

## Life-cycle cost in building management – economic assessment model applied to public school buildings portfolio

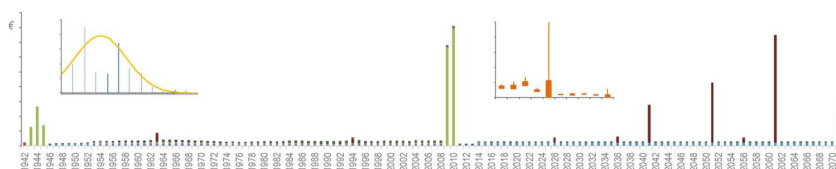
### Summary

In Portugal and internationally, public real estate represents an investment effort that mobilizes significant financial resources from public budgets, which are increasingly restricted. However, while it is increasingly important to justify investments and subsequent associated expenditure over a number of decades or even centuries, information relating to the economic performance of that public property asset over its life cycle is practically unknown. Currently, the existing information is not readily available or properly organized and, in many cases, needs precision. This thesis aims to contribute to overcome these current limitations and facilitate the widespread incorporation of the Life Cycle Cost (LCC) concept in the current Architecture, Engineering and Construction (AEC) sector professionals involved in Building Management (BM) activities. In this context, an original and innovative model for the building's economic performance assessment throughout their life cycle is presented. In the design and development of this model, are considered the requirements of all international and european standards, applicable regulations, as well as the main advances of the scientific community and the best practices and international trends of the industry in the fields of Facility management, asset management and project, programme and portfolio management. The proposed model is based on a PDCA (Plan-Do-Check-Act) continuous improvement cycle and consists of four decision making processes in BM and LCC informed. Each processes covers a number of stages. The first planning process covers the stages of determining the scope and objectives of the economic assessment of buildings life cycle, the organization of data, the LCC calculation method and the definition of the applicable economic performance indicators. The second implementation process guides the stages of data collection, values correction, and results visualization. The third monitoring process covers the stages of performance indicators determination, results analysis, and database development. Finally, the fourth process of improvement, includes the stages of communication of results and intervention strategies throughout buildings life cycle.

The proposed model applies to any type of buildings (public or private) and can also be adapted for public infrastructures applications. In the scope of this thesis, the practical applicability was tested with a 166 public school buildings portfolio. The test consists in five distinct contexts of economic performance assessment during a period of 130 years. In addition to confirming the applicability of the original proposed model, the results of the five test applications allowed to deepen knowledge about the costs related to construction, operation, maintenance, repair, replacement, rehabilitation, energy consumption, water consumption and deconstruction over the life cycle of the public-school buildings portfolio studied, with a constructed area of 2,404,500 m<sup>2</sup> and an estimated LCC net present cost of 9,74 billion euros. The accumulated experience with this test application allowed to consolidate the proposed approach, which can be replicated in other contexts, at industrial and technological level, without significant additional work. On the other hand, knowledge about this portfolio benefits the management activities of entities, such as Parque Escolar and Ministério da Educação with LCC-informed decisions. In addition, the generated database, with more that 2 million results (economic performance indicators) structured in tables and dynamic charts, can made available to AEC professionals concretizing the ambitious objective to contribute to widespread adoption of LCC concept and a more informed decision through the economic sustainability of public real estate investments.

### Keywords

Life Cycle Cost (LCC), Building Management (BM), public school buildings, economic performance, database.



Life cycle costs of a building project.



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