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Elemental cost estimating: current UK practice and procedure

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ABSTRACT

Purpose - Elemental cost analysis is perhaps the best known product-based cost model and provides the data upon which elemental cost planning is based (Kirkham, 2007 p. 173). The technique has been used by quantity surveyors to base their predictions during the design stage since the 1950s (Morton and Jagger, 1995). There has, however, been no recent attempt to establish the extent to which practicing quantity surveyors use this technique (if indeed they still do so) and the manner in which cost analysis is currently carried out.

Design/methodology approach - A nationwide questionnaire survey of UK quantity surveying practices was undertaken. The survey sought to establish: the extent to which elemental cost estimates are prepared for proposed developments; the format used to prepare these estimates (together with the degree to which the BCIS Standard Form of Cost Analysis (SFCA) is still used); the factors that affect the use of elemental cost estimates; and the level of the detail to which these estimates are analysed. Further, the survey investigated the predilection within the surveying profession for single-figure and elemental format cost models.

Findings – The study clearly establishes that UK quantity surveying practices routinely undertake elemental cost planning during the design phase of a project and that the BCIS SFCA is the most popular approach to cost planning. Further, they established that while around 70% of the respondents would not currently use single figure estimating software, between 85% and 95% indicated that they would be encouraged to use it if it was able to generate an elemental breakdown of its prediction.

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Keywords - Cost analysis, Element, Elemental cost estimating, Elemental Cost planning

Paper type – Research paper

INTRODUCTION

Elemental cost planning, during the design phase of a project, first came into vogue during the years after the Second World War, when the art of accurate single price estimating became increasingly difficult to practice because of unsettled economic conditions and the use of non-traditional designs (Kirkham, 2007 p. 168). This system is still used, enabling the cost of a scheme to be monitored during design development.

An element is defined as a major part of the building, which always performs the same function irrespective of its location or specification (Kirkham, 2007 p. 173). A series of elements are used to perform a cost analysis, which is a major characteristic of the elemental cost planning. According to Ashworth (2004), cost analysis is the "... systematic breakdown of cost data, generally on the basis of an agreed elemental structure". The process of using such an elemental structure, during the estimating process, to calculate approximately the cost of each of the elements, is called elemental cost estimating.

The aim of this paper is to establish the extent to which quantity surveyors undertake cost planning and the manner in which elemental cost estimating is currently applied.

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BACKGROUND

The idea of elemental cost analysis first developed as the need for a design cost plan emerged. The process is based on the concept of being able to compare the value of a proposed building with other completed schemes in order to ascertain whether or not the amount of money allocated to each part of the building is reasonable, both in itself and as proportion of the total building cost (Kirkham, 2007 p. 173).

How can two different buildings be compared to achieve the above requirements? A simple way would be to compare the summary pages of their bill of quantities. Before doing this, however, one has to account for and/or eliminate the influence due to any difference in the size of the two buildings. To do this, each part of the bill of quantities would have to be divided by the floor area of the respective building. This would give comparable figures (cost/m^2). Unfortunately, comparing the summaries of bill of quantities does not necessarily provide useful information, as the bill of quantities is separated into trade or work section totals. It would only provide information about how much each work section, such as, excavation, concrete, brickwork etc. will cost. One building may have more expensive concrete works than another simply because the first one is a concrete framed building, while the second one, has a steel frame. It is clear from this example that work section totals do not give valuable information on which to make appropriate cost comparisons.

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This is where the concept of 'elements' emerged: the bill of quantities had to be divided in such a way that makes a comparison between two buildings easier and that produces more useable results. It was considered that some parts of the building always perform the same function irrespective of the building type. The frame, for example, always provides structural stability no matter what the building is. Therefore, if buildings were divided into such 'elements,' a comparison would then be straightforward. Nevertheless, there are numerous ways a building can be divided into elements as some components might perform more than one function. A parapet wall, for example, could be part of the element 'roof' or the element 'external walls'. This is only one of numerous examples, all of which indicate the need for a standardised approach.

