Polytechnic University of Catalonia

The School of Industrial, Aerospace and Audiovisual Engineering of Terrassa

BUDGET

Study for the computational resolution of the conservation equations of mass, momentum and energy. Application to different aeronautical and industrial engineering problems.

Thesis submitted in order to obtain the degree in Aerospace Technology Engineering

Author:
Francesc Hernández Garcia

Director:
Asensio Oliva Llena

Co-Director:
Jordi Vera i Fernández

Barcelona. Spring, 2022

Contents

List of Tables

1 Direct costs

In this document, the costs of the elaboration of the study are presented. Regarding the direct costs, these are mainly the amount of engineering work multiplied by the hourly rate set by the student. As the hourly rate is self-imposed, the student considers that a reasonable price for it is 10€/h.

This price comes from the hourly rate that the UPC recommends for doing academic practices. The thesis consists on approximately 620 engineering hours, which would correspond to **6200€** of direct costs.

2 Indirect costs

Regarding the indirect costs, these are mainly the computer, energy usage and software licenses.

- **Computer**: The laptop used for developing the thesis has been an ASUS SonicMaster X541. It carries a memory of 8GB DDR4, Graphics 620 and processor i7-7500U [1]. The average cost was around 550€.
- **Energy**: At least one hour of computing time and one hour of simulation is estimated for each working hour. As the thesis consists on approximately 620 active working hours, a total of 1240 hours of computer usage are estimated.

  The specifications of the computer report a power supply of 65W, which corresponds to an energy consumption of $65W \cdot 1240\ h \cdot \frac{1\ MW}{10^6\ W} = 0.0806\ MWh$. The average cost of the electricity in Spain has fluctuated around the 150€/MWh [2]. Therefore, the estimated cost for the energy usage is 12€.
- **Software**: the software used for developing the thesis has been *MATLAB R2021a* for the post-processing, *Visual Studio Code 1.67.1* for C++ code editing, *Overleaf* for writing the thesis, *Ubuntu 20.04* as OS, and *WebPlotDigitizer 4.5* to digitize reference results.

Software	Price
MATLAB R2021a	Students licence, 69€
Visual Studio Code 1.67.1	Free of charge, 0€
Overleaf	Free of charge, 0€
Ubuntu 20.04	Free of charge, 0€
WebPlotDigitizer 4.5	Free of charge, 0€

Table 1: Price of the software.

  The only licence needed is for *MATLAB R2021a*, which despite having a cost of 69€, the student has obtained the licence without any cost through the Polytechnic University of Catalonia. Despite this, the university has paid this price, and therefore it is an indirect cost needed for developing the work.

Concluding this section, the indirect costs yield a total of **631€**.

3 Total costs

The global costs of the study are computed and summarized in Table 2, yielding an estimated total cost of approximately **6831€**.

Direct cost	6200€
Indirect cost	631€
Total cost	6831€

Table 2: Summary of the costs of the thesis.

4 References

[1] ASUS. "ASUS X541 - Tech Specs". In: (2022). (Accessed on 15/05/2022). URL: https://www.asus.com/Laptops/For-Home/Everyday-use/ASUS-X541/techspec/.

[2] Agencia de Datos - Europa Press. "Precio de la factura de la luz, datos y estadísticas". In: (2022). (Accessed on 15/05/2022). URL: https://www.epdata.es/datos/precio-factura-luz-datos-estadisticas/594.