A MODEL FOR FORECASTING THE RUNNING COSTS OF COMMERCIAL BUILDINGS IN SRI LANKA

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(178015E)

Degree of Master of Philosophy

Department of Building Economics

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Signature of the supervisor: ..... Date: 23/12/2020

DEDICATION

I dedicate this thesis to my beloved family…

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ABSTRACT

A model for forecasting the running costs of commercial buildings in Sri Lanka

Conventionally, early-stage investment decisions on buildings were purely based on initial capital costs and simply ignored running costs and total lifecycle cost. This was basically due to the absence of estimating models that yield running costs at the early design stage. Often, when the design of a building, which is responsible for 10 to15% of its total cost, is completed, 80% of the total cost is committed. This study, therefore, aims to develop a model based on building characteristics, which enable an early-stage determinant of running costs of buildings, to predict the running costs of commercial buildings. While positioning this research in a positivist research paradigm, a survey research strategy was adopted along with a questionnaire survey and a documentary review for data collection. The study involved 135 respondents for identifying factors influencing the running costs of commercial buildings and 46 commercial buildings were accessed to collect running costs and building characteristics data. A Pareto analysis, relative significance index (RSI), bivariate correlation analysis, regression modelling, and hedonic price imputation index were performed on collected data. The RSI confirmed, eight categories of running costs factors: environmental, maintenance, managerial, building characteristics, building design and construction defects, social, tenant, and political, respectively. Among 48 sub-factors identified, the study confirmed, natural deterioration, failure to identify the true cause of a defect, lack of preventive maintenance, insufficient fund, building services, building age, occupancy, vandalism by tenants, misuse of property, expectation of tenants have a substantial impact on running costs. According to the Pareto analysis, utilities (39%), services (19%), admin work (14%), and cleaning (8%) are four main cost constituents, responsible for 80% of running costs, which can be represented by highly correlated building characteristics of the number of floors (0.950), building height (0.945), and building size (0.943). Approximately 94% of the variance in annual running costs/GIFA (sq.m) is expressed by variables of net floor area, the number of floors, and working hours/day together with a mean prediction accuracy of -1.6%. The index constructed revealed, there is an increasing trend of running costs of commercial buildings in Sri Lanka, in office and bank buildings particularly, over the last recent years. Further, a noticeable increase in running cost can be observed during the first quarter while there is a slight reduction in the second quarter of each year. Early-stage supportive running costs estimation model proposed by the study would enable construction professionals to benchmark the running costs and thereby optimise the building design. The developed hedonic model illustrated the variance of running costs concerning the changes in characteristics of a building. While facilitating early-stage running costs estimation, the study findings collectively support building owners, designers and constructors, and facilities managers to optimize the in-use phase costs of a commercial building in terms of designing and constructing cost-effective, sustainable facilities by altering building characteristics during its' design stage as well as carefully considering the significant running costs factors during its' in-use phase.

Keywords: Building characteristics, Commercial buildings, Hedonic price imputation index, Regression modelling, Running costs

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Journal article

Geekiyanage, D., and Ramachandra T. (2020). Nexus between running costs and building characteristics of commercial buildings: hedonic regression modelling. Built Environment Project and Asset Management. (10) 3, 389-406. https://doi.org/10.1108/BEPAM-12-2018-0156
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LIST OF ABBREVIATIONS

AECO	:	Architecture, Engineering, Construction and Owner-operated
ANN	:	Artificial Neural Network
ANOVA	:	Analysis of variance
BCIS	:	Building Cost Information Service
BIM	:	Building Information Modelling
BOMA	:	Building Owners and Managers Association
BREEAM	:	Building Research Establishment Environmental Assessment Methodology
BS-ISO	:	British Standards - International Standards Organization
CA	:	Circulation Area
CAPEX	:	Capital Expenses
CIDA	:	Construction Industry Development Authority
CMC	:	Colombo Municipal Council
CRC	:	Corporative Research Centre
DTI	:	Department of Trade and Industry
GIFA	:	Gross Internal Floor Area
IBM	:	International Business Machines Corporation
ICTAD	:	Institute of Construction Training and Development
LCC	:	Life Cycle Cost / Costing
LEED	:	Leadership in Energy and Environmental Design
LKR	:	Sri Lankan rupee
NFA	:	Net Floor Area
NRM	:	New Rules of Measurement
O&M	:	Operation and maintenance
ONS	:	Office for National Statistics
OPEX	:	Operating Expenses
PIOC	:	Price Index of Operating Costs
R&D	:	Research & Development
RIBA	:	Royal Institute of British Architects

RICS	:	Royal Institution of Chartered Surveyors
RII	:	Relative Important Index
RSI	:	Relative Significance Index
SAE	:	Society of Automotive Engineers
SPSS	:	Statistical Package for the Social Sciences
TPISH	:	Tender Price Index for Social Housing
VIF	:	Variation Impact Factor
WFR	:	Wall-to-Floor-Ratio
WLC	:	Whole Life Cost / Cycle
WLCC	:	Whole Life Cycle Costing
WWR	:	Window-to-Wall-Ratio