It was the need for standardisation that led the Building Cost Information Service of the RICS to introduce the first Standard Form of Cost Analysis (SFCA) in 1969. Robertson (1995) states that while the BCIS succeeded in producing its first form of elemental cost analysis in 1963; it took a further six years before the elemental format could truly be called a 'Standard Form of Cost Analysis'. This form uses the concept of 'elements' discussed above. It provides a standard way of dividing the building into elements by separating it into 8 major divisions: substructure, superstructure, finishes, fittings and furnishings, services, external works, preliminaries and contingencies. Additionally, superstructure, finishes, services and external works are further sub-divided into 8, 3, 15 and 4 components respectively (See Table 1). According to Kirkham (2007 p. 178), because "... the detail is grouped in this hierarchical way an analysis at the level 1 [top level] into the eight items only will be quite compatible with a fully detailed analysis... of another project". This makes the comparison of two

projects very easy, regardless of the amount of information that is available for each project. The SFCA also has a set of rules on how to separate the building into elements, resolving the problem of standardisation discussed above. The establishment of the SFCA laid the foundations for the further development of cost analysis and cost planning.

<<<< Insert Table 1 about here >>>>

Despite its long existence, the SFCA is still widely used. This is due to the fact that it gained a great measure of support during its formation and subsequent use. Most quantity surveying practices implement their analyses according to it, while those that do not, risk being isolated from acknowledged good practice. Despite this, however, some reservations have been expressed regarding its use; most of which are concerned with the way that the elements are separated. Whilst it is indeed a standardised form, some commentators suggest that the standard sub-divisions are inappropriate.

Gleeds, an international property and construction consultancy, have initiated the strongest opposition to the use of the SFCA as common practice. According to Southgate (1988a), the SFCA has served the profession well since the early 1950's, but it neither adequately reflects the manner in which buildings are constructed nor, except in a very general way, the order of construction. It is, therefore, difficult without further analysis to relate the cost to form, shape, structural type, or construction time. Further, it has been stated that because of the way that the standard form is currently structured, there is a difficulty in dealing with different options for structural and elevational items as they are allocated to different sub-elements (Anon, 1989).

The structure of a building, for example, is contained within the frame, upper floors, roof, stairs, external walls (load bearing) and partitions (load bearing) (Southgate, 1988a). The structure, however, is the responsibility of the structural engineering consultant. The point that Southgate makes with this example is that the way the SFCA is separated into elements does not serve the surveyor in an optimum way, as the responsibilities for each work section involved in the building process are scattered among the elements. Furthermore, it does not help the surveyor examine alternative solutions in an effective manner; for example, if the cost of different structural solutions had to be examined then this would be difficult as each of the different options would affect all the elements that the structure influences. By combining these elements into one section of the cost plan, such analysis would be simplified. This would help to make the recording of cost information more simple and flexible. A further advantage, according to Southgate (1988b), is that the data from one type of building could be used for another. For example, cost data of an office block and a hotel could be compared, as, with the structural data kept together, the structural element of the buildings may be directly comparable. Therefore, for the example given above, if the structure of the office block and the hotel were similar then there could be a direct comparison of the costs of the two even though the building functions are different.

While the discussion in the previous paragraph was mainly directed towards the structural elements of a building, it is not only the structure that it is distributed across different elements of the SFCA. The same situation applies to the building envelope and interior partitions. In order to address these concerns, Gleeds, restructured the traditional form of cost

analysis. According to them, this did not require significant change: the only difference occurs within the superstructure and internal finishes elements of the SFCA. Gleeds named their approach 'functional elements' to distinguish them from the traditional elements and to stress the fact that they cater for the different functions that reflect the manner and order of construction (See Table 2).

<<<< Insert Table 2 about here >>>>

IMPETUS FOR THE RESEARCH

Ongoing research at The University of Manchester has resulted in the production of ProCost: Neural Network based cost modelling software, which can predict the final cost of a building during the very early stages of the design process (Emsley *et al.* 2002, Lowe *et al.* 2002, Lowe *et al.* 2006a). Supporting research identified a series of variables that influence the cost of the building (for example, procurement, site variables, structure variables etc), which were incorporated in the input section of the software's interface (Lowe *et al.* 2007a, 2006b, 2007: see Table 3). After the user inputs a value for each of these variables for the building under consideration into the software, then the neural network model predicts a cost for the building based on similar relationships from previous projects. The output of the model is deterministic: that is, the prediction is given in the form of a single figure.

