



Project of an UAV of infinite autonomy

BUDGET

AUTHOR

Sánchez Bravo, Àlex

DIRECTOR

Pérez Llera, Luis Manuel

ESEIAAT

Polytechnic University of Catalonia

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1 Introduction

This document presents the summary of the costs of the project. The Direct Costs of the project include the cost of the design itself, the cost of the materials and the price of the products bought off-the-shelf. Note that the costs don't include the parts of the aircraft that haven't been designed, like the electric wiring, the thermal insulation and the fittings between parts, or the manufacturing costs themselves. It is therefore a summary of the costs of the design up to this stage and those others would have to be estimated in a continuation of the current work.

2 Direct Costs

2.1 Design Cost

The design cost is constituted mainly by the wages of the designer himself. Taking into account that this project has been carried out by an undergraduate student, with still some way to go to become an experienced engineer, a price of 15€/hour has been considered fair. The total wages are displayed in table 1.

Concept	hours	price/hour	Total
Design	300 h	15 €/h	4.500 €

Table 1: Cost of the engineering design.

2.2 Airframe

The estimate cost of the M60J CFRP has been extracted from Krenkel [2008]. The price of ROHACELL film has not been found. However, it is known that Mylar film is a similar product, so the price of the skin has been approached by the Mylar film cost. Mylar film can be easily found in a search in the internet. Something similar happens with the ROHACELL HERO; the prices of the exact product haven't been found, so the price of ROHACELL RIST has been used, which is also an aviation foam with similar characteristics, and manufactured by the same company.

Concept	Material	Amount	Unit Cost	Total
Spars and Boom	Toray M60J	1,24 kg	1500 €/kg	1860 €
Skin	HOSTAPHAN FILM	4 rolls	27 €/roll	108 €
Ribs	ROHACELL HERO	1 sheet (61x122x1 cm)	146 €/sheet	146 €

Table 2: Cost of the airframe

2.3 Electric Devices

Regarding the products of UAV Navigation (the FCS and the Data Link), the manufacturer itself gave the estimation that appears in table 3 by mail. This value includes the FCS, the communications system aboard the aircraft and also the ground station to be able to communicate with ground. Estimating the price of solar cells has been somewhat tricky. From Horowitz et al. [2018] it is extracted that triple junction solar cells of the same type of ours can cost up to 50\$/W, which in the current design scales up to 75.000€ in total, as can be seen in table 3. The volz servos prices is also unavailable, so the price of a similar product (DITEX Wing TD0807W Telemetry Servo) has been taken. The price of this product can be consulted online at [Unmanned Systems Source] webpage. As for the batteries, Licerion batteries are the latest of the State of the Art technology, so there is no similar technology to obtain the price from. A kind guess has been made taking into account the current market available technology. It is estimated that the total price of the batteries will be of the order of the price of the solar cells.

Concept	Amount	Unit Cost	Total
Servo motor DA 15-N-ISS	4	106 €	424 €
Batteries Licerion V2	-	-	90.000 €
MicroLink Solar Cells	2,44 kg	30.800 €/kg	75.000 €
Flight Control System & Communications System	-	-	18.000 €

Table 3: Cost of the electric devices.

2.4 Power Plant

The propeller is a Xoar product and can be easily found in a typical online distributor. It must be mentioned that if the propeller has to be a custom one this price could rise up. The price of the motor, at its turn, can be found in [Xoar] webpage. The price of a custom planetary gearbox can be also found easily in the internet. The price displayed in table 4 is referred to a custom planetary gearbox from Faulhaber.

Concept	Amount	Unit Cost	Total
Propeller Xoar PJP-T-L 40x10	1	138 €/unit	138 €
Xoar 148867 motor	1	348 €/unit	348 €
Faulhaber planetary gearhead	1	247 €/unit	247 €

Table 4: Cost of the power plant.

3 Indirect Costs

The major amount of the indirect costs of the design are attributable to the software licences. Table 5 shows the prices of the licences necessary to carry out a project like this one. For the licences that last more than the period of use, only the proportional part of the cost has been considered, which is what happens with the Matlab licence. Besides, the considered cost has been the one a graduate engineer would have to pay (not the price of a student licence, which is much lower).

The price of the Matlab Standard licence can be obtained from [MATLAB] webpage and the price of the Solidworks Professional package has been extracted from [CIMWORKS] webpage.

Concept	Duration	Cost	Total
Solidworks Professional	3 months	1320 € (3 months)	1310 €
Matlab Standard	3 months	800 € (12 months)	200 €

Table 5: Cost of the software licences.

4 Total cost

Now a total approximate of the costs is given in table 6. It must be said that, especially for the propulsion, if some elements have to be custom made (like the propeller), the cost could increase significantly. The cost of the airframe is also quite low regarding the others, but the manufacturing cost has not been considered yet, and this could well increase the cost of the airframe one order of magnitude.

Concept	Cost
Design	4.500 €
Airframe	2.100 €
Electric Devices	183.000 €
Propulsion	700 €
Licences	1500€
TOTAL	192.000 €

Table 6: Breakdown of the total cost of the aircraft (approximate).

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