Expanding the integration of engineering and technology education and financial institutions with the incorporation of location cost modelling in construction cost estimations

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ABSTRACT: Many Greek financial institutions finance engineering firms or construction projects based on budgetary information provided by professionals in the construction industry. Financial institutions need more reliable cost data for development projects in industrial, residential, tourist and educational sectors. Bad practices and bad early advice by estimators and professionals discourage private, public and international clients from committing more funds to new construction projects, simultaneously increasing financial risks. An independent researcher gathered construction cost data for projects from Greek financial institutions, between 2006 and 2007, with emphasis on the residential sector, and then analysed the data. Conclusions show that initial construction cost estimates should be based on location cost modelling for the Greek construction industry and financial institutions. This provides a mechanism for better construction planning, budgetary control and monitoring of property investments; and to the financial institutions, an understanding of the importance of cost engineering to industry, engineering and technology education.

INTRODUCTION

The role of professional engineers, valuers and estimators in a less buoyant period of economic activity must be aligned to construction industry and property market needs, hence providing better services for citizens, financial institutions and investors. The professionals should be able to manage development projects, respect legislation, the building environment and engineering technology, as well as citizens' affordability and investors' contributions [1].

The construction industry has changed, from being traditional, to that of a modern and prospective mirror, due to the achievements of many firms in the European construction sector. They were well positioned for future growth, providing long-term opportunities for investors and financial institutions with three clearly defined areas of potential growth: a) the residential property market in continental Europe; b) the commercial office property market; and c) the national infrastructure, with an emphasis on Public-Private Partnerships [2].

It is widely known that the construction industry is particularly important to the Greek national economy because it exerts a substantial influence on basic macroeconomic indicators and employment. The reduction of vacancies and the worsening of industrial/professional relations [3] and employment conditions in the periods 2004 to 2007 and 2009 to 2011 have indicated that the construction industry has entered into a period with intervals of recession (and of financial risks) and also the need for strong financing. The industrial relations in the sector worsened regarding the violation of labour legislation, inadequate safety measures to reject accidents at work and the high rates of casual and undeclared work [3].

The growth of the domestic construction industry was dependent on: a) infrastructure works carried out between 2000 and 2009; b) funds and programmes from the European Community Support Framework; c) impressive investments in private construction activity, especially in the residential sector; d) completion of infrastructure works in Athens; e) the reduction culture in the Public Investment Programme (Figure 2); f) lack of interest on the part of private capital in financing works, due to the great long- and short-term loan obligations of some technical/construction firms and the bank trusteeship system, in which many contractors appear to have become trapped (including Foundation for Economic and Industrial Research [4]). It is internationally agreed that *the most important function that facilitates construction organisations to accomplish profit maximisation is cost control* [5].

Molson has said:

> *[The] Greek real estate market produces expensive products with low returns and high maintenance costs in a long-term period, discouraging investors and new buyers. Simultaneously, the housing credit system faces a reduction [in] applications for housing mortgages. The Greek construction industry, despite years of training,*

remains notorious for its inability to forecast and control costs within the limits of the budget, discouraging private, public and international clients [from committing] more funds to new construction projects (secure contracts) and financial institutions [from controlling] efficiently the housing credit system. To make construction attractive to investors, and properties affordable to citizens, the industry must demonstrate its ability to forecast, control and report accurately private, public, international property development and engineering projects. The integration of Engineering & Technological Education (E&TE) and Industry can provide the mechanism to bring together critical demands in the Greek real estate market, in order to produce low cost, quality, affordable buildings with a long-term remaining useful life [6].

Molson's professional view is that:

The successful implementation of projects in both engineering and construction is vital, in order to maintain estimates within budgets and to achieve targets and milestones (scheduling) set up by Financial Institutions, investors and other public and private bodies. The impacts of overrun budgets and time schedules, of poor estimates and project control reports are always negative messages to the marketplace and the public. Industry must concentrate on practical improvements.

