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AFRICA ASSOCIATION OF QUANTITY SURVEYORS

**PROFESSIONAL SKILLS STUDY GUIDE 6**

**COMPILE A PROJECT COST INFORMATION DATABASE FOR BUILT ENVIRONMENT PROJECTS**

1st EDITION – November 2020

**ORGANISATIONAL COMPONENT**

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| **GENERAL PREMISE AND EDUCATIONAL APPROACH**The general objective with this module is to emphasise **understanding** rather than **memorising** and to develop the candidate’s skill to apply the principles in a practical way. A problem-driven approach to learning is followed. Candidate-centred and co-operative learning is encouraged in order to optimally develop the skills outlined in the study component.The module comprises ten main parts, each one contributing to an understanding of the cost information management procedures for Built Environment projects. The breakdown of this module is as follows:Part 1 – The approach towards design cost management.Part 2 – Consulting relevant experts and literature.Part 3 – Applying project cost information databases to the financial management of built environment projects.Part 4 – Some examples of the factors which could affect or vary the rate used in a square metre estimate.Part 5 – Evaluating existing database technologies and methodologies.Part 6 – Establishing strategies for project information input and retrieval.Part 7 – Accessing relevant information.Part 8 – Setting up and maintaining a database.Part 9 – Formatting and entering information into the databasePart 10 – Applying project cost information databases to the financial management of built environment projectsEach of these sections has specific learning outcomes which are identified in the module outline.**LEARNING ACTIVITIES** |
| The relevant study material is available through the office of the Africa Association of Quantity Surveyors (AAQS). Candidates may have the choice of mastering the content of this module solely through self-study and/or attending workshops offered by AAQS accredited professional institutions. The interaction between candidates and the AAQS and/or accredited professional institutions will therefore depend on the choice of offering. |
| The delivery of this module is by an alternative approach to learning and teaching. Theoretical content within the primary reader is limited, rather you will be asked to work through a series of linked learning sources, predominantly extending your theoretical knowledge base through focussed readings, as well as being supported by experience gained in your work environment. Once you have undertaken the required readings indicated, the module requires you to answer the sample questions on the subject area (Addendum A) as a ‘self-study’ exercise. Should you wish to engage with this subject for gaining CPD ‘credits’ only, you are required to undertake the readings and submit acceptable answers to at least 5 of the sample questions on the subject area (Addendum A) as a ‘self-study’ exercise at the end of the module. In this event, the study material is considered to be equivalent to approximately 30 hours of study time. |
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| **ASSESSMENT CRITERIA AND FEEDBACK*** The minimum pass mark for a module is 50%.
* Exam entrance will be determined by either the submission and satisfactory evaluation of an assignment / or alternatively, through satisfactory completion of a multiple-choice test on the subject area. The process to be adopted will be decided upon by the AAQS.
* The final assessment will be a written examination. The examination will be a maximum of 180 minute (3 hours) hand written paper.
* No supplementary assessment is granted.
* The results for the assignment / test exam entrance marks will be communicated to candidates within 4 weeks from the date that the agreed process is undertaken. The results of the final assessment will be inputted into the candidate’s personal profile on the SACQSP website within 1 week after announcement of the final results.

**LEARNING ASSUMED TO BE IN PLACE**NQF level 6 (360 credits) qualification or equivalent.Although 360 credits is the minimum level for learning assumed to be in place, it is recommended that candidates develop actual project experience and discuss issues with appropriately qualified professionals at every available opportunity before undertaking this particular module.An understanding of project cost information databases is dependent on a sound knowledge of both theoretical and practical aspects of quantity surveying practice.CREDITSThe credit weighting of this module is 10 which equates to 100 notional hours, inclusive of all readings, assignments and examinations. Studying the content of this module alone is not sufficient to master the required skill. Candidates are required to study the databases in the practices where they work and to undertake cost analysis that results in addition to the databases in order to gain a comprehensive understanding of the requirements for the analysis of data in different scenarios.**STUDY COMPONENT**

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| The competencies, skills and range statement stated in this section are those as contained in the South African Qualifications Authority Unit Standards entitled: *(1)* *Compile a Project Cost Information Database for Built Environment projects (2) Undertake budgetary reporting on and monitoring of built environment projects (3) Prepare cost estimates for built environment projects***CANDIDATES WHO SUCCESSFULLY COMPLETE THIS MODULE WILL GAIN THE FOLLOWING COMPETENCIES:**The ability to:1. define the requirements of a built environment project cost information database
2. access relevant information
3. set up and maintain database
4. apply project cost information databases to the financial management of built environment projects

**TO DEMONSTRATE TO AAQS-ACCREDITED ASSESSORS THE SCOPE OF PROFESSIONAL COMPETENCE GAINED BY STUDYING THIS MODULE, THE CANDIDATE WILL BE REQUIRED TO:** Illustrate that he/she is capable of:1. consulting relevant experts and literature
2. specifying and evaluating scope of information to be included in databases
3. evaluating existing database technologies and methodologies
4. establishing a strategy for project information input and retrieval
5. identifying sources of relevant information
6. accessing and evaluating information
7. ensuring that selected database satisfies project cost information requirements
8. customising database to satisfy project cost information requirements, where relevant
9. formatting and entering information into databases
10. monitoring currency of data and overall information in databases
11. updating database content as required
12. developing and maintaining a policy for database maintenance
13. selecting appropriate data from cost information database
14. demonstrating the application or relevant data

**RANGE STATEMENT**This module relates to the performance of work typically undertaken by quantity surveyors and newly qualified persons are expected to demonstrate their acquired skills through their ability to perform the following in their place of employment. |  |
| 1. understand the cost information requirements of construction projects
2. develop appropriate cost information databases for construction projects
3. utilise cost information databases for the financial management of construction projects
4. Combine facts, ideas and proposals into a complex whole.
5. Understand and apply basic computer skills.
6. Demonstrate problem-solving skills.
7. Demonstrate communication and presentation skills.
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PRESCRIBED SOURCESThe sources below must be studied extensively and it is therefore compulsory that each candidate obtain a copy or have unlimited access to each document whilst undertaking the module:Candidates are required to read the following documents that deal with services to be rendered by professional quantity surveyors that specifically deal with estimating methods and setting up price databases:1. Association of South African Quantity Surveyors. (2013a) *Guide to Elemental Estimating & Analysis for Building Work.*
2. Association of South African Quantity Surveyors. (2013b) *Contract Price Adjustment Provisions (CPAP)* Available at www.asaqs.co.za
3. DelQS Quantity Surveyors. (2013) *Further sources of property data*, Available at www.Delqs.com
4. Flanagan, R. and Tate, B. (1997) *Cost Control in Building Design*. Blackwell Science Ltd,
5. Medium Term Forecasting Associates. (2013) *Report on Building Costs* First Quarter 2013.
6. Statistics South Africa. (2016) Statistical Release P0151. March 2016. Available from www.statssa.gov.za

Candidates are required to read the following papers dealing with current issues and developments in the management of the production process of price determination documents:1. Akintoye, A. (2000). *“Analysis of Factors Influencing Project Cost Estimating Practice”. C*onstruction management and Economics, Volume 18, pp 77-89.
2. Bowen, P.A. (1993a) Cost modeling: calls for a paradigm shift – *Source*: Bowen, P.A. (1993) A communication-based approach to price modeling and price forecasting in the design phase of the traditional building procurement process in South Africa. Unpublished PhD Thesis, University of Port Elizabeth.
3. Bowen, P.A. (1993b) Theory of price planning and price control – Extract from PhD.
4. Bowen, P.A. (1993c) Traditional cost estimating techniques for buildings – Extract from PhD
5. Bowen, P.A. (1993d) Uncertainty in building price forecasting: price data considerations – Extract from PhD.
6. Bowen, P.A. (1995) A communication-based analysis of the *theory* of price planning and price control. *RICS Research Paper Series*, No.2, Royal Institution of Chartered Surveyors, London.
7. Bowen, P.A., and Edwards, P.J. (1998) Building cost planning and cost information management in South Africa. *Journal of Construction Procurement*, Vol.4, No.1, pp.16-26.
8. Bowen, P.A., and Pearl, R.G. (1994) Accuracy of cost engineers’ building price forecasts in South Africa, in Association of Cost Engineers (UK) 13th International Cost Engineering Congress *'Cost Management for the 21st Century'*, London, October, pp.CE14.1-CE14.16.
9. Olatunji, O.A., Sher, W., and Gu, N. (2010). “*Building Information Modelling and Quantity Surveying Practice”.* Emirates Journal for Engineering Research, Volume 15 no. 1, pp 67–70.
10. Pearl, R.G. (1994) Hazards of estimating without price data, in Association of Cost Engineers (UK) 13th International Cost Engineering Congress *'Cost Management for the 21st Century'*, London, October, pp. CE13.1 - CE13.13.
11. Pearl, R.G., Bowen, P.A., Akintoye, A., and Hardcastle, C. (2003) Analysis of tender sum forecasting by quantity surveyors and contractors in South Africa. *Acta Structilia, Journal for Physical and Developmental Sciences*, Vol. 10., Nos. 1 & 2.
12. Pearl, R.G., Bowen, P.A., and Nkado, R.N. (1997) A communication-based examination of construction planning and tendering, in ARCOM 13th Annual Conference proceedings, Kings College, Cambridge, September, Vol 1, pp. 220-229
13. Potts, K (2010) ‘The first estimate should equal the final account’ – quantity surveying and the development of elemental cost analysis and cost planning. In Proceedings of RICS Cobra conference, Dauphine University’, Paris, September 2-3.

