UNIVERSITAT POLITÈCNICA DE CATALUNYA

Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual de Terrassa

UNIVERSITAT POLITÈCNICA DE CATALUNYA

BACHELOR'S DEGREE IN AEROSPACE TECHONOLOGIES ENGINEERING

BACHELOR'S THESIS - BUDGET

Computational studies of non-viscous and viscous fluid flows

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1.1 Human resources

This project has been carried out by a single junior engineer along a 4 months semester (during 16 weeks working an average of 5 days per week, 4 hours per day, a total of 320 hours) with the collaboration, guide and help from Ph.D. engineers from *Centre Tecnològic de Transferència de Calor* (CTTC), estimated as 40 hours.

Assuming the average wage of an junior engineer and a Ph.D. engineer are around 15€/hour and 40€/hour [1, 2] the overall human cost can be estimated in Table 1.1.

	Total hours [h]	Price per hour [€]	Total price [€]
Junior engineer	320	15	**4,800.00**
Ph.D. engineer	40	40	**1,600.00**
Human costs [€]			**7,400.00**

Table 1.1: Human costs

1.2 Hardware costs

The only hardware cost is a laptop with the following cost and specifications (Table 1.2) [3].

Laptop	MacBook Inch-2011	**Manufacturer**	Apple, Inc.
Year	Mid 2011	**Processor**	1,8 GHz Intel Core i7
Memory	4 GB 1333 MHz DDR3	**Graphics**	Intel HD Graphics 384 MB
		Total Price [€]	1,700.00

Table 1.2: Hardware costs

Considering a five-year linear amortisation of the laptop during 16 weeks of the duration of the project, the cost of hardware is 104.63 € (Eq.1.1).

$$Cost_{hardware}[€] = 1700 \cdot \frac{1 \; years}{5 \; total \; years} \cdot \frac{16 \; weeks}{52 \; weeks \; per \; year} = 104.63 \; € \quad (1.1)$$

1.3   Software costs

Several software programs have been used in the elaboration of the project in order to elaborate the code for the solutions, to represent the graphs, to write the report and to manage the bibliography and links consulted (Table 1.3).

Software	Main task	Cost per year [€]
Visual Studio Code	Development of code	Free
MATLAB Student Version	Plot graphs	70.00
Overleaf Latex	Write report and docs	Free
Mendeley	Manage bibliography	Free version
LucidChart	Create diagrams	Free version
	Total price	**70.00**

1.4   Electricity costs

During the elaboration of the project, a laptop was used.

The power consumption of the used laptop, in this case *MacBook Air (13-inch, Mid 2011)* with a processor 1,8 GHz Intel Core i7 and memory 4 GB 1333 MHz DDR3, knowing that the power for a voltage of 220 V and an intensity 1 A, therefore the power is 220 W = 0.220 kW (P = V · I) (Specs consulted in [3]).

According to *Endesa*, the price of kWh is 0.1255 €/kWh [4].

Therefore, supposing that the number of hours using the computer are around 350 h the cost of electricity is:

$$Cost_{electricity} = 350\ h \cdot 0.220 kW \cdot 0.1255 \frac{€}{kWh} = 9.66€ \qquad (1.2)$$

For this calculus the establishment of light and light contract has been totally neglected, and it has only taken into account the electricity that consumes the laptop, not the light consumed by the office or room where the project has been done.

1.5 Total costs

In Table 1.4, the total cost of the study is summarised, which was determined by the sum of the human resources, plus the hardware, plus the software costs and the cost of printing and binding the report.

	Price [€]
Human costs	7,400.00
Hardware costs	105.00
Electricity costs	10.00
Software costs	70.00
Printing and binding	50.00
Total price	**7,635.00**

Table 1.3: Total costs

2   Bibliography

References

[1] *Salary With a PhD in Engineering | Career Trend.* URL: https://careertrend. com/salary-phd-engineering-31775.html (visited on 06/08/2019).

[2] *Salary: Junior Engineer | Glassdoor.* URL: https://www.glassdoor.com/ Salaries/junior-engineer-salary-SRCH{_}KO0,15.htm (visited on 06/08/2019).

[3] *MacBook Air (11 inch, mid 2011) - Specs.* URL: https://support.apple. com/kb/sp631?locale=es{_}ES (visited on 06/01/2019).

[4] *Precio del kWh en 2019: Endesa, Iberdrola, EDP, Podo y Lucera.* URL: https: //tarifasgasluz.com/faq/precio-kwh{\#}que-es-kwh (visited on 06/08/2019).