Financial institutions, in order to control risks, to secure contracts and payments (their returns), set up specifications for valuations and many institutions are searching for special consultancy and advisory services. The author suggests the development of an approach for construction cost estimations, based on location cost modelling for the Professionals and Financial Institutions, for better construction planning, budgetary control (in the valuation process) and monitoring of property investments and finance.

INTEGRATION OF THE GREEK RESIDENTIAL MODEL AND FINANCIAL INSTITUTIONS

Greek Property Market

The demands of clients, practitioners and users are for low cost, quality, affordable buildings with long-term useful lifespans and by the Greek Ministry of Economy and the local Borough Councils to increase revenues from property taxation [6] and VAT, from 19% (2004) to 23% (2010). The housing production process (construction) and supply traditionally have been controlled by the private sector in modern Greece. Over the past two decades, Greece had remarkable real estate development, mainly due to a sharp increase in financing availability and the decrease of financing costs [7] impacted by bankers' policies. The development of the real estate market resulted in a significant increase in privately owned residences (up to 83% in the year 2005 and with an actual trend > 85% in 2009). Molson has said:

There has been limited involvement by public organisations (e.g. OEK) and the Greek Orthodox Church, resulting in a huge individual citizen's debt …, due to house buying and small constructors' loans [6].

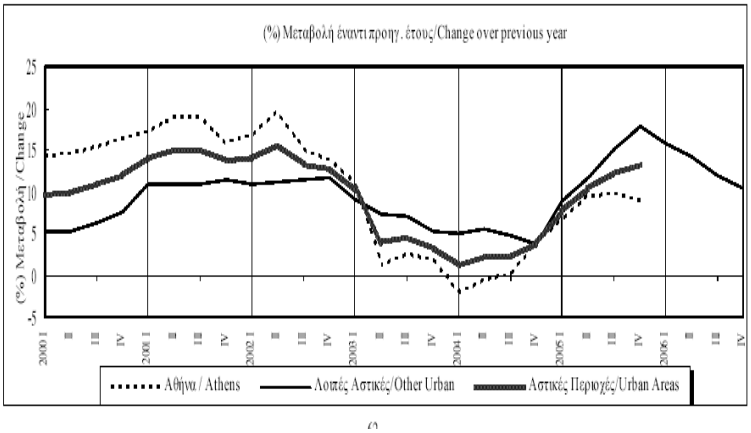


Figure 1: Quarterly fluctuations in the period 2001 to 2006 (Source: National Bank of Greece).

The well-established economic policy for changes in the Country's property tax framework has monopolised both the property and construction markets (especially in the residential sector) particularly between 2005 and 2006 (Figure 3) and between 2008 and 2010. This forced many citizens to invest in properties, especially residential apartments and land plots and private contractors to submit and authorise building proposals in advance (the increase on which was 124% by December 2005!), (e.g. before the new VAT law was applied by January 2006; yielding peak prices and, by 1 January 2010, there was an additional increase on property taxation) to speed up housing transfers and simultaneously increase prices in areas with a huge contractor debt. Thus, the construction cost escalation monopolised the residential construction market between 2006 and 2010.

The main characteristics of the residential market discussed are:

- regular income for citizens (add salary reduction trends) and householders' financial statements;
- progressive reduction of demand from 2006 (Figure 3) and high asking prices;
- loans constitute the main source of financing in the residential sector;
- rental values remain constants and, in many cases, there are reductions at present.

The author affirms that …*banks, money lending institutions, government and private organisations have not secured their returns on huge investments in the construction market, because of the lack of development of a proper cost control and forecasting strategy in the construction sector, in order to minimise and control risks*.