<<<< Insert Table 3 about here >>>>

Research was conducted to evaluate the use of ProCost in practice (Soutos, 2002), using semi-structured interviews and practical application of the software with potential users. Four

subjects from three different organisations were interviewed. A beta version of the software had been distributed to these organizations so that they could use it in parallel with their existing estimating techniques. Part of the interview schedule related to user satisfaction with the software in its current form and sought ways in which this might be improved. The results of the research indicated that the potential users of ProCost required not only a single figure output but also an elemental breakdown of the estimate. The existing capability of ProCost, particularly the provision of a single figure output did not totally reflect the requirements of estimators. These results initiated a new development stage for the software: an investigation into the feasibility of providing an elemental breakdown of the output of ProCost.

As discussed above the results were based on short interviews with a relatively small number of people, who did not necessarily represent the profession as a whole. In addition, having implemented an extensive literature review it became apparent that there had been no recent attempt to investigate the extent to which elemental cost estimating was presently used in practice. It was, therefore, decided to proceed with a nationwide survey to elicit the extent and current practice of current elemental cost estimating.

METHODOLOGY AND ANALYSIS

Methodology

The most efficient way of undertaking the survey was deemed to be a questionnaire distributed to a number of quantity surveying practices. In order to establish a sample, the RICS online directory was used (http://www.ricsfirms.co.uk/).

The questionnaire incorporated nine questions, all of which were in the form of multiple-choice responses. The form was divided into two parts: Part one investigated the current elemental cost estimating practice, while part two was more specific to ProCost, investigating ways in which the software could be improved. The questionnaire is reproduced in Appendix A.

Five hundred questionnaires were distributed by mail. The aim was to make the survey nationwide, covering England, Scotland, Wales and Northern Ireland. With the aid of the online RICS directory, individually named quantity surveyors at quantity surveying practices within an 80 miles radius of the centres of London, Cambridge, Birmingham, Manchester, York, Cardiff, Glasgow, Inverness and Belfast were selected. Of the 500 questionnaires distributed, 200 were returned, a response rate of forty percent. This is a relatively high figure, indicating the high interest of the industry in the research project. Of the returned questionnaires, seven were incomplete, either because the addressee was no longer practicing as a quantity surveyor or was not in a position to answer the questionnaire. Therefore the following analysis (descriptive statistics) is based on the remaining 193 responses.

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The aim of the survey, therefore, was to investigate current elemental cost estimating and planning practice. The key questions to be addressed - were:

- Do quantity surveyors currently prepare elemental cost estimates, and if so to what extent?
- What format do they use in order to prepare these estimates?
- What is the detail level at which the elemental estimates are prepared?
- How do factors such as the stage of the estimate or the size of the project influence the decision to prepare elemental cost estimates and their level of detail?
- Would the incorporation of an elemental output increase the willingness of the quantity surveyors to use cost modelling software such as ProCost?

Analysis

Data analyses were undertaken using the Statistical Package for the Social Sciences (SPSS for Windows, release 16.0). Descriptive statistics, cross-tabulation and Pearson's chi-square were calculated.

FINDINGS

The principal results of the survey are as follows:

Frequency of elemental cost estimate production

Perhaps the most important question, as the subject of elemental cost estimating has not been investigated for quite some time, related to the frequency that elemental cost estimates were produced. Also the research team were interested in establishing, whether or not quantity surveyors were currently preparing elemental cost estimates in practice (or whether it was a term that existed only textbooks. Another reason for the significance of this question was that the rest of the questionnaire was dependent on it. If the majority of practitioners replied that they did not generally prepare elemental cost estimates then the whole idea of investigating the manner in which these estimates are prepared has no practical significance.

Question one had five possible answers: Always (100% of projects), Often (about 75% of projects), Sometimes (about 50% of projects), Rarely (about 25% of projects) and never (0% of projects); responses are presented in Table 4. Only 1.6% of those surveyed indicated that they do not use elemental cost estimates at all (this group were excluded from the remainder of the analysis. Almost half of the respondents (49.7%) answered that they often (for about 75% of their projects) prepare elemental cost estimates. In addition to this, 30.1% indicated that they used elemental cost estimating on all their projects. This means that virtually 80% of the respondents' stated that they use elemental cost estimating either often or always on their projects. This finding justified further investigation of current elemental cost estimating practice.

<<<< Insert Table 4 about here >>>>

Preferred format of elemental cost estimates

As discussed previously, there are a number of standard ways of carrying out an elemental cost analysis. The two most common formats according to the literature are the BCIS Standard Form of Cost Analysis (SFCA) and the reduced 'functional elements' format. The SFCA is the most established format, however, it has some disadvantages over Gleeds' 'functional elements', this research wanted to investigate if the SFCA is still widely used or whether other forms of elemental estimating have replaced it. In addition to these two major formats, there are other formats that individual practices might use and in order to incorporate these formats a third option was added to the possible answers for question two. The possible answers in this question were: 'BCIS SFCA', 'Functional Elements', or 'other'. The latter was open-ended allowing the respondent to insert the particular format that he/she used.