RECOMMENDED READINGThe reference sources listed below are intended to provide candidates with details of texts which can contribute to an extension of the basic knowledge base provided by the study material provided. Some of these may be cited in the study guide. Whilst you will not be examined directly on the detailed content of these sources, it is necessary to study their contents in order that your understanding of the principles involved in this study area is fully developed.1. Anon (2007 Elemental cost planning: current UK practice and procedure. Draft report.
2. Bowen, P.A., and Le Roux, G. K. (1994) The nature, treatment and communication and uncertainty in building price forecasting. Publication details unknown.
3. Bowen, P.A., Hall, K.,A. and Edwards, P.J. (1998) The pricing of contract preliminaries: quantity surveyors and contractors compared. Publication details unknown.
4. Bowen, P.A., Hall, K.,A., Edwards, P.J., and Akintoye, A, (1996) The pricing of contract profit and overheads: quantity surveyors and contractors compared. *CIB Working Commission 55, International symposium, Zagreb. pp. 153-170.*
5. Ferry D J, and Brandon P S. (1999) *Cost Planning of Buildings (Seventh Edition).* Blackwell Publishing.
6. Fortune, C. (2006) Process standardization and the impact of professional judgement on the formulation of building project budget price advice. *Construction Management and Economics*, No. 24. October, pp. 1091-1098.
7. Jaggar, D., Ross, A., Smith, J., and Love, P. *Building Design Cost Management*. Blackwell Publishing, 2002.
8. Kirkham R. (2007) *Ferry and Brandon’s Cost Planning of Buildings (Eighth Edition).* Blackwell Publishing.
9. Kiziltas, S., and Burcu, A. (2009) Contextual Information requirements of cost estimators from past construction projects. *Journal of Construction Engineering and Management*, September. pp. 841-852.
10. Sabol, L. 2006) Challenges in cost estimating with Building Information Modelling. Design + Construction Strategies. pp. 1-16.
11. Seeley I H. (1996) *Building Economics (Fourth Edition)*. Macmillan Press Limited.
12. Sinclair, N., Artin, P., and Mulford, S. (2002) *Construction cost data workbook*. Conference on the International Comparison Program – World Bank. Washington D.C. March 11-14.
13. Succar, B. (2009). “*Building information modelling framework: A Research and Delivery Foundation for Industry Stakeholders”.* Automation in Construction, Volume 18, pp 357-375.
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**MODULE CONTENT**

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| **1.****1.1****1.2****1.3****1.4****1.5****1.6****1.7****1.8****1.9****2.0****3..0****3.1****4.0** | **THE REQUIREMENTS OF A BUILT ENVIRONMENT COST INFORMATION DATABASE****INTRODUCTION****THE APPROACH TOWARDS DESIGN COST MANAGEMENT****CONSULTING RELEVANT EXPERTS AND LITERATURE****APPLYING PROJECT COST INFORMATION DATABASES TO THE FINANCIAL MANAGEMENT OF BUILT ENVIRONMENT PROJECTS****COST MODELLING****THE APPLICATION OF TRADITIONAL COST MODELS****SOME EXAMPLES OF THE FACTORS WHICH COULD AFFECT OR VARY THE RATE USED IN A SQUARE METRE ESTIMATE****EVALUATING EXISTING DATABASE TECHNOLOGIES AND METHODOLOGIES****ESTABLISHING STRATEGIES FOR PROJECT INFORMATION INPUT AND RETRIEVAL****ACCESSING RELEVANT INFORMATION****SETTING UP AND MAINTAINING A DATABASE****FORMATTING AND ENTERING INFORMATION INTO THE DATABASE****APPLYING PROJECT COST INFORMATION DATABASES TO THE FINANCIAL MANAGEMENT OF BUILT ENVIRONMENT PROJECTS****SELF ASSESSMENT QUESTIONS** |

1. **THE REQUIREMENTS OF A BUILT ENVIRONMENT PROJECT COST INFORMATION DATABASE**

**Learning outcomes**

*After studying this section, you should be able to:*

*define the requirements of a built environment project cost information database by*

* *consulting relevant experts and literature.*
* *specifying and evaluating the scope of the information to be included in the database.*
* *evaluating existing database technologies and methodologies.*
* *establishing the strategy for project information input and retrieval.*

**1.1 INTRODUCTION**

**1.1.1 The design and cost planning**

The success or failure of a project hinges on the skill of the design team to achieve the right balance between the cost, size, form and specification for the building. Any two of the mentioned factors can be seen as the function of the remaining factor. The relationship between design and cost can be illustrated as follows:

 Cost

 Size Form and specification

**Figure 1: Relationship between design and cost**

**Source: Cost Planning of Buildings (page 92)**

Cost information systems must therefore be compatible with design methods, but should not dictate the design method unless cost is of paramount importance. Although each consultant would like to achieve optimisation in their own field of expertise, it is rather the performance of all the fields of expertise acting together that will determine the degree of client satisfaction.

**1.1.2 Cost planning**

References to the need for proper cost planning dates back to biblical times yet thorough budgetary planning and management remains problematic to this day (3). Several examples of recent projects that were and are still marked by controversy with regard to major budgetary overruns are frequently reported in the press. Projects that come to mind are the stadiums developed for the 2010 soccer world cup, the Gautrain rail and station projects and the Medupi and Kusile power stations.

 The cost planning process involves a variety of procedures and techniques that are consecutively applied by the quantity surveyor as the design process unfolds. It starts with the development of a ballpark figure and is refined alongside the design development (3). A good cost planning system should:

* ensure that there is a good correlation between the first cost plan and the tender
* ensure that the available funds are allocated effectively and economically to the various elements
* involve the measuring and pricing of approximate quantities
* aim to achieve good value for money.

 Cost planning is conducted in three stages namely:

* defining the brief and setting the budget
* cost planning and control of the design process
* cost control of the procurement and construction stages

 The second stage is the most crucial as the decisions taken at this stage influence the whole life performance of the building. This stage includes formulating the brief, investigating design solutions and cost control of the design development. Unfortunately, the time and effort spent on the three stages is not always commensurate with the importance of each

 The terminology estimating and cost planning are often used interchangeably however an estimate becomes a cost plan only when the following requirements are met:

* the estimate is set out in such a way that the information on each drawing produced can be checked against the estimate without waiting for the complete design. Possible errors can be identified and adjusted before the drawing is used for the preparation of billed of quantities
* it should be possible to compare the estimate to other systems to determine whether the amounts allocated to the various parts (trades or elements) of the building are reasonable and is also a reasonable proportion of the total value.

**1.1.3 The use of cost information**

 Cost information is generally used in quantity surveying practices for the following four purposes:

* to control and monitor the costs of a contract for which a contractor has already been selected through the various processes performed during the construction and final accounting stage
* to estimate the future costs of a project and input into design changes to ensure that it is as close as possible to the tender sum
* to allocate the costs in a cost plan to the items according to the client’s priorities and ensuring that the expenditure is done accordingly
* to act as the basis for negotiating the rates with a contractor for the purpose of agreeing the contract costs for contracts to be procured otherwise than the traditional methods.