Modern residential properties in *urban areas*, *Athens* and *other urban areas* in Greece should respect:

> *… the legislation; building environment and engineering technology; citizens' affordability and contribute to the economic and social welfare of Greece. The astronomically high property prices have to be avoided in the Greek real estate market in future, especially in the housing sector (rural or main residences).*
>
> *The financial risks allocated to asking housing prices are hidden issues in market analysis and there is a gap in the determination of interactions. Therefore, a new code for sustainable homes demands higher standards for energy efficiency and it will be made mandatory for both existing and new homes.*
>
> Thus …
>
> *…Property developers, design and construction consultants, independent engineers and construction firms must understand better the property market interactions, the new E.U.'s standards/Directives and should be able to demonstrate their knowledge and skills in cost management, especially [on] the issue of cost control and forecasting, in order to manage housing profits under pressure in an overestimated property market*.

Financial institutions are defined as *any bank, building society, or other reputable financial institution, which lends money to citizens and practitioners to buy or improve their premises, including under a purchase or lease arrangement,* including Construction and real estate development.

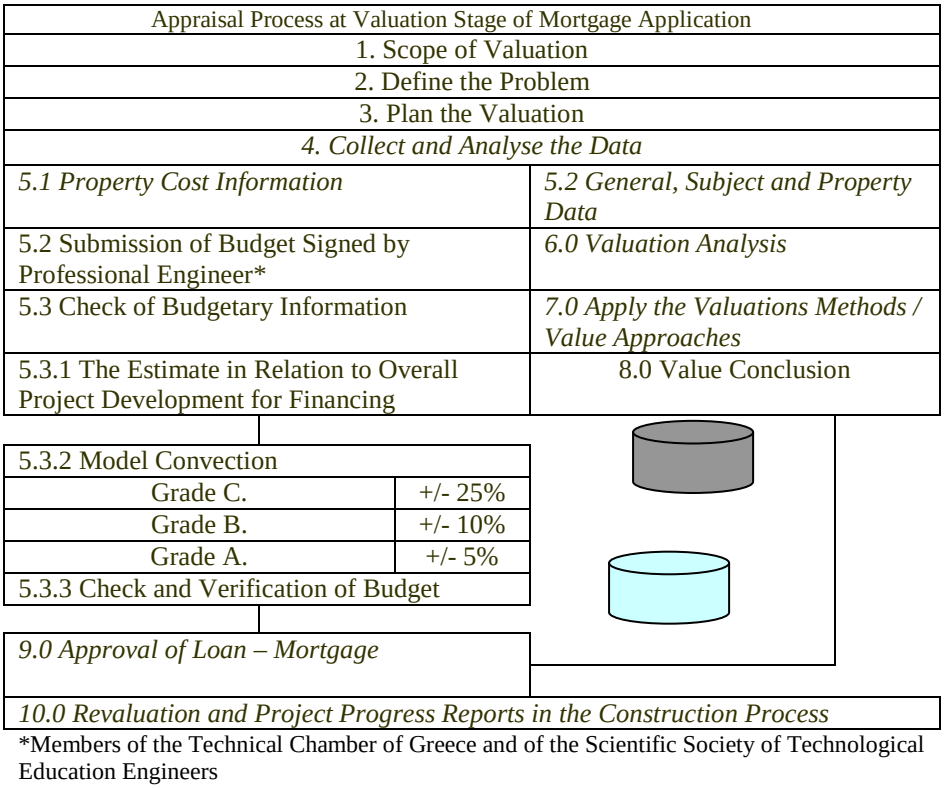
According to the author's experience of solving problems in the valuation process, many technical managers and staff of financial institutions (technical and valuation divisions) agree that many Institutions need more reliable cost data for development projects in the industrial, residential, retail, tourist and educational sectors, in various locations of Greece. The bad practices …*such as arbitrary constructions; claims dispute; half-done building applications; incomplete design; labor disputes; miscalculation of bills of quantity; misunderstanding of building regulations; poor budgets; poor estimates; poor ethics; poor maintenance management; poor planning; poor quality; environmental pollution, etc,* … and *bad early advice by estimators and professionals, are discouraging the private, public and international clients [from inputting] accurate information and [committing] more funds into new construction projects in the future and simultaneously [increasing] financial risks*. Another important issue for managers is the *actual price of property*. Today, many Greek banks employ the services of chartered surveyors and international valuers (such as American Appraisal, Danos & Associates, King Hellas, Axies, Savills and other private firms) for valuation and project management services. According to the author's valuation practice, the most famous financial institutions in Greece are listed in Table 1.