As can be seen in Table 5, the vast majority (76.3%) of the respondents indicated that they use the BCIS SFCA format when preparing elemental cost estimates. This is highly significant confirming that the SFCA is still generally used, despite its age. Only 14.2% of the respondents stated that they use 'functional elements', while 9.5% indicated other ways of implementing elemental cost estimating. Of the latter, one third stated that they use both the SFCA and the 'functional elements' format at the same time, or depending upon the project. Another popular answer amongst this category of respondents was the use of an in-house

technique or company specific format. Finally, other responses included hybrid estimates and approximate quantities.

<<<< Insert Table 5 about here >>>>

The degree of association between question one (frequency of use) and question two (choice of elemental cost estimating format) was investigated using cross-tabulation. Pearson chi-square indicated a significant relationship ($P \leq 0.02$). The results (presented in Table 6) show that those respondents that frequently (often) prepare elemental cost estimates, the more likely they are to use the BCIS SFCA format rather that the functional elements way. This result is of interest as it has practical implications for the choice of format of the proposed ProCost elemental estimation tool; it is reasonable to assume that those who frequently prepare elemental cost estimates are likely to be the potential users of the software.

Before reporting the analysis of the next question it is worth mentioning that questions three and four were only directed to the 76.3 percent of respondents that stated that they use the BCIS SFCA. The remainder of the respondents were directed to ignore these questions.

The level of detail of cost estimates and the factors that influence its selection

The responses indicated that the majority of quantity surveyors in the UK use the BCIS SFCA format when preparing elemental cost estimates. However, as discussed above, the

SFCA has two different levels of detail, the *top level* that consists of 8 group elements and the *detailed level* where 4 of the groups are subdivided further into 30 elements.

The purpose of question three was to examine which of these two detail levels is predominantly used and to establish the factors that might influence this choice. While examining the possible answers for a multiple-choice question and after a series of discussions with the research team and industrial collaborators it was apparent that one of the most important parameters that can normally influence the selection of the detail level of the SFCA is the time stage of the estimation process. Normally the top level is used at an initial stage, while the detailed level is used during the later part of the estimating process, when more information is available for the building under consideration. The second factor to be investigated is the size of the project. This was believed to be very significant, as some practices might consider it un-economical to conduct a very detailed elemental cost estimate for small projects.

This question required the sub-set to state which level of detail they normally use. The possible answers were: “top level only”, “detailed level only”, “either depending on the stage of the project”, “either depending on the size of the project” and “other”. These answers gave the respondent the option to state whether they use one level of detail only irrespective of any factors, whether the detail level that they use depends on the stage of the estimate, whether it depends on the size of the projects, and finally with an open ended option, it gave the opportunity to state any other possible factors that may affect the level of detail of the estimate.

<<<< Insert Table 7 about here >>>>

As shown in Table 7 above, only 3.9% of the sample stated that they only use the top level of the SFCA throughout the estimating process. The most common response to the five possible options was the detailed level: 42.1% of the respondents indicating that they use the detailed level of the SFCA throughout all the stages of the estimating process regardless of any other factor. A relatively high portion of the sample (14.5%) declared that the selection is depended on the size of the project. This means that a detailed level cost estimate might be applied when the project under consideration is a large one with the respective amount of fee income to cover the additional work and resources required. Only 1.3% indicated that there were other factors that might influence the decision. The most common examples given were: design complexity, similarity to historical projects, and level of information available for producing the estimate. This small percentage denotes that the major factors that influence the choice of format used are the size of the project and the stage of the estimate. As illustrated in Table 7, 38.2% of the respondents stated that the selection of an appropriate level of detail level is dependent on the stage of the estimate: the second most popular responses. This suggests that the time stage of the estimate is indeed a very important factor directly influencing the choice of format. This aspect is, therefore, analysed further.

The influence of design stage on the level of detail selected

As reported above, almost forty percent of the respondents indicated that the selection of the format (detail level) of an elemental cost estimate is directly dependent on the timing (design stage) at which the estimate is required. In order to investigate further the way that the stage of the estimate affects the selection of the level of detail, this question asked the sample to indicate at which stages they use the top level and the detailed level formats. The stages given were: the initial-brief stage, the sketch plan stage, the approved design and the pre-tender stage.