 To gain a greater understanding of the economic trends within the built environment and the relationship between design decisions and how they influence the cost of buildings, the cost information needs to be studied, analysed, classified and structured in a particular way to assist in the development of cost evaluation models. The four main headings under which cost data / information can be classified, are:

* forecasting of costs – information relating to cost/m2, elemental unit rates, bill rates and inclusive rates. The techniques for calculating each of these types of rates is discussed in detail later on. The information is derived from analysing historic projects and updating it by applying building cost indices.
* comparison of costs – data usage here is focused on comparing the cost of items with similar function or buildings of different design to facilitate decision-making. The structuring of the data is important so that it will reflect the cost implication if the design or specification of a specific item is changed.
* balancing of costs – the cost strategy must reflect the client’s requirements therefore the allocation of the overall budget to smaller packages should reflect the client’s preference. The data is obtained from previous projects that are allocated proportionately to the total cost of the project.
* analysing cost trends – costs are analysed to determine the trends of how costs for specific items are changing relatively to each other or over time. This informs the choice of materials, etc..

**1.1.4 Improved cost information**

 In order to understand, use and develop cost techniques correctly we need to know where the information originates from and what information is to be used. The techniques currently employed to model costs evolved from calculation processes that were performed manually and hence are oversimplified. It should be borne in mind that all models are simplifications of what they represent and therefore will never be perfect or 100% accurate.

Improved or better cost information is continuously sought and is driven by the needs for:

* cost information to be provided quicker;
* more information to be provided so that better informed decisions can be made;
* more reliable cost information to be provided so that more assurance can be introduced into the decision-making process;
* information to be provided at an earlier stage in the design process and
* information to be provided in a more understandable format.

In order to reap the full benefit of modern information technology, such as integrated software, the need for greater standardisation and greater integration of systems is required.

 Sophisticated computer aided architectural (CAD) design systems in use today that model proposed projects in three dimensions as the building is designed are capable of producing elemental cost models as the design evolves. The difficulty of marrying the design process with an elemental cost analysis is to allocate cost data to the elemental cost model that is sophisticated and robust enough to enable the architect to utilise it unassisted. The ideal would rather be to develop a system through which the quantity surveyor could directly interact with the architect as the design evolves. The danger of allocating incorrect or oversimplified cost data is that the result produced by the systems might seem convincing to a person that does not understand the complexities of cost forecasting.

**1.1.5 Embracing knowledge management and IT techniques**

Knowledge management is defined as “the process of identifying, capturing, organizing, and disseminating the intellectual assets that are critical to the organisation’s long-term performance” (7). Knowledge management should however not be confused with information management which merely entails the collection and management of information.

Knowledge management is particularly important for cost planning because it provides feedback of information from previous projects for use in the cost planning of future projects. The advantages of knowledge management for cost planning are that:

* a basis for collating cost data is provided from which inferences on the effectiveness of cost planning strategies can be drawn
* it improves existing supply chain communication lines
* it enables the cost planner to alert the client to variations from the forecasted project cost.

Many IT applications have been developed in recent years in attempts to increase the efficiency of project co-operation. Applications developed are:

* e-procurement and e-collaboration within the supply chain. The major take-up of these applications are hampered by IT integration.
* electronic measuring and estimating systems (WinQS, QS-Plus, etc.).
* digitisers and computer aided taking off systems.

The emphasis of the IT development to date has been on development of software to reduce the time of producing the required level of information for complex built environment projects for each discipline separately rather than developing integrated software that would enable the professional team to address all the issues pertaining to different disciplines in the same design development phase to collectively enhance the project objectives.

Future development will definitely be focused on the development of integrated comprehensive solutions hence research articles dealing with the subject of building information management (BIM) have been included in the module for required reading.

**1.1.6 The cost planner**

 The increasing trend of applying alternative procurement strategies has resulted in the earlier appointment of the quantity surveyor to act as the client’s project financial manager. In order to determine the exact extent to which the client requires the involvement of the cost planner, the following questions need to be answered:

* is the client placing the appointment directly with the cost planner or is the appointment being placed by the architect / principal agent on behalf of the client? Direct appointments are characterised by the above average interest of the client in the cost aspects.
* is the cost planner required to prepare only an estimate, and prepare a bill of quantities, expected to be involved in the budgeting for the building cost only or the building including furniture and fittings or is the cost planner required to manage the budgeting for the entire project?
* have other appointments been made or does the client need assistance in identifying and appointing other team members?

 It is clear from the questions that the extent to which the cost planners is required to be involved and the specific priorities of the client will determine what techniques the cost planner would apply.

 Cost planning involves a lot of work, but quantity surveyors soon learn from experience which items are of cost significance and where short-cuts are in order. The use of IT applications, standardised forms and procedures will speed things up considerably if the staff is familiar with them. Large offices have good developed systems and tend to have separate divisions that deal with cost planning.

**1.2 THE APPROACH TOWARDS DESIGN COST MANAGEMENT**

**1.2.1 The project brief**

 The briefing process is of vital importance for every built environment project. During this process the client’s requirements are investigated, developed and communicated to all relevant stakeholders. A good brief isn’t easy to achieve but essential to ensure client satisfaction with the final product. The brief provides the guideline according to which the design is developed. The consideration of different options from the outset leads to the avoidance of potentially expensive design variations. Although there is no set methodology for producing a brief, there are common aspects that need to be considered, such as:

* establishing the need to build hence establishing whether the need can be solved by altering the current accommodation or building a new building
* determining whether there are adequate financial and human resources from the client’s side and what the client’s involvement in the process will be
* clear communication to ensure that the client provides clear and unambiguous information to the design team and that design team translates the information into the correct design
* uphold good interpersonal relationships and forge trust within the team and between the team and the client
* ensure that the design approach is appropriate for the particular project. Each project is unique and more complex projects pose more challenges than smaller projects.
* the end user of the building needs to be involved if it is not the same entity as the paying client
* the information gathering techniques need to be established.

Specific design considerations that need to be addressed are issues such as:

* the constraints the design is subject to such as the physical constraints that the site and available materials pose, constraints imposed by external bodies such as the local authority or constraints imposed by the client and his advisors in terms of costs, quality, specific shape, etc.
* the client’s priorities need to be determined and ranked according to importance
* the required space and the arrangement of spaces according to the end users’ activities needs to be determined
* what form the building should take
* the level of specification.

**1.2.2 The cost information systems and design methods**

 As mentioned before the cost information system must be compatible with the design method, but the cost should not dictate the approach to the design unless the cost is of paramount importance. It is therefore important for candidates to realise that there are two approaches according to which design cost management can be undertaken and these are (1) designing to a cost and (2) costing a design (9). When designing to a cost the designers need to work within the budget established by the client and ensure that the functional, technical and quality requirements are achieved within the budget. When costing a design, the client’s need and requirements are established and the design is developed accordingly. A realistic and affordable budget is developed according to the design. Setting the budget at an early stage in the design development does however not limit the design team to explore various solutions in the design process.

 The two approaches to design cost management are illustrated as follows:

**DESIGNING TO A COST**

**COSTING A DESIGN**

Design to suit client requirements

Client establishes cost limit / budget

Revise

Revise

Design forms basis of initial costing

Design team develops design within budget

Affordable?

Design within budget?

Yes

No

Yes

No

 **Figure 2: Basic approaches to design cost management**

 **Source: Building Design Cost Management (page 11)**

 The cost saving potential early on in the project and the equally limited opportunity to effect changes at a later stage in a project is illustrated as follows:

 

 **Figure 3: Potential for saving, adapted from Flanagan and Norman (1963)**

 **Source: Building Design Cost management (page 11)**

**1.2.3 The client’s budget**

 As soon as the briefing process is completed the next step is to determine the client’s budget based on the information that emanated from the briefing process. It is important that candidates realise that the building cost is merely one component of the client’s budget.

It is important to realise that the construction cost is only one of ten items of the client’s total capital outlay. In commercial developments private investors or developers invest capital in property development projects because they hope to get a better risk-commensurate return on their capital than from alternative forms of investment such as shares, savings accounts at banks, etc. In property investment this return, in its simplest form, is the yearly net income earned from the property divided by the total capital amount invested or total capital outlay. This is also known as the initial return.

Public sector “investors” on the other hand do not necessarily have financial return on investment as an objective. They do however, have to conform to cost budgets based on the relevant cost norms for specific types of services or buildings, and on the need to balance spending of limited tax income with a wide range of national needs

 Total capital outlay consists of among others:

* cost of land.
* legal costs of acquiring the land, applying for appropriate land use, etc.
* construction cost including demolition costs required to prepare the site for the new development.
* professional fees.
* furniture, fixtures and equipment.
* marketing costs (letting or selling).
* interim or capitalised finance costs.
* management, running and maintenance cost where the building is retained by the client or only partially sold or where the building is let and the tenant agreement stipulates that the client is responsible for maintenance.