Table 1: Sample of Greek Financial Institutions (2007 to 2010).

Financial Institutions in Greece		
Aegean Baltic Bank	Citi Bank	NOP AMRO
Alpha Bank	Credit Agricole	ING Bank
American Bank of Albania	Egnatia Bank	Lamia Cooperative Bank
Arab Bank	Emporiki Bank of Greece	Omega Bank
Aspis Bank	Eurobank EFG	Opel Bank
ATE Bank	Eurohypo	Pagkritia Bank
Achaiki Cooperative Bank	FBB	Pancretia Cooperative Bank
Bank of America	Hellenic Bank	Panellinia Bank
Bank of Attica	Laiki Bank	Piraeus Bank
Bank of Cyprus	Marfin Egnatia Bank	Probank
Bayerische Hypo- und Vereinsbank	Marfin Bank	Proton
BNP Paribas Hellas	Millennium Bank	Royal Bank of Scotland
Chanion Cooperative Bank	National Bank of Greece	UCI

The author, acting as an independent researcher, gathered construction cost data for new projects from the Greek financial institutions (at the stage of collection and analysis of data in the valuation process) between 2005 and 2007, with emphasis on the residential sector, and analysed the data. Projects are allocated to new or existing clients and investors, investing in properties, at the stages of building design and construction in the appraisal process (Figure 2). The land values analysis is an appraisal problem for valuers.

The grade for an estimate is allocated to the level of information provided by the client of the financial institution [8]. Grade C refers to the applicant's budget with limited information (including location, basic description of construction works, drawings of property and limited information over quantities) about the subject property under valuation. Grade B comprises more accurate information about the bill of quantities and construction activities/works. Grade A refers to the definitive estimate with detailed information over project activities and tasks. The financial institutions need more reliable cost data for development projects in the industrial, residential, tourist and educational sectors, in various locations of Greece. Common projects financed by Greek banks are listed in Table 2.



*Members of the Technical Chamber of Greece and of the Scientific Society of Technological Education Engineers

Figure 2: Building cost information gathered in the appraisal process (valuation stage).

Table 2: Development projects by building category (Source: A.R.N. Molson's in-house statistical data).

Real Estate Market	Type of Projects	Type of Buildings
Residential sector	Apartments - Mezonettes	Within 2-8 floors buildings
	Houses	Mezonettes and villas, detached houses, rural residences and villas
Education sector	Schools – nursery schools	Private schools, PPP scheme schools
		Nursery schools – children play areas
Retail sector	Retail centres	Generally buildings, shopping centres, hypermarkets, supermarkets
	Retail	Shops, sports centres with mixed uses
Office sector	Office Office centres Mixed offices	Office buildings – concreted framed – office buildings mixed facilities – steel framed – buildings with mixed uses (banks, etc) – buildings for financial institutions (banks, insurances, etc), medical use
Industrial sector	Factory, Advanced factory, Logistic, Logistic, Petrochemical	Generally factories – factory steel framed – factory with mixed facilities – warehouse steel framed – generally warehouses – distribution centres
Tourist sector	Hotels – Accommodation – Facilities – Houses	Hotel units and Complexes, rental rooms, restaurants, clubs, leisure centres, private tourist villages, organised tourist settlements
Other	Hospitals	Private hospitals, private clinics, health centres

The Importance of Location Cost Modelling

Many local professional engineers agree that the research for construction information is a continuously and feed-forward process in both stages of design and construction and, more specifically, when this concerns national infrastructure projects or property investments. The need for accurate information at the construction stage is still greater when the investor is active in special properties or in the border, rural and tourist areas, far from his headquarters [9].

