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Design of a system for measuring the weight and balance of sailplanes

Budget

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In this document, the cost of this project is going to be calculated. The budget is going to have two separate parts: one with the specific cost of the part of the system that has been designed, and another one with an estimation of the cost of the complete system (so that the feasibility of the project can be considered).

1 Specific cost of the project

The cost of this project, as has been designed, consists on the sum of all the chosen components and additional parts designed from scratch (like the datum bar). The following tables break down the cost into separate parts, and a summary of the cost is shown at the end.

Concept	Unit cost	Quantity	Total cost
Omega LCEC-1K load cell	\$300	4	\$1,200
Omega LCAE-45KG load cell	\$241	4	\$964
Dimetix DLS-C15 laser sensor	€1,405	1	€1,405
LaserLyte V5D	€297.79	1	€297.79
Hammerhead HLLT10 level	\$49.99	1	\$49.99
TOTAL			€3,652.69¹

Table 1: Cost of the individual commercial components.

For the datum bar, a flat stainless steel bar is going to be used as a raw material. For obtaining the final datum bar, an estimated time of 1.5 h of work is necessary.

Concept	Unit cost	Quantity	Total cost
ASTM A276-10 304 stainless steel flat bar	\$29.91	1	\$29.91
Labour	€50 / h	1.5 h	€75
TOTAL			€101.43¹

Table 2: Cost of the datum bar.

Then, the total cost of the project is shown below.

Concept	Total cost
Commercial components	€3,652.69
Datum bar	€101.43
TOTAL	€3,754.12

Table 3: Total cost of the project.

Additionally, we must consider the design labour:

Concept	Unit cost	Quantity	Total cost
Design labour	€60 / h	300 h	€18,000

Table 4: Cost of the design labour.

¹ Price in EUR after the conversion from USD as of June 20, 2016 (EUR 1 = USD 1.13544).

2 Estimated cost of the complete system

In this section, we will estimate the cost of the project if the design was extended beyond the current scope, so that the design of the full system would be obtained.

- **Electronics:** two electronics modules would be needed, each with a microcontroller to read and process the signals from the load cells and perform the necessary calculations. The front electronics module would also have to control the laser sensor and the laser pointer. The price is estimated as follows:
 - **Microcontrollers:** €100 for the one at the front, and €80 for the one at the rear. The one at the front is more expensive as it needs more features and has to be able to provide a user interface. This price enables to include wireless connectivity between the scales.
 - **LCD display and buttons:** €15
- **Materials and labour:** to accurately determine the amount of material needed, a structural analysis would have to be done. However, we can make an estimation based on the weight of similar aircraft scales:
 - **Front scale:** a reasonable estimation would be 12 kg of aluminium. As for the labour, around 12 hours would most likely be enough.
 - **Rotating arm:** for the rotating arm, 1 kg of aluminium is estimated. An additional 2 hours of labour would be required, approximately.
 - **Rear scale:** even though the structure does not need to be as strong as the front, this scale would have to include the elevating mechanism, so 12 kg of aluminium also seem like a good estimation. Around 14 hours of labour would be needed to manufacture the structure.

With these considerations, the approximate cost of completing the system would be the following:

Concept	Unit cost	Quantity	Total cost
Front microcontroller	€100	1	€100
Rear microcontroller	€80	1	€80
LCD display and buttons	€15	1	€15
Front scale material	€2.5 / kg	13 kg	€32.5
Rear scale material	€2.5 / kg	12 kg	€30
Manufacturing labour	€50 / h	28 h	€1,400
TOTAL			€1,657.50

Table 5: Estimated cost of completing the system (for feasibility evaluation purposes only).