 **Figure 4: Components of life cycle costs. Adapted from Flanagan and Norman (1983)**

 **Source: Building Design Cost Management (page 27)**

The construction cost is however a significant portion of the total capital outlay and since income earning potential is to a large extent limited by market conditions outside the control of the client, it stands to reason that construction cost is one of the major input costs that have to be managed to yield the required return on capital.

**1.3 CONSULTING RELEVANT EXPERTS AND LITERATURE**

**1.3.1 Expert systems**

 Expert systems or otherwise known as intelligent knowledge based systems are sophisticated computer programmes that manipulate the stored body of knowledge to produce results that emulate the reasoning, experience and judgement of human experts.

 Quantity surveyors draw on several sources of knowledge n performing their day-to-day activities such as providing cost and contractual advice and preparing bills of quantities. The larger a firm the more information is available and the more important it becomes to manage the information effectively. The knowledge sources are classified in three classes namely (1) explicit knowledge; (2) tacit knowledge and (3) implicit knowledge. Explicit knowledge is easily codified, stored, distributed and communicated to others and is contained in familiar documents such as in books, such as the standard methods of measurement or the standardised conditions of contract. Tacit knowledge on the other hand is based on experience, instinct and personal insight hence not easy to codify, store or communicate. Implicit knowledge falls in between explicit and tacit knowledge.

Quantity surveyors apply a wealth of experiential knowledge hence the uptake on the development of databases and expert systems has been very slow. Where it has happened, the databases are developed for use by the individual larger firms that have developed the databases and the information is not made available in the public domain.

**1.3.2 Building Cost Information System (BCIS)**

The BCIS was developed by the Royal Institution for Charted Surveyors (RICS) and is offered on-line to all practicing quantity surveyors affiliated with the RICS. The system offers the following information:

* Cost analyses and trends
* Indices
* Average building prices including materials, labour, earnings, wages and rates
* Tender price studies including market conditions, tender levels and tender price forecasts
* Average percentage of preliminaries
* Daywork rates and build-ups
* Wage agreements

The BCIS systems have been developed over a period of more than 50 years. Currently there is no equivalent system in South Africa.

**1.3.3 South African Publications**

Arguablythe best-known publication available in South Africa that resembles the analysed cost information provided to RICS members through the BCIS platform is the annual publication by the Davis Langdon an AECOM Company titled “Africa Property and Construction Handbook” that is available from their website [www.davislangdon.co.za](http://www.davislangdon.co.za/) It should be noted that several other professional QS consulting firms provide similar information, although not always made available publically on a regular basis.

 In addition, there are other important sources of useful data for use within South Africa that are available to built environment participants. Some of these are listed on the website of DelQS (reference sheet made available to candidates ). Prominent amongst these are the various publications of the Bureau for Economic Research, as well as that of Medium Term Forecasting Associates (MFA), both of which are based in Stellenbosch. The BER material may be accessed via their website [www.ber.ac.za](http://www.ber.ac.za/). A typical report (produced quarterly) from MFA has been provided in this module for reference by candidates. The contents of this document are primarily used for pre-contract price forecasts, but some sections extend it’s usage to the presentation of typical BOQ rates for a small range of selected work items. Another source of similar data (BOQ / elemental estimating rates) is the website of the Africa Association of Quantity Surveyors (AAQS) accessible at [www.aaqs.org](http://www.aaqs.org/)

Data for use in calculating post-tender price fluctuations (cost escalation), commonly referred to as the “Haylett Formula” is normally more formally described as Cost Price Adjustment Provisions (CPAP). The structure of this approach is described in a short booklet which is available on the website of the Association of South African Quantity Surveyors ([www.asaqs.co.za](http://www.asaqs.co.za/)), a copy of which is made available in this module to candidates. The actual calculated indices used in calculations are published on a monthly basis in Table P1051, issued by Statistics South Africa ([www.statssa.gov.za](http://www.statssa.gov.za/)).

An extensive range of data relating to the broader property market is available via [www.rode.co.za](http://www.rode.co.za/). Some sections within the site do however, deal more particularly with construction information. Data relating to performance issues within the construction sector may be found on [www.cidb.org.za](http://www.cidb.org.za/), home site of the Construction Industry Development Board. Extracts of the 2013 report of this organisation are made available to candidates in this module.

**1.3.4 Price Books**

 The biggest challenge in preparing estimates is obtaining rates for all the items especially if the individual or firm involved in the project do not have experience of specific materials or construction techniques. Price books published in South Africa are titled Merkels and Build-Aid. Both publications include unit rates for a variety of items.

Price books available in the United Kingdom include Spon’s Architects’ and Builders’ Price Book, Laxton’s Price Book and Wessex Price Book. Spon also publishes a Mechanical and Electrical Service Price Book, a European Construction Costs handbook and an Asia-Pacific Costs Handbook.

Price books should be used with caution as the rates contained differ in make-up. Price books do have a very useful role to play as practitioners use them as verification for their own knowledge and assumptions (9).

Practitioners in South Africa however still appear to prefer using rates from price determination documents in their offices and from projects in which they have personal experience.

**1.3.5 Research initiatives**

 Through the years there have been several attempts to establish a standard classification system with little take-up. The latest approach to developing a standard classification system for the built environment is called the Uniclass. This approach includes building as well as civil construction and makes provision for the entire lifecycle of a project from inception through to the end of its operation. The system is arranged in tables that can either be used alone or in combination for:

* arranging libraries
* structuring product information
* coordinating project information
* structuring technical and cost information
* developing frameworks for databases

 The system consists of the following 15 tables:

* A. Form of information – for organising reference materials in libraries
* B. Subject disciplines – organising information in disciplines e.g. architecture, quantity surveying, engineering, etc.
* C. Management – information is classified according to management and / or project management according to project stages
* D. Facilities – construction work is classified according to activities
* E. Construction entities – these are construction entities of significant scale such as buildings and the entities are classified according to physical shape and function
* F. Spaces – the spaces are classified according to a number of characteristics such as location, scale and degree of enclosure
* **G. Elements of buildings – the physical parts of buildings that perform the same function of each different building. This is of course at the heart of design cost management and elemental estimating as it is practiced today**
* H. Element for civil engineering works – the intention of this table is to complement table G in aiding the design cost management
* J. Work sections for buildings – the intention of this section is to organise information to be contained in specifications and in bills of quantities
* K. Work sections for civil engineering work – this table is based on the civil engineering standard method for measurement CESMM3 and compliments table J
* L. Construction products – the use hereof is to classify trade literature and design / technical information relating to construction products such as bricks, doors, frames, paint, etc.
* M. Construction aids – this table is used to classify trade literature and technical information relating to construction plant and equipment such as formwork, scaffolding, tools, machines, etc.
* N. Properties and characteristics – intended to arrange information according to the shape, size, appearance, etc.
* P. Materials – this is used to classify the different kinds of material such as timber, cement, stone, plastic, etc.
* Q. Universal Decimal Classification – the intent of this table is to illustrate how information that is not included in the Uniclass system such as philosophy, geography, maths, etc. can be classified. This creates a link between general information and project specific information (9).

 The framework given above is very brief. Candidates are referred to the following website for deeper insight into the Uniclass system.

[**http://www.cpic.org.uk/en/utilities/document-summary.cfm?docid=B6B36A53-D52F-48F1- 9496D6194184C3D7**](http://www.cpic.org.uk/en/utilities/document-summary.cfm?docid=B6B36A53-D52F-48F1-%09%099496D6194184C3D7)

**1.4 SPECIFYING AND EVALUATING THE SCOPE OF THE INFORMATION TO BE INCLUDED IN THE DATABASE**

 In order to understand what information is to be inputted into the database one must have an understanding of what the information is to be used for and in what format the information is required. As stated before cost data / information could be classified in terms of:

* forecasting of costs
* comparison of costs
* balancing of costs
* analysing of costs

 The classification referred to above pertains to the specific use of the information contained in a database. The database therefore needs to be planned in such a way that it delivers the information in the format needed for application in the cost models commonly used in quantity surveying practices.

