requested kind of system. Since the project is of standard complexity, with already studied technologies, it is fair to assume a high value for this field.

**PLEX**: The developer team experience regarding the importance of platforms. It is possible to consider a nominal value, reflecting the team actual experience.

**LTEX**: Measure of the level of programming language and tool knowledge. Considering previous experiences, the team level can be rated as high.

**TOOL**: The usage of software tools to code, edit or management. This project utilized only the basic tools, so the cost driver can be considered as nominal.

**SITE**: Multisite development factor. The team is fully collocated, so it is possible to assume an extra high value for this effort multiplier.

**SCED**: This rating measures the schedule constraints imposed on the project team. In this particular case the schedule varied from 100% to 130% due to deadlines, so it is fair to consider the nominal/high value.

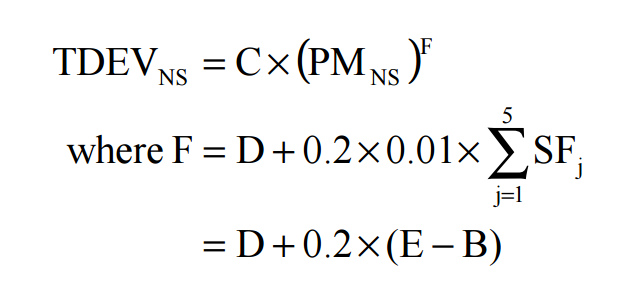
Once the cost drivers are decided, it is possible to calculate the product of the effort multipliers, and so eventually obtain the effort.

EAF (Effort Adjustment Factor) is so obtained as ∏ EMi

**EAF** = 0.92 x 1 x 1 x 1 x 1 x 1 x 1 x 1 x 1 x 1 x 0.90 x 0.88 x 1 x 0.91 x 1 x 0.83 x 1 = **0.55**

Effort is then calculated by the already presented formula:

**PM** = A x EAF x (Size)^E = 2.94 x 0.55 x (6.164) ^ 1.08 = 2.94 x 0.55 x 7.13 = **11.52**

The duration of the project is then estimated using the dedicated formula:

Considering the following parameters

F = 0.28 + 0.2 x (1.08 – 0.91) = 0.28 + 0.2 x 0.17 = 0.28 + 0.034 = 0.314

**TDEV** = 3.67 x (11.52) ^ 0.314 = 3.67 x 2.15 ≈ **8** **months**

And finally the number of people allocated (obtained as Effort / Duration) matches the actual availability, in fact:

**Number of People** = PM / TDEV = 11.8 / 8 ≈ **2 people**