In practice, a good engineer or consultant usually undertakes the estimation and sets up a budget for a type of construction in his/her hometown. Engineers in charge of estimations generally are very familiar with major sources of cost data in their own areas, but they are often unaware of useful sources of cost data and related information in other regions. This problem is exacerbated by lack of time to perform proper research of publications in various languages, and lack of information about key factors that can have an impact on estimates for particular geographic locations [10].

A *location factor* is an instantaneous, overall, total cost factor for converting a base project cost from one geographic location to another. This factor recognises differences in productivity and costs for labour, engineered equipment, bulk materials, commodities, freight, duty, taxes, etc... and project administration. The cost of land, scope/design differences for local regulations and codes, and differences in operating philosophies, are not included in the location factor. With the current rush of industries attempting to globalise, the use of location factors has become increasingly important. Location factors should be used to factor a base estimate for comparing costs at differing locations and not for the funding estimate for the selected location. After selection, a higher quality estimate should be developed for project funding [11].

In property development, the crucial factor is location. Location is also important when citizens buy a residential property, e.g. in Athens, other urban and tourist areas. It can influence the price of the property in an unpredictable way and the ratio of actual demand/housing product available. In addition, specialist firms such as Massa, Bridgewater, Humphreys, John Brown - and Baker Mallett (UK) - have developed a useful sample of international cost location factors.

Molson's concluding remarks are:

> *The application of location cost modelling [to] a new construction project is judged as suitable for civil engineers and independent contractors that act in tourist and bordering regions, as well as for professionals that draw up budgets for Financial Institutions (such as Banks, etc) in various locations of Greece* [9].

Data Gathering and Research Methodology

The population of this study incorporates professionals who submitted budgets to Greek financial institutions in order to provide the necessary valuation data requested by the technical and valuation services of financial institutions. The submitted budgets were gathered from international property consultants and valuers (such as Danos & Associates RICS, etc), namely, from the independent consultants of subject financial institutions. The institutions are prohibited from providing economic data of this kind, of their clients, and complete detailed surveys.

The sampling of budgets comprises 62 submitted cases for approval at the valuation stage of clients' applications for financing (Table 3).

Table 3: Sample of construction cost estimates submitted for approval.

Real Estate Market	Type of Buildings for Funding	No. Submitted Budgets	Applications-(%)
Other Sector	Car Parking Station	1	1.61%
Industrial Sector	Distribution centres	1	1.61%
Industrial Sector	Factory of foods	1	1.61%
Industrial Sector	Factory steel framed	2	3.23%
Residential Sector	Mezonettes (Maisonettes)	1	1.61%
Tourist Sector	Restaurants, clubs, leisure centres	1	1.61%
Tourist Sector	Rural residences	1	1.61%
Industrial Sector	Unit of bottling of metal water	1	1.61%
Industrial Sector	Warehouse steel-framed	1	1.61%
Residential Sector	Traditional building	2	3.23%
Industrial Sector	Factory concrete-framed	2	3.23%
Office Sector	Office Unit	2	3.23%
Office Sector	Office Building	3	4.84%
Residential Sector	Block of flats	8	12.90%
Residential Sector	Independent residence	15	24.19%
Residential Sector	Apartments	20	32.26%
Total		62	100.00%

Data were gathered using a survey (budgetary input form) prepared by the independent researcher. Before preparing the survey, the problem was defined and 20 interviews with valuers and management were undertaken. The collection and processing of the interview data was based upon the experience and skills developed during a period of practice in Europe.

According to the sample analysis, the residential sector dominates the interest of clients for property investments and finance (in total 74.19%). Office and industrial sectors occupy 8.06% and 12.90%, respectively. Greater emphasis is put on the residential sector, due to the number of professionals (74.19%) involved in the estimation process (48 out of 62 budgets signed) and to the rapid development of the housing credit system in Greece.

Data Analysis and Development Approach

Due to size, only the basic data analysis and the development approach for the cost estimations based on location cost modelling for the Construction Industry and Financial Institutions are given, which emerged from the survey.