<<<< Insert Table 8 about here >>>>

As revealed in Table 8, the top level approach is mainly used at the brief stage, with its frequency of use falling gradually as the estimating process continues reaching zero during the pre-tender stage. Conversely, the situation is reversed in respect of the detailed level approach, which starts with zero frequency of use at the brief stage. Following which there is a considerable increase in its use at the sketch plan stage when the estimator has more information concerning dimensions and quantities; it reaches its peak at the approved sketch design when the majority of the information is available. Following this, there is a slight fall in its application at the pre-tender stage as other techniques are applied in combination with elemental cost estimating. If the results are compared, it can be shown that there is a general relationship between the frequencies of use and the development of a building's design. When the frequency of the top level is high, that of the detailed is low, which is very appropriate as it denotes the gradual change in use of format (level of detail) depending on the stage of the estimate/design. For example, during the brief stage the detailed level is not

used at all, while the top level is reaches its greatest frequency. Similarly, during the sketch plan stage there is an equal distribution between the frequency of use of the top level and the detailed level: their use dependent on practice policy. At the approved sketch design stage the top level is generally not used, while the detailed level reaches its peak. Finally, at the pre-tender stage the top level is not used at all, while those who still use elemental cost estimating at this stage use the detailed level of the SFCA.

Motivation to prepare elemental cost estimates

The purpose of question six was to examine whether the preparation of an elemental cost estimate generally depends on the requirements of the client or whether it is incorporated within the practices' general policy. The possible answers for this question were 'only on request by the client', 'as practice general policy on all projects' or 'other'. The inclusion of the option 'other' was made in order to elicit other possible reasons.

<<<< Insert Table 9 about here >>>>

As can be seen from Table 9 the vast majority of respondents (71.6%) stated that the decision to prepare an elemental cost estimate was a function of their general policy. 18.4% indicated that they would only prepare elemental cost estimates when requested to by a client, while 10% responded that other factors influenced the decision. About three quarters of this latter group stated that the decision depended on the project type and its nature. Others answers

included: “when there is enough information available”, “depending on the fee”, or for “complex schemes only”.

The degree of association between question six (motivation for preparing an elemental cost estimate) and question one (frequency of use) was investigated using cross-tabulation. Pearson chi-square indicated a highly significant relationship ($P \leq 0.001$). Predictably, the results (presented in Table 10) show that almost 95% of those respondents who always prepare elemental cost estimates do so as a matter of general policy, while 90% of those who rarely prepare elemental cost do so as a client requirement.

<<<< Insert Table 10 about here >>>>

The requirement for PROCOST to provide an elemental cost output

Question 7 sought to investigate the functionality of ProCost. Its purpose being to investigate if practitioners would utilize *single-figure* price estimating software: at this stage, ProCost only produced a single figure price output. As Table 11 shows: 28% of the respondents indicated that they would use the software in its current format, while 18.5% stated that they would not; it also shows that more than half of the respondents (53.4%) would possibly use such software in the future. However, in reality, the responses suggest that if ProCost were to be marketed in its current format, potentially of 72% of the potential user group would not use it.

<<<< Insert Table 11 about here >>>>

Desirability for ProCost to produce an elemental breakdown of building costs

The respondents were then asked to indicate how desirable they considered the inclusion of an elemental feature within the ProCost software to be. 47.9% answered that they would "prefer" for the software to generate an elemental breakdown, while 51.6% replied that it was essential for this enhancement to be included. Only 0.5% suggested that such a move would make no difference to their rejection of the software (See Table 12).

<<<< Insert Table 12 about here >>>>

Inclusion of an elemental estimating function as an encouragement to use ProCost

The final question sought to validate question 8. As Table 13 indicates, 94 percent of the respondents confirmed that if an elemental breakdown was generated by the software then they would be encouraged to use it.

<<<< Insert Table 13 about here >>>>

The ProCost development team should, therefore, carefully consider these findings, in particular the responses to the last two questions, as they provide a clear indication that the adoption of an elemental output format is vital in order to increase the software's applicability to current practice.