**1.4.1 COST MODELLING**

 Over the years several cost models have been developed for application at different design stages. The different cost models for the forecasting of costs in the built environment therefore require different levels of information. To gain an understanding of what kind and level of information is required for the application of each cost model the models are discussed below

**1.4.1.1 Prototypes**

 In a manufacturing environment building a prototype of a new product is common practice. This is for a number of reasons namely:

* to identify and solve three-dimensional problems that are not apparent on drawings.
* to identify the tools required for manufacturing the product.
* to help estimate the cost of production.
* to test and evaluate the functional performance of the product.
* to provide a sample to the customer as evidence of the quality standard to be achieved.

 All problems are ironed out during the process of building, correcting and testing the prototype before the product is actually manufactured on large scale.

**1.4.1.2 Other types of models**

 It is obviously not possible to follow the process described above for built environment projects because:

* buildings are very large.
* they are designed to last a very long time hence simulating for testing purposes would not be possible. It is however possible to simulate individual components.
* construction is expensive and time consuming.
* each building is designed uniquely.

 The design of a building needs to be assessed in terms of appearance, functionality and cost effectiveness to ensure that the client’s demands are met to their satisfaction. To accomplish this models that represent the real situation are built to a smaller scale and could be:

* three-dimensional architect’s scales and / or drawings.
* three-dimensional computer “walk-through” graphic programmes.
* mathematical modules such as energy efficiency calculations.

**1.4.1.3 The objectives of cost modelling**

 Costing is one of the measures of function and performance for any project therefore cost models should attempt to:

* give the client confidence in the expected cost.
* develop a quick representation of the building in such a way that the costs can be tested and analysed.
* establish a system for advising the designer on cost that is compatible with the process of building up the design. The system should be able to be refined as more detailed design information becomes available.
* establish a link between design and cost control and a manner in which costs are generated and controlled on site.

**1.4.1.4 Traditional built environment cost models**

 The earliest form of a cost model developed by quantity surveyors is the priced bill of quantities where the descriptions and measured quantities contained in the bills represent the work to be performed to the contractor’s estimators and by pricing individual items and multiplying the prices with the quantities a cost model of the building is established.

It is common knowledge that the design needs are to be completed or far advanced before the preparation of bills of quantities can be undertaken. The information is presented at such a late stage of the design that it doesn’t afford the client the opportunity to decide whether the project is viable and to employ extensive resources at a considerable cost to develop the design. The client also doesn’t know what the financial requirement of the project is and no cost control can be exercised during the design development stage. For these reasons simpler cost models were developed for employment at an early stage that is commensurate with the amount of design information available at different stages.

 The pyramid in figure 5 below shows the type of cost models (2, 3) that have been developed for use at the corresponding design stages. The models at levels 1 to 3 are product-based and the ones at levels 4 to 7 are process-based

 Design stage Level Cost modelling type User Example

Brief stage

Sketch design

 1 Unit Cost/bed

 2 Space Cost/m2

Detailed design

 3 Element QS Cost/element

 4 Approx. quantities Rough quantities

 5 SMM Bill of Quantities

Working drawings

 6 Operations Contractor Cost/operation

 7 Resources Cost of labour,

 Plant, material

 **Figure 5: Cost modeling**

 **Source: Cost Planning of Buildings (Seventh Edition) (p113)**

The complexity of the cost model to be applied thus depends on the amount of design information that is available at the time that the cost information is needed.

There is no sense in applying a complex costing model at the earliest stage of development before detailed information is available and the sole purpose of the cost advice would be to determine whether the project is viable at all.

1.5 THE APPLICATION OF TRADITIONAL BUILT ENVIRONMENT COST MODELS FOR FORECASTING COSTS

1.5.1 Single price rate methods (Unit method)

1.5.1.1 Cost-per-unit

 The cost‑per‑unit method of estimating is an extremely rough and rather unreliable method of estimating. This method can be used for buildings and facilities, and for certain types of service installations.

**1.5.1.1.1 Buildings and facilities**

 The method consists of multiplying the use‑factor of a building (such as the number of flats in a block of flats, the number of seats in a church, the number of children to be accommodated in a school, the number of persons to be accommodated in an old-age home, etc.) by a monetary rate, thereby obtaining an estimate of the total building cost. This method can be used to give a very rough indication of total cost, and may also be employed for setting a target or cost limit.

 An example of the use‑factors employed for setting a cost limit for a hospital is as follows:

* Ward block ‑ number of beds
* Out‑patients section ‑ number of out‑patients that could be treated in that section per day
* Kitchen block ‑ number of meals to be served per day

These use‑factors are multiplied by a pre‑determined monetary rate usually based on comparable historical records, and an estimate of total building costs is then arrived at which could become a cost limit after due allowance has been made for factors such as special site conditions, difficult foundations, etc.

Other examples would be:

* Church or cinema - number of seats x R?? per seat
* Primary school - number of pupils x R?? per pupil
* 3-Star resort hotel - number of beds or rooms x R?? per bed or R?? per room

 These cost limits should be updated from time to time to allow for increases in building costs. It could also serve as a target or cost limit, which may not be exceeded by the professional team and forms part of their brief.

**1.5.1.2 Service installations**

It would appear from the above that this method is more suited to buildings than to service installations such as water and sewer mains, etc. This is not entirely true. Unit costs are commonly developed for instance for service reticulation in a proposed residential ward or township. Based on a certain level or standard of service provision it is possible to analyse a range of completed projects and produce unit costs from the historical data for water, sewerage, roads, storm water, etc. per serviced stand:

 Example of unit costs for service reticulation per serviced residential stand in a new township:

* + Water supply - Ra
	+ Sewage disposal - Rb
	+ Electrical supply - Rc
	+ Roads and streets - Rd
	+ Street lighting - Re

 The total cost of services for the township could then be estimated by multiplying the number of serviced stands planned by the unit cost per stand for each type of service.

1.5.2 Square metre method (also called superficial or space method)

 This is a method which has been employed for many years, and is still in general use. It is suitable only for buildings and similar facilities and not for service installations.

 The method consists of multiplying the total construction area by a monetary rate, thus obtaining an estimate of building costs. The costs of all external paving, yard or boundary walling, other external works and any items of exceptional value are separately calculated. The monetary rate is based on recent or concurrent rates for comparable buildings. An example of the application of this method is as follows:

 The comparison of single price estimating model using the cost analysis of office block A to forecast the cost of office block B. Both office blocks have a footprint of 50 m x 15 m. Both blocks are 30 m high but office block A consists of 7 storeys (4.29 m high) and office block B consists of 8 storeys (3.75 m high)

|  |  |  |
| --- | --- | --- |
|  | Office Block A | Office Block B |
| 1 | Area = 5 250 m2 | Area = 6 000 m2 |
| 2 | Actual cost = R 28 100 000 | Actual cost = R 31 900 000 |
| 3 | R / m2 = R 5 352.38 | 6 000 m2 x R 5 352.38= R 32 114 280 |
| 4 |  | 0.67% difference – well within an acceptable range |

  **Table 1: Square method of estimating**

 **Source: Author**

1.5.3  Approximate or inclusive‑quantities method

 *(This method is suitable for both building works and services construction)*

 This is a method whereby the important cost items are measured in much the same way as the items in a bill of quantities, except that items of identical or near identical measurement are grouped together (e.g. although varying in exact area, the areas of the floor finishes, screeds, surface beds, hard-core and earth filling are sufficiently similar to permit them to be grouped together. Sundry items of little value are not measured but are allowed for as a percentage addition.

 This method, although basically sound, has the following important disadvantages:

* It is time‑consuming and tedious.
* Detailed information is required such as is usually provided only on working drawings.
* It is sometimes difficult to decide which items are sufficiently costly as to require measurement e.g. is the cost of the skirting such that it may be ignored or should it be measured in detail?
* Great skill and experience is required in judging the percentage of cost to be allowed for sundry items.

 Rough or approximate quantities can be successfully used in supplementing other systems of estimating.

1.5.4 Elemental method

Candidates are referred to the Guide to Elemental Cost Estimating & Analysis for Building Works, 2013 published bythe Association of South African Quantity Surveyors (ASAQS) which provides a structured framework for compiling and presenting elemental cost estimates.

 This method is suitable for estimating both building works and services. Of the methods discussed, the elemental method of estimating is considered the most reliable, accurate and consistent. It is commonly accepted that this resource-based modelling delivers better results and is more adaptable than the product-based bills of quantities.

