

Budget

The aim of this document is to specify the costs of each part of the thesis. The budget will contain all the costs regarding the development of the project since there is no final product besides the resulting data gathered. The budget breakdown is shown below:

1. Human effort

The human effort is computed as the cost per hour of the engineering team multiplied by the total hours invested in the project. This includes modeling and simulation hours (meshing and overall simulation setup) on one hand and the data acquisition, coding, interpretation of results and redaction time on the other hand. The price per hour estimated for this project, as it is being developed by a junior engineer, is 15€/h. Note that the time required for external research in order to obtain a higher knowledge in the study field or the time needed for learning how to use the different software is not computed for the cost.

Activity	Duration (h)	Price per hour (€/h)	Cost (€)
3D modeling	20	15	300
Simulation	150	15	2250
Coding	10	15	150
Document production	50	15	750
Meetings and results interpretation	50	15	750
			4200

2. Licensing

2.1. Matlab

Academical cost for a MATLAB license is 500€ for a perpetual license or 250€ per year. A company should expect a cost of 2100€ for a perpetual license or 840€ per year.

2.2. MSC Nastran

There is no data available about the pricing for academical use nor commercial use. Searching thoroughly through the internet and forums, the most basic commercial MSC Nastran bundle price with pre and post processor is expected from 10000€ to 30000€ plus a yearly cost around 2000€. Thus, the standalone version should be expected around 5000-7000€. The academic version should be cheaper, so a 2000€ of cost could be assumed (it could be even less if more than one license is purchased). The yearly cost will not be considered as the project duration is 6 months.

2.3. Beta CAE ANSA & META

Another time the company does not provide any pricing list. Based on the internet, the pricing for a commercial bundle including both pre and post processors could go around 10000€, i.e., without solver and without any additional packages. Thus, the cost considered for the academic use will be around 3000€. These prices are for perpetual licenses, as there is no information on yearly subscriptions.

2.4. SolidWorks

The SolidWorks license for students costs 30€/year and it is the cheapest price offered. If the project was done by a company, the cheapest perpetual license would cost around 4000€ while the yearly subscription license would cost around 1200€. The cost for academical research could be considered around 500€/year.

3. Electricity

The average cost of electricity nowadays is 0.3€/kWh. Adding the simulation hours for the 1D and 3D models (around 20 days), coding (10h), meetings and results interpretation (50h), 3D modeling (20h) and document production (50h), the resulting number of hours is 610. Considering that the average computer's power is 350W, a total of 213.5kWh have been consumed during the project. Thus, the cost is around 65€.

4. Total cost

The total cost will consider the cheapest option of every section. Of course, if the company or academic research center negotiates the price only for the required time or buys the perpetual license of the products and uses them for more projects, the economical repercussion would be significantly less.

Another way to decrease the cost would be purchasing and using a complete Computer Aided Engineering (CAE) Software Bundle, which is usually much cheaper, and using another free programming language for the code. As the UPC university already had all these software applications, they were the ones used.

For this study it is considered that the company or academic research center does not have any license and pays half of the yearly subscription price, as the project has been developed in 6 months.

Academic research center

Activity	Cost (€)
Human Effort	4200
Matlab License	125
MSC Nastran License	1000
Beta CAE ANSA&META	1500
SolidWorks License	250
Electricity	65
	7140

Commercial Company

Activity	Cost (€)
Human Effort	4200
Matlab License	420
MSC Nastran License	6000
Beta CAE ANSA&META	10000
SolidWorks License	600
Electricity	65
	21285

As explained before, the cost could be significantly lowered if some negotiation is carried out, the software is purchased as a bundle or other open-source programs are used.

The final budget expected for the academic research center is around 7000€ while for the commercial company is 3 times higher (21000€).