SUMMARY AND CONCLUSIONS

This research clearly establishes that UK quantity surveying practices do indeed routinely undertake elemental cost estimating as a common procedure during the design phase of a project. Approximately 80% of the respondents confirmed that they prepared such estimates

for most, if not all their projects, with 70% indicating that they do so, not because their client required it, but as a general policy. It was suggested that based on this process practitioners were able to gain more control of the design.

Regarding the format of the cost analysis, three quarters of the respondents use the BCIS Standard Form of Cost Analysis: confirming that the SFCA is still the most popular approach to cost analysis despite its age and the numerous criticisms levelled against it. As regards the level of detail, four out of ten respondents only use the detailed level of the SFCA as a general practice. The remainder predominantly use either the top or detailed level depending on the size of the project and, more importantly, on the stage of the estimate. The top level is mainly used at the brief stage of the project, while a mix of the two levels is used at sketch plan stage. During the latter stages of the design process the detailed level is the most commonly used approach.

One of the main objectives of the survey was to investigate the enthusiasm within the UK quantity surveying profession for the incorporation of an elemental estimating element within the ProCost cost model. The results established that although approximately 70% of the respondents would not currently use single figure estimating software, between 85% and 95% indicated that they would be encouraged to use it if it was able to generate an elemental breakdown of its prediction. Further, all the respondents confirmed that the research team should incorporate an elemental estimation facility, with half the sample indicating such a development was essential.

This leaves the dilemma of which elemental format to incorporate. The survey has established that the most popular cost analysis format currently in use is the BCIS's SFCA, which has two forms: the top level, which contains only eight elements, and the detailed level, which incorporates an additional 30 sub-elements. While ProCost is essentially an early

stage cost estimation tool, primarily it should be capable of generating a top level elemental break-down (during the feasibility and brief stage) but have the capacity to generate a detailed level breakdown as more information on the proposed project becomes available. This would align the software with current practice and potentially increase the potential user group of the software. Encouragingly, 60% expressed an interest in the ProCost research and requested further information on it.

REFERENCES

Anon (1989) Cost planning system the Gleeds way, *Construction Computing*, Winter 1989/90, 34-37.

Ashworth A. (2004) *Cost studies of buildings*, 4th edition, Longman Publishing.

Emsley M. W., Lowe D. J., Duff A. R., Harding, A. and Hickson A. (2002) Development of neural networks to predict total construction costs, *Construction Management and Economics*, 20, 465-472

Jagger, D., Ross, A. Smith, J. Love, P. (2002) *Building Design Cost Management*, WileyBlackwell

Kirkham, R. (2007) *Ferry and Brandon's Cost Planning of Buildings*, 8th edition, WileyBlackwell, Oxford

Lowe D. J., Emsley M. W. and Duff A. R. (2002) *The Costs of Different Procurement Systems: A Decision Support Model*, Proceedings from the 3rd International Conference on Decision Making in Urban and Civil Engineering, London, 6-8 November, Edited by Farzad Khorsrowshahi

Lowe, D.J., Emsley, M.W. and Harding A. (2006a) Predicting construction cost using multiple regression techniques. *Journal of Construction Engineering and Management.* 132(7), 750-758

Lowe, D.J., Emsley, M.W. and Harding A. (2006b) Relationships between total construction cost and project strategic, site related and building definition variables. *Journal of Financial Management of Property and Construction*, **11**(3), 165-180

Lowe, D.J., Emsley, M.W. and Harding A. (2007) Relationships between total construction cost and design related variables. *Journal of Financial Management of Property and Construction*, **12**(1), 11-23

Morton R. and Jaggar D. (1995) *Design and the economics of building*, Spon, London.

Potts, K. (2008) *Construction Cost Management: Learning from Case Studies*, Taylor & Francis

Robertson D. (1995) Building classification. *Chartered Surveyor Monthly*, April.

Seeley, I. H. (1995) *Building Economics*, 4th edition, Palgrave Macmillan

Smith, J. and Jaggar, D. (2006) *Building Cost Planning for the Design Team*, 2nd edition, Butterworth-Heinemann

Southgate T. (1988a) A new approach: Tony Southgate discussed a new method for cost planning, *Chartered Quantity Surveyor*, November, pp35-36

Southgate T. (1988b) A new approach: The second part of Tony Southgate's discussion of a new cost planning method, *Chartered Quantity Surveyor*, November, pp 35-36

Soutos M. (2002) *Early stage construction cost estimating. PROCOST: A practical evaluation of a neural network based system*, Unpublished MSc Dissertation, UMIST, Manchester