**1.5.4.1 General**

 For this method buildings are divided into elements (e.g. structural frame, external envelope, internal plumbing, etc.) An **e*lement*** is that part of a building that always performs the same ***function*** irrespective of its construction or specification. It doesn’t matter for instance that the *external envelope* of a building is made of brick walls and steel windows, or of reinforced concrete walls, or of steel/aluminium curtain walling, or of corrugated iron cladding for that matter; it would still be measured and priced under the element *external envelope,* because its function remains the same – that of enclosing the building for protection against the elements, and security and privacy of the occupants.

Each element is further sub‑divided into **components** e.g. the element e*xternal envelope* could be divided into the components such as b*rick and block walling, external finishes, windows, doors,* etc. The method of division and sub‑division is defined and consistent for all buildings, thus facilitating the use of information obtained for one building when estimating the cost of other similar buildings.

Note that this method differs fundamentally from the standard measurement method for bills of quantities, where work is divided into trades.

In the elemental method for instance there could not be an element such as “Concrete Work”. “Concrete work” can occur in more than one element, for instance in the elements:

* “Substructure”, in the component unreinforced strip footings.
* “Ground floor”, in the component solid floors.
* “Structural Frame”, in the component columns.
* “External Facade”, in the component concrete walls.

“Brick walls” could likewise not be an element. Brick walls can occur in the elements:

* “Substructure”, in the component brick and block walls.
* “External facade”, in the component brick and block walls.
* “Internal divisions”, in the component brick and block walls.
* “Balustrading, handrails, etc.”, in the components balustrade walls, or parapet walls respectively.

Both when analysing the cost of an existing building and when estimating the cost of a new building, each of the elements or components is considered and evaluated in the plane in which it occurs: namely, the external facade would be evaluated per square metre on elevation, the concrete slabs per square metre on plan, strip foundations per metre and sanitary fittings and plumbing per unit or point.

A useful aspect of elemental cost estimates is that quick comparisons between elemental rates of similar buildings can be made to check whether designs and specifications are functional and cost effective.

Service installations such as water supply can similarly be divided into elements such as *plumbing, fire protection,* etc. The element *plumbing coul*d be further divided into components such as *sanitary fittings, cold water supplies, hot water supplies (of different diameters), geysers,* etc..

**1.5.4.2 Measurement required**

In any estimating system it is necessary to define exactly what method of measurement is to be applied and also the degree of accuracy required. It should be borne in mind that if the measurements required are too detailed or complicated then you are in fact back to overstepping the boundary between estimating and preparing a tender document. An estimating system should be both fairly accurate and capable of providing an answer over a reasonably short working period.

In view of the above certain measuring conventions have been adopted. Flooring for instance is measured right across internal and external walls, external facade right across the concrete floor slabs but internal walling from top of slab to underside of slab. In the case of floor finishes and the external facade there will of course be a certain over-measure which has to be allowed for in either the pricing, by deducting a percentage or by regarding the over-measurement as compensation of the sundry items that are measurable in standard measuring systems for tender documents but not measured when estimating.

**1.5.4.3 Unit of measurement**

In which unit of measurement should an element or a component be measured? In the case of a wall for example it is obvious that the best unit of measurement is per square metre on elevation. The estimating guide states the unit of measurement for each element and component.

**1.5.4.4 Pricing**

 At component level it is fairly easy to price items and many item prices can be built up from rates obtained from bills of quantities. At element level this is more difficult and it is usually necessary to employ cost information obtained by elemental analyses of previous or current projects where tenders have been obtained and priced bills of quantities are available.

 The build-up of component rates is very similar to the build-up of rates for inclusive items in the “Rough Quantities Method”.

**1.5.4.5 Estimating the cost of primary elements**

 i.) Build‑up of prices at component level

 The following example illustrates the build-up of the component applied floor finish of the element floor finishes:

 Component: Applied floor finish (price per m2)

Screed R 55.00

Vinyl floor finish R 65.00

 R 120.00

Less: Adjustment for over-measure (as explained above) 10% (R 12.00)

 R 108.00

Plus: Sundries (e.g. floor finish in openings, brass dividing strips, etc.) 5% R 5.40

**Rate per m2 R 113.40**

##  ii.) Build‑up of rates at element level

 At element level it is more difficult to build up a rate, for example:

 Example 1: Internal electrical installation

 Usually this is inserted in the bills of quantities as a lump sum figure. The only way of determining a rate for this element is by cost research into past tenders, or by obtaining a rate from the electrical consultant.

 For simple installations, such as houses it is possible to estimate an amount for the basic distribution board, earth leakage, etc. (say R6 000.00); then add light points at say R280 per point and power points at say R320 per point; stove and geyser isolators at say R350 each; bells, TV-points and telephone points at R280 each and cable from connection to distribution board at say R65/m.

 Example 2: Internal plumbing

 Plumbing points such as water supplies, sanitary plumbing, etc., can be determined only by cost research into past tenders. The following is an example of an elemental estimate at component level for the element "Plumbing":

 Analysis of a priced bill of quantities shows the following inclusive rates for various components of the element:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DIMENSIONS | DESCRIPTION | QUANT | UNIT | RATE | AMOUNT |
| 15 | WC | 15 | No | 1 250.00 | 18 750.00 |
|  | WHB | 15 | No | 850.00 | 12 750.00 |
|  | Baths | 15 | No | 2 150.00 | 32 250.00 |
|  |  |  |  |  |  |
| 3/15 = 45 | Sanitary sundry fittings | 45 | No | 350.00 | 15 750.00 |
|  | Sanitary plumbing | 45 | No | 900.00 | 40 500.00 |
|  | Cold water supply | 45 | No | 950.00 | 42 750.00 |
|  | Taps, traps, etc. | 45 | No | 1 500.00 | 67 500.00 |
|  |  |  |  |  |  |
| 2/15 = 30 | Hot water supply | 30 | No | 1 250.00 | 37 500.00 |
|  |  |  |  |  |  |
| 15 | Geysers | 15 | No | 3 500.00 | 52 500.00 |
|  | Cold water supply | 15 | No | 950.00 | 14 250.00 |
|  | ELEMENTAL TOTAL |  |  |  | R 334 500.00 |

 The above is equivalent to an average rate of R 5 575.00 per “point” - 60 points

 The price of R 850.00 for a wash hand basin includes for instance the total price of the basin itself, its pedestal or brackets, but excluded the taps or mixer, waste, plug and trap as measured in the base bill

The price of R 950.00 per cold water supply point would have been arrived at by adding together from the base bill the following items measured under internal water supplies, and dividing the total by the number of points serviced with cold water:

* All internal cold water piping and pipe fittings
* Service pipes (or flexible connectors)
* Valves, stop cocks, etc.

 Example 3: External envelope (total area of element taken as 1000 m2)

 It has been assumed for the purpose of this example that the individual component rates have already been built up or obtained from cost research.

 Walling 700 m2 R 285.00 R 199 500.00

 External finishing 700 m2 R 90.00 R 63 000.00

 Windows 300 m2 R 550.00 R 165 000.00

 Window sundries (glass, etc.) 300 m2 R 360.00 R 108 000.00

 External doors 18 no R 1 800.00 R 32 400.00

 Element total R 567 900.00

 Element rate is therefore R 567.90 per m2 on elevation (R 567 900/1 000 m2)

**iii.) Estimating the cost of special installations**

The estimator must be aware that certain types of facilities require special installations, and that these will not necessarily be shown on the sketch plans at early stages

 For instance:

* A building housing main-frame computers requires raised access flooring and climate control in certain rooms
* Hospitals must have stand-by generators for emergency power supply
* Shopping centres must have signage (fire signage, directional signage, pylon signage, etc.)
* Security and access control are almost a standard requirement for most facilities these days

Estimators should develop standard checklists for queries to the architect/engineers/client with regard to the inclusion of special items in the estimate. The *Guide* can be used as a basis for this, but the list should be augmented from own experience, and by consultation with colleagues who have dealt with complex buildings before.

**iv.) Estimating the cost of alterations**

Alterations can vary from simple refurbishment (cleaning, patching, painting) to major structural and layout changes. In the case of the former, it may be possible to develop inclusive square metre rates for use in very preliminary estimates from analysis of previous projects if the work is very similar. The only proper way to do the latter is more detailed measurement (the guidelines in the Standard System of Measuring Building Work could be followed here).