From the survey, it was concluded that many estimates were not accurate at the valuation stage and an approval of total cost - client's sum of borrowing - is required. More specific outcomes of the survey are:

- 67.74% of building projects concern development and construction works;
- 32.26% of building projects concern refurbishments, maintenance and partly reconstruction works;
- 40.32% of submitted budgets for evaluation lack basic information on quantities;
- 8.06% of submitted budgets are based on the *factoring method* (as percentage of each activity in total construction cost);
- 32.26% of submitted budgets are based on main activity cost (e.g. excavations, foundations, electrical installations, etc);
- 51.61% of submitted estimation sheets range from 4 to 20 main activities;
- 48.39% of submitted estimation sheets range from 21 to 40 main activities;
- 25.81% of submitted estimation sheets are detailed, with tasks and sub-tasks;
- 88.71% of submitted budgets were overestimated and have been corrected by assessors;
- 27.41% of submitted budgets used financial institutions' bulletins of budget (entry and monitoring forms);
- 9.67% of submitted budgets used factoring models for constructions (residential properties).

A high financial risk is allocated to the banks' customers, due to the poor estimates and inaccurate bills of quantity.

Almost all submitted budgets checked by the independent consultants experience mismanagement of information. Successful implementation of building projects in construction is vital, in order to maintain estimates within budgets and achieve targets and construction schedules (project progress reporting) set up by the financial institutions, investors, and other public and private bodies. The impacts of overrun budgets and time schedules, of poor estimates and project progress control reports are always negative messages to borrowers. Financial institutions must concentrate on practical improvements at the valuation stage of mortgage application, with the incorporation of location cost modelling for housing grants/loans and, as well, the issue of *duration of construction plan*.

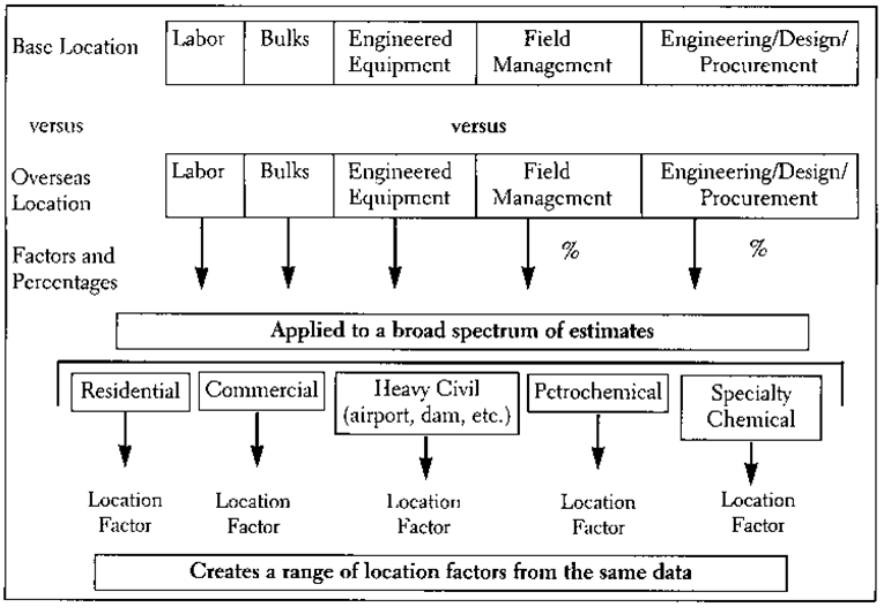


Figure 3: Bernard A. Pietlock's Factoring method [12].

