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A new machine learning approach to support asset management in water distribution networks.

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Budget

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1. Introduction

As attached to the thesis report, this document aims to summarize which have been the cost for the entire success of the study, from scratching the preliminary idea up to the conclusions.

The study has not required any development of physical product; therefore, the project did not incur into any cost designing and manufacturing the object.

Moreover, *R* and *Rstudio* are free software environments with no need of specific license. Thus, the only voice of cost that is recalled in the budget evaluation regards the human time spent during all the steps of the job.

A wage of 10€/hour has been assumed, independently on the task carried out, either reading documents, programming or writing the final report. The assumption mainly comes from the cost-opportunity of the time spent on the development of the work, taking as reference the hourly wage of a professional employment.

The time spent has been mainly assessed per chapter and sub-chapter. However, some section has not a dedicated section in because too small to measure the time spent on it.



2. Budget assessment

The following table includes all the topic for which was possible evaluating the related economic resources needed for the development. For each task, the following voices have been measured/calculated:

- *Hours/day*: number of hours spend in average per working day during the development of the task.
- *No. days*: number of days spent on the task.
- *Total hours*: value given by multiplying values of the first two column of the table.
- *% Time*: the percentage of time requested by each task over the total time needed for the work.
- *Total cost*: results given by multiplying values in the column “total hour” and the hourly wage (10€/h).



Task	hours/day	No. Days	€/hour	Total hours	% time	Total cost	% €
Project redaction		10		20	2%	200.00 €	2.45%
Project redaction	2	10	10.00 €	20	2%	200.00 €	2.45%
Literature review		48		208	25%	2'080.00 €	25.49%
Selection of related documents	4	10	10.00 €	40	5%	400.00 €	4.90%
Maintenance strategies	6	8	10.00 €	48	6%	480.00 €	5.88%
Prediction field	4	20	10.00 €	80	10%	800.00 €	9.80%
Economic goal	4	10	10.00 €	40	5%	400.00 €	4.90%
Data exploration		23		92	11%	920.00 €	11.27%
Data requirement and collection	4	2	10.00 €	8	1%	80.00 €	0.98%
Data cleaning	4	15	10.00 €	60	7%	600.00 €	7.35%
Data validation	4	6	10.00 €	24	3%	240.00 €	2.94%
Data analysis		30		180	22%	1'800.00 €	22.06%
Studying relationships between variables	6	30	10.00 €	180	22%	1'800.00 €	22.06%
Prediction		31		124	15%	1'240.00 €	15.20%
1st logistic	4	13	10.00 €	52	6%	520.00 €	6.37%
Random Forest	4	12	10.00 €	48	6%	480.00 €	5.88%
More critical scenario	4	3	10.00 €	12	1%	120.00 €	1.47%
2nd logistic	4	3	10.00 €	12	1%	120.00 €	1.47%
Economic assessment		18		92	11%	920.00 €	11.27%
1st assessment model	4	8	10.00 €	32	4%	320.00 €	3.92%
2nd assessment model	6	10	10.00 €	60	7%	600.00 €	7.35%
Extra work		13		52	6%	520.00 €	6.37%
Extra work	4	13	10.00 €	52	6%	520.00 €	6.37%
Revision		8		48	6%	480.00 €	5.88%
Revision	6	8	10.00 €	48	6%	480.00 €	5.88%
Total		181 Days		816 h	100%	8'160.00 €	100.00%

Table 1 Cost assessment



3. Conclusions

Given a total amount of 816 hours, spread over 181 days, the total budget estimated to develop such a thesis is 8,160.00 €. Actually, for a more accurate analysis, each stage of the work should be matched to its proper cost per hour, because each step requires certain level of expertise and sometimes, as for programming, the cost associated can be higher. However, since it is not easily possible to quantitatively evaluate the level of expertise or the difficulty of each stage of the study, it is reasonable to consider the 10€ per hour as unique wage.