A few aspects to bear in mind are:

* when solid components of a building are broken up, their volume for handling and carting away purposes increase substantially (up to 50% or more).
* most municipalities levy a dumping charge at their land fill sites for building rubble.
* allow sufficient contingencies for what may be found once old structures and components are opened up or removed.
* alterations is difficult and risky work therefore contractors will tend to apply higher mark-ups than for new work of the same value.
* when for example an opening has been cut into an existing wall, in most cases it will be required to re-paint the whole wall, or even the whole room rather than just patching and making good around the opening.

**v.) Estimating the cost of external works and services**

As with special installations, very little formation is available for external works and services. Attention must be given to stormwater disposal, and landscaping (hard and soft) and planting, garden furniture, etc. (4)

Check with the local authority for service connection fees. These can be substantial. Where additional work is done at existing premises, it is often necessary to allow for substantial and costly upgrades to services and connections (4).

It can be difficult to estimate for demolition of existing buildings. The costs are largely determined by the value of salvageable materials such as windows and doors, roof timber, sheeting and tiles, sanitary and other fittings, wooden flooring (in older buildings), etc. Unless the client specifically wants to retain these materials for own use, the contractor is allowed to take them and allow a credit (reduction in price) equivalent to their value. In some instances, the value of these items may even exceed the cost of breaking down and removing bulk materials such as concrete and brickwork. In cases like that, demolition tenders will contain two options – tenderers can insert a cost, or more likely offer to “buy” the building from the client and pay for it.

**1.5.5 Contingency allowances**

 This is one of the most misunderstood and misused aspects of estimating. Consultants (and their clients) see it as a simple case of “add 10% so we have a bit of fat in the estimate”.

 More correctly contingencies should be divided into two categories:

* “Price and detail development” – to allow for lack of detail at sketch plan and estimating stage. This allowance should be high in the very preliminary stages, and reduce with each subsequent estimate as more detail becomes available from the design team. Once tenders are in and construction is ready to start, this could possibly be reduced to a very small allowance unless parts of the design are still incomplete.
* “Construction contingencies” – to allow for real unforeseen expenditures. The circumstances of the project will determine the amount that should be allowed. It should also reduce up to a point, but some amount should remain in place until construction is well underway, or even up to the very end of construction.

How much to allow will depend on the circumstances. It is usual to allow 2% to 5% of estimated final building cost for each category in the preliminary estimates, reducing perhaps to 1% to 2.5% at tender stage.

**1.5.6 Estimating for tenant installations**

Commercial property developers often allow certain amounts in the capital expenditure on projects for tenant installations. An office building for example, may be designed as an open plan shell, with an allowance of say R 1 700/m2 of the area on plan for carpeting, partitioning and ceilings to the tenants’ requirements. (If it works out to more than the allowance, the tenant must pay in the difference).

1.5.7 Construction area

 In an attempt to standardise the method of measurement of the construction area it is defined in the Guide to Elemental Cost Estimating and Analysis for Building Works, 2013, published by the Association of South African Quantity Surveyors, as follows:

 "The Construction Area of a building is the total of all the areas of a building measured on plan at each covered floor level over the external walls or external line of the outermost vertical enclosing planes or, where applicable, the centre line of parting walls between buildings."

 The following items are specifically to be **included** in the calculation of construction area:

* Internal stairwell and staircase areas
* Lift shaft areas
* Duct space areas
* Mezzanine floor areas
* Finished floor areas in attic spaces
* Floor areas to penthouses, staff quarters, lift motor rooms, etc.
* All open but covered porches, balconies and balcony corridors within the enclosing planes of the main building
* Floor areas to attached sheds, carports, etc., and all partially completed rooms, porches, balconies, etc., provided the relevant areas are covered and have at least two of their walls not less than two-thirds of the storey height on which they occur

 The following items are specifically to be **excluded** in the calculation of construction area:

* External steps and paved areas
* Areas of projecting roof overhangs, hoods, canopies and the like
* Enclosed open areas (Light or ventilation wells and courtyards)
* Areas of open covered ways and carports, etc.
* Areas of unenclosed fire escapes
* Areas on plan of small projections such as pilasters, attached piers, fins, chimney breasts, etc.

 The areas of different types of buildings within the same overall building project, such as the office block of a factory project should, as far as possible, be kept separate from each other

 Although the definition of building area is defined for the use with elemental estimates, the methodology of measuring the overall construction area is commonly adopted for all cost models

**1.5.8 Different rates generally quoted**

 The main purpose of income generating or commercial buildings is obviously to generate an income for the investors in the building or property to yield return on their investment. For such buildings different areas are calculated to express different statistics. The construction area is not to be confused with these different areas that are:

* building area – that is the construction area excluding major vertical penetrations, basements and parking
* rentable area – revenue-producing area
* useable area – the area that can exclusively be used by a tenant
* common area – area that the tenant has access to such as lift lobbies, public toilets, etc.
* supplementary area – any other revenue-producing area not included in the rentable area such as storerooms, balconies, terraces, passages, foyers, parking bays, etc.

 There are four basic rates per m2 which are generally quoted. For example, a building of say 1 000 m2 construction area and 800 m2 usable or rentable area, the following rates could be quoted for comparison purposes:

* *Basic building rate* ‑ excluding special items and external works and services

 (example R7 500 000/1 000 m2 = R 7 500.00 per m2)

* *Building rate*, i.e. basic rate plus special items such as specialist work, mechanical work, etc. but excluding external works and services

 (example R7 800 000/1 000 m2 = R 7 800.00 per m2)

* *Project rate* ‑ overall rate, including external works and services

 (example R8 200 000/1 000 m2 = R 8 200.00 per m2)

* *Use factor rate* – construction cost expressed per m2 of usable or rentable area

 (example R8 200 000/800 m2 = R 10 250.00 per m2 of rentable area)

Although this is interesting to note and important for candidates to be aware of, this module deals with the analysis of building cost expressed as a rate per m2 of construction area only.

**1.6 SOME EXAMPLES OF THE FACTORS WHICH COULD AFFECT OR VARY THE RATE USED IN A SQUARE‑METRE ESTIMATE**

1.6.1 Size of buildings

 If two buildings of similar construction, finishes and with say the same number of fittings, bathrooms and kitchens are compared, the larger building should have a lower rate per m2. Likewise, for similar buildings with different size rooms the building with the larger rooms should have a lower rate. Consider the following example:

 Building A: Building B:

##  Grootte van Gebou

##  Figure 6: Size of building

##  Source: Building Economics (page 35 adapted)

## Building A has a floor area of 120 m2. Let us say the external walling is 3 m high. The area on elevation of external walling is 46 x 3 m = 138 m2. The ratio of external walling to floor area is 138/120=1.15.

## Say all the horizontal elements together (floors, roofs, etc.) cost R1 325/m2, and the external walling R650/m2 on elevation. The total cost of building A would then be:

 Horizontal elements: 120 m2 @ R1 325/m2 = R 159 000

 External walling: 138 m2 @ R 650/m2  = R 89 700

 Total R 148 700/120m2 = R 1 239.17/m2

 The same calculation for building B would yield the following results:

 Horizontal elements: 240 m2 @ R1 325/m2 = R 318 000

 External walling: 76 x 3 m = 228 m2 @ R 650/m2 = R 148 200

 Total R 466 200/240m2 = R 1 942.50/m2

 with an external walling to floor area ratio of 228/240 = 0.95

**1.6.2 Fullness on plan**

 It is obvious that the rate per square metre for a block of flats with two‑bedroom flats only, will differ a great deal from the rate for a block of bachelor flats. To illustrate the influence of "fullness on plan", examine the following buildings:

Building A: Building B:

 

**Figure 7: Fullness on plan**

**Source Core notes**

Assume that the superstructure walling for both these buildings is 3 metres high. It is obvious that the horizontal elements and the external walling would cost the same for both buildings. Taking therefore, the internal walling only, the position will be as follows:

 Building A ‑ 3 x 10 m x 3 m = 90 m2 of internal walling at a rate of say, R365 per m2 (this allows for finishes both sides) = R 32 850 or R 82.13 per m2 on plan.

 Building B ‑ 5 x 10 m x 3 m = 150 m2 at R 365 per m2 = R 54 750 or R 136.88 per m2 on plan.