Soutos, M and Lowe, D J (2011) Elemental cost planning: current UK practice and procedure. *Journal of Financial Management of Property and Construction,* **16**(2), 147-162 eScholarID:126423 | DOI:10.1108/13664381111153123

Figures 1-5 removed – the following tables inserted:

Table 1: BCIS Standard Form of Cost Analysis (SFCA)

1	**Substructure**	5D	Water Installation
2	**Superstructure**	5E	Heat Source
2A	Frame	5F	Space Heating
2B	Upper Floors	5G	Ventilating System
2C	Roof	5H	Electrical Installation
2D	Stairs	5I	Gas Installation
2E	External Walls	5J	Lift & Conveyors
2F	Windows & External Doors	5K	Protective Installation
2G	Internal Walls & Partitions	5L	Communications Installations
2H	Internal Doors	5M	Special Installations
3	**Finishes**	5N	BWIC with Services
3A	Wall Finishes	5O	Profit & Attendant Services
3B	Floor Finishes	**6**	**External Works**
3C	Ceiling Finishes	6A	Site Works
4	**Fittings & Furnishings**	6B	Drainage
5	**Services**	6C	External Services
5A	Sanitary appliances	6D	Minor Buildings
5B	Services equipment	**7**	**Preliminaries**
5C	Disposal installation	**8**	**Contingencies**

Bold: 8 major divisions – top level analysis

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Table 2: Gleeds' Functional Elements

Substructure	
Structure	**Interior**
Frame, floors and roof	Internal walls and partitions
Stair structures	non load bearing
External walls – load bearing	Internal doors
Internal walls – load bearing	Raised floors
Envelope	Suspended ceilings
Roof coverings	Internal Finishes
External walls – non load bearing	Wall, floor and ceiling
External cladding	Fittings
Windows and external doors	Services
	External works
	Preliminaries

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Table 3: Classification of input variables (Source Lowe et al. 2006a, 2006b, 2007)

Project strategic variables								
Contract form	CFORM	(O)	Procurement strategy	PROC	(O)	Tendering strategy	TEND	(O)
Duration	DUR	(S/weeks)	Purpose	PURP	(O)			
Site related variables								
Site access	ACCS	(O)	Type of location	LOC	(O)			
Topography	TOP	(O)	Nature of site	SITE	(N)			
Design related variables								
Building definition			Structure			Finishes and openings		
Envelope	ENVLP	(S/m^2)	External walls	EXWL	(S/£)	Ceiling finishes	CEILF	(S/£)
Function	FUNC	(S/£)	Frame	FRAME	(O)	External doors	EXDR	(S/£)
GIFA	GIFA	(S/m^2)	Piling	PILING	(N)	Floor finishes	FLRF	(S/£)
Height	HEIGHT	(S/m)	Roof construction	ROOF	(O)	Internal doors	INDR	(S/£)
Quality*	QUAL	(O)	Roof profile	RFPRO	(O)	Internal walls	INWL	(S/£)
Shape complexity	SHAPE	(O)	Stair types	STAIRS	(O)	Internal wall finishes	INWLF	(S/£)
Storeys above ground	STABV	(S/number)	Substructure	SUB	(O)	Roof finishes	ROOFF	(S/£)
Storeys below ground	STBL	(S/number)	Upper floors	UPFL	(O)	Windows	WINS	(S/£)
Structural units	UNITS	(S/number)				Services installations		
Wall-to-floor ratio	WALFL	(S/ratio)				Air conditioning	AC	(S/£)
						Electrical installations	ELEC	(S/£)
						No. lifts	LIFTS	(S/number)
						Mechanical installations	MECH	(S/£)
						Protective installations	PROT	(S/£)
						Special installations	SPEC	(S/£)

Note: N = nominal, (e.g., piling: 0 = no piling, 1 = piling); O = ordinal (e.g., shape complexity: 0 = low, 1 = medium, 2 = high); and S = scale (e.g., external doors: a proportional scale based on relative costs).

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Table 4: How often do you prepare elemental cost estimates? (n= 193):

Never	Rarely	Sometimes	Often	Always
3	14	22	96	58
1.6%	7.3%	11.4%	49.7%	30.1%

Table 5: Which format do you use in order to prepare elemental cost estimates? (n= 190)?