The author argues that the location factors provide a way to evaluate relative construction cost estimate differences between two geographic locations in Athens, in the capitals of prefectures (a prefecture is an administrative district), and other urban and tourist areas in Greece. Location factors can be applied to the budget submitted for evaluation, at an early stage of the valuation process, for cross checking and adjustments. Pietlock stated the quite common methods of developing location factors are (see also Figure 2):

- *Cost-versus-cost (comparing actual costs from two similar projects);*
- *Cost-versus-estimate (comparing the actual cost of a project at one location to an estimate for the same scope of work at another location);*
- *Estimate-versus-estimate (comparing the same project scope of work estimated at two or more locations).*

Means Cost Data reflect the average cost of construction in cities across Greece. The location cost factor is used to adjust the Means Cost figures to the specific location of a proposed project. The location cost factors for a development project of a block of flats in Athens or in urban areas are shown in Table 4. The bank's assessor can use location cost modelling to check the variability and validity of a submitted estimate by the representative engineer. A location cost factor can be developed from a bank's in-house data or from the historical cost information of previous projects:

- for each activity of a building construction plan listed in budgetary sheets;
- for each groundwork, or main activity based on the factoring method (in %).
- under the general limitation for selecting the scope of funding (in Euro currency) as shown below: i) Refurbishments, maintenance and part-reconstruction or ii) Development and construction.

Specification of the Proposed Cost Location Modelling

This process is about assessing the variability and validity of each activity of a submitted estimate for a residential property fund in Greece and, simultaneously, to estimate the accepted cost (€) or factoring ratio (%) of the proposed activity, task or group of works. The variation will be compared and measured against the proposed activity cost/factor. If the tests are successful, the sum of accepted costs represents the construction cost estimation, which would be financed by the financial institutions [13].

Table 4: Sample of location cost factoring for a block of flats in urban areas.

Item	Description of Construction Works	Means Cost Data as Percentage (%)	Item	Description of Construction Works	Means Cost Data as Percentage (%)
1	Building Permission	5.70%	11	Double glazed	1.30%
2	Excavation, foundation and structural concrete frame	22.60%	12	Fencing and metal works	1.00%
3	Internal and external walls	5.70%	13	Floor finishes (wooden and marble)	10.10%
4	Wall finishes	7.20%	14	Types of Hygiene and ceramic tiles	6.00%
5	Plumbing installations	2.90%	15	Plastering	0.40%
6	Heating installations	5.00%	16	Internal and external painting	5.70%
7	Insulation	1.30%	17	Elevator	2.00%
8	Electrical installations	3.30%	18	Locks and	0.30%
9	Internal doors & kitchen fittings	9.10%	19	Benefits / Services	2.40%
10	External doors & windows (PPC Aluminum)	4.80%	20	Gardening	1.20%
			21	Unanticipated Cost	2.00%
Construction Budgetary Rate Sheet				Total	100.00%

This is briefly summarised by using the following simple formula for a new residential construction (based on submitted budget):

$$\textit{Bank's Activity Factor}\ (\%) = [\textit{proposed budget activity factor}\ (\%)]\ \text{x}\ \textit{(BAF)}[(\textit{local VAT rate})/(\textit{national VAT rate})]\ \text{x}\ [(\textit{local material inflation})/(\textit{Athens' material inflation})] + |V_1| \Rightarrow = \textit{(a)} + |V_1|,$$

where: a is the outcome of factor calculations and V_1 is the variance : $|V_1| = [\ (BAF) - (a)\ ]$

For example, to estimate the accepted/approved cost location factor of a task for excavation, foundation and structural concrete frames (residential property), located in the border zone (e.g. Leros Island), all parameters are input into the Bank's Activity Formula, below:

[22.60 %] = [24.0 %] x [(13%)/(19%)] x [(110)/(100)] $\Rightarrow$ *[22.60 %] = 18.063% +* $|V_1|$ $\Rightarrow$ *22.60 = 18.063 + 4.537* $\Rightarrow$ *0.0.* Namely, 22.60% is the subject factor for Leros Island.

Where: (24.0%) is the proposed factor for the subject task; (13%) is the local VAT (2007) for Leros region; and (19%) is the national VAT (2007); (110) is the local material cost index; (100) is Athens' material cost index.

CONCLUSIONS

The conclusions are that initial construction cost estimations could be based on location cost modelling in the valuation process, for the Greek construction industry and financial institutions [13], providing a mechanism for better construction planning, budgetary control and monitoring of property investments. As well, it offers a way to understand the importance of cost engineering in both industry, and engineering and technology education [13].

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