**1.6.3 Shape of building**

 Examine the following buildings:

Building A: Building B:

 

 **Figure 8: Shape of building**

 **Source: Building Economics**

 Building A: Floor area: 400 m2 and an external wall length 80 m

 Building B: Floor area: 400 m2 and an external wall length 208 m

 Assume a rate of R1 380 per linear metre of external wall the cost of the external walls of Building A would be R 110 400 and that of Building B R 287 040 and the respective rates/m2 R276/m2 for Building A and R717.40/m2 for Building B

**1.6.4 Circumference area ratio**

 

244 m2

244 m2

 **Figure 9: Circumference area ratio**

**Source: Building Economics (page 38)**

The circumference of building A is 70 m and that of building B 100 m. If the height of the walls is 3 m the circumference area ratio would be:

 Building A: 210/244 = 0.86 Building B: 300/244 = 1.23

 Building B has 43% more external walling and if kept in mind that the external walling constitutes approximately 25% of the total cost of the building, Building B would cost 11% more due to the increased amount of external walling



**Figure 10: Building of irregular shape**

**Source: Building Economics (page 32 adapted)**

Although the simplest building form is the most cost effective it is not necessarily the most practical in terms of the required accommodation. The point of this illustration is however to illustrate the influence on cost. The irregular form would require more manholes and longer length of pipes and would necessarily be more expensive

**1.6.5 Floor‑to‑ceiling height**

 It is obvious that the rate per m² for a building of 3m floor‑to‑ceiling height will be lower than the rate for a building with 4m floor‑to‑ceiling height.

**1.6.6 Height of building**

The difference in the rate per square metre for a single or double‑storey building and that of, for example, a forty‑storey building respectively could be substantial. Horizontal wind loads for instance become a marked factor in structure costs when buildings start exceeding twenty storeys.

**1.6.7 Constructional differences**

For example, reinforced concrete walling instead of brick walling, or hollow‑tile slab construction instead of solid slab construction, or industrialised building methods instead of conventional methods, etc.

**1.6.8 Difference in finish and/or architectural detail**

It is apparent that the rate per square metre will be substantially affected if, for instance, marble floor slabs are used instead of granolithic floor finish, or precast terrazzo cladding instead of bagging and limewash to walls.

For the estimator employing the square‑metre method of estimat­ing, it is fairly easy to assess the difference in rate for the horizontal components of the building such as floors, ceilings, roofs, etc., and more difficult to assess differences in the vertical plane since there is very little or no relationship between the horizontal building area and the vertical components of the building.

**1.6.9 Sanitary fittings, joinery fittings, etc.**

 A concentration of toilets or sanitary fittings will make a substantial difference in the rate per m² of the building.

**1.6.10 Site**

 The following are a few of the items which could affect the square‑metre rate:

* Nature of foundations
* Sloping or level site
* Position of municipal sewer connection, resulting in excessive length of drains.
* Access difficulties

 The aspect of forecasting of costs and the dangers of applying cost information without understanding the compilation thereof has now been addressed in detail. The aspects of comparison of costs, balancing of costs and analysing of costs will be addressed later on.

**1.7 EVALUATING EXISTING DATABASE TECHNOLOGIES AND METHODOLOGIES**

As stated previously most databases are not in the public domain as the developers thereof regard the development thereof as their competitive edge in relation to other players in the market.

Small practices, without a comprehensive cost/price database of their own, or with a portfolio of different types of buildings, would have the need to consult databases in the public domain. Large practices on the other hand are likely to have established databases and are inclined to rely on their own computer-based systems that have been developed over many years, rather than utilising databases in the public domain.

The main problem with existing cost databases is that the information contained in the database is in support of the current cost models applied. The information in the cost models cannot readily be transformed from one cost model to the other as the design development unfolds which renders the information redundant as the project moves into its next development phase for example the rate per m2 calculation becomes redundant when the elemental estimating model is applied and the elemental estimating becomes redundant when the bill of quantities is developed. The repetition in developing new cost information is obvious.

The technology exists to save the information generated at each stage. An integrated approach is needed to break through the translation barriers.

**1.8 ESTABLISHING STRATEGIES FOR PROJECT INFORMATION INPUT AND RETRIEVAL**

 Information flow in the built environment remains limited regardless of the advanced technology that has developed over the last few years. This limited flow can largely be contributed to the absence of a standardised classification system. This situation causes a lot of duplication of effort that inevitably leads to human error. It also complicates search patterns hence restricting IT application. Regardless of the frustration experienced with the non-integrated information systems practice still needs to continue and cost analysis still need to be produced.

**1.8.1 Describing and coding the information**

Information systems need to fully describe (1) what it is, (2) how it is achieved and (3) when it is achieved. Earlier on in this module the framework for the Uniclass information system is given. The section that specifically pertains to the content of this module is Table G: Elements for buildings. The table is divided and subdivided into different levels that are identified by a specific numbering system for example:

|  |
| --- |
| Numbering |
| Level | Example |
| Table | Ee |
| Group | 30 |
| Subgroup | 65 |
| Object | 88 |

The numbering of the Object would for instance be Ee-30-65-88. The proposed Uniclass tables containing the groups and subgroups for building elements are attached to this module for information. All other tables can be obtained from the website stated in 1.3.5 above.

It is also possible that the coding can be conducted according to the numbering system contained in the ASAQS’s *Guide to Elemental Estimating & Analysis for Building Work.* 2013. For example the strip footings (object) contained in the element of substructure (subgroup) that is part of the preliminary elements (group). The object number could thus be 1-100-100.10. As mentioned before, no standardised classification system exists in South Africa. The following list of building types is given in the guide and could possibly serve as a classification.

 

**Figure 11:**

**Building types**

**Source: *Guide to Elemental Estimating & Analysis for Building Work (page 20)***

**1.8.2 Inputting the information**

 The analyses need to be done for every building type to produce cost information to be used for every one of the cost models divided into the different levels and coded according to the developed coding system.

**1.8.3 Retrieving the information**

 Together with the development of the coding and description systems a comprehensive index needs to be developed to ensure that the information can be readily retrieved. The process of selecting the actual information for a specific purpose is discussed later on.

**2. ACCESSING RELEVANT INFORMATION**

**Learning outcomes**

*After studying this section, you should be able to:*

*Access relevant information by:*

* *identifying sources of relevant information.*
* *accessing and evaluating information.*

**2.1 INTRODUCTION**

 In earlier years the quantity surveyor did not get involved in the project until the architect had developed the design to production drawing stage at which time the quantity surveyor would commence with the preparation of the bills of quantities. The role of the quantity surveyor has changed radically since 1990 and today the quantity surveyor is often appointed before any of the other consultants.

The methodology of working has changed together with the changed role and responsibility of the quantity surveyor. The need of clients to know early on in the design development process what their financial commitment is likely to be has led to the development of methodologies for determining the costs early on. The main source of information however remains the information derived from price determination documentation.

**2.2**  **RELIABILITY AND RELEVANCE OF COST INFORMATION**

**2.2.1 The database**

Arguable the biggest challenge is to ensure that the cost information inserted into the database (computer system) is relevant for all the uses of the cost model and that the information is reliable. The principle of GIGO (garbage in – garbage out) is still relevant in the most sophisticated systems.

**2.2.2 The reliability of cost information**

 The cost information is as reliable as the information relating to wages, materials, plant and overhead costs factored into the billed rates obtained from contractors at tender stage. The consultant quantity surveyor then analyses the costs in the bills of quantities to derive cost data that is used to forecast the cost of the next similar building. Of course the system described is fraught with problems. The most important aspects of these problems are discussed below:

**2.2.2.1 Variation in pricing methods**

 The reliability of billed rates is quite an issue. If one had the opportunity of examining the rates in two different bills of quantities priced for the same project one would notice quite a discrepancy between the unit rates. Should the overall tenders differ by 1% from each other it is highly unlikely that all the rates in any one trade would differ only by 1%. It is highly likely that the lowest tender would contain unit rates that are higher than those in the second tender. The reasons for these inconsistencies need to be considered

**2.2.2.1.1 Distribution of preliminaries, overhead costs and profit**

 The choice of pricing the preliminaries in the trade or rather including the costs thereof as add-ons to the other trades is a matter of pricing habits rather than genuine contractual differences e.g. whether the cost of scaffolding is added to preliminaries or to the cost of brickwork.

**2.2.2.1.2** **Difference in facilities between firms**

 A firm that owns its joinery works may be able to quote more cheaply for joinery than a firm that has to have the items manufactured by an outside company, particularly in busy times.

**2.2.2.1.3 Different site techniques**

 The contractor’s site techniques will influence his pricing e.g. to use a tower crane or not, to use ready mixed concrete or establish a