BCIS SFCA	Functional Elements	Other
145	27	18
76.3%	14.2%	9.5%

Table 6: How the relative frequency of BCIS/functional changes according to the regularity of elemental estimates preparation

	Always		Often		Sometimes		Rarely	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
BCIS SFCA	46	90.2%	75	88.2%	17	77.3%	7	63.6%
Functional elements	5	9.8%	10	11.8%	5	22.7%	6	36.4%
Total	51	100%	85	100%	22	100%	11	100%

Table 7: At which level do you prepare your cost estimates? (n= 152):

Top	Detail	Either dependent on stage	Either dependent on size	Other
6	64	58	22	2
3.9%	42.1%	38.2%	14.5%	1.3%

Table 8: How the estimating stage affects the frequency of use of the top and detailed level

	Brief	Sketch plan	Approved design	Pre-tender
Top level	42	27	3	0

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Detailed level	0	28	39	29

Table 9: Reason for preparing elemental estimates (n= 190)?

General policy	Client requirement	Other
136	35	19
71.6%	18.4%	10%

Table 10: Relationship between question 1 and 6

	Always		Often		Sometimes		Rarely	
	Count	**Percent**	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
General Policy	54	94.7%	70	83.3%	9	60%	1	10%
Client requirement	3	5.3%	14	17.7%	6	40%	9	90%
Total	57	100%	84	100%	15	100%	10	100%

Table 11: Utilization of *single-figure* price estimating software (n= 189)

Yes	No	Maybe in the future
53	35	101
28.0%	18.5%	53.4%

Table 12: Desirability for ProCost to produce an elemental breakdown of building costs (n= 190)

Essential	Preferable	No difference
98	91	1
51.6%	47.9%	0.5%

Table 13: Would the inclusion of an elemental estimating function encourage you to use ProCost? (n= 187)

Yes	No
176	11
94.1%	5.9%

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APPENDIX A

1. How often do you prepare elemental cost estimates?
   (Please tick the relevant box)
   - ❑ Always (100% of projects)
   - ❑ Often (about 75% of projects)
   - ❑ Sometimes (about 50% of projects)
   - ❑ Rarely (about 25% of projects)
   - ❑ Never (0% of projects)

2. Which format do you use in order to prepare an elemental cost estimate?
   - ❑ BCIS Standard Form of Cost Analysis (SFCA) → Go to Question 3
   - ❑ Functional Elements → Go to Question 6
   - ❑ Other (Please state): _____ → Go to Question 6

3. The BCIS Standard Form of Cost Analysis is separated in two levels: The *"top level"*, consisting of 8 group-elements (i.e. substructure, superstructure, finishings, etc…) and the *"detailed level"*, which consists of approximately 35 elements (i.e. superstructure = frame + upper floors + roof + …).
   At which of these two levels do you prepare your cost estimates?
   - ❑ Top Level only →Go to Question 4
   - ❑ Detailed level only →Go to Question 4
   - ❑ Either, depending on the stage of the estimate →Go to Question 5
   - ❑ Either, depending on the size of the project (Top-level for small projects, Detailed level for bigger projects) →Go to Question 6
   - ❑ It depends on other factors. Please describe: _____ _____ →Go to Question 6

4. At which stage of the design process do you use this type of elemental cost estimate? (You can tick more than one box):
   - ❑ Brief stage – Preliminary estimate
   - ❑ Sketch plan stage
   - ❑ Approved sketch design
   - ❑ Pre-tender stage

   → Go to Question 6

5. I use the **top level** of SFCA at:
   - ❑ Brief stage – Preliminary estimate
   - ❑ Sketch plan stage
   - ❑ Approved sketch design
   - ❑ Pre-tender stage

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and the **detailed level** of SFCA at:

- ❑ Brief stage – Preliminary estimate
- ❑ Sketch plan stage
- ❑ Approved sketch design
- ❑ Pre-tender stage

6. When would you normally prepare elemental cost estimates?
   - ❑ Only on request by the client
   - ❑ As practice general policy on all projects
   - ❑ Other (please state):

     _____

7. Would you use a computer-based program that produces a single figure price for a project as an additional tool to your estimates?
   - ❑ Yes
   - ❑ No
   - ❑ Maybe in the future.

8. At this stage the ProCost software produces *a single price* estimate at its output. How desirable do you think it is to give an *elemental breakdown* of the costs as well?
   - ❑ It is preferable
   - ❑ It is essential
   - ❑ It does not make a difference.

9. Would the inclusion of such a feature encourage you to use such a program?
   - ❑ Yes
   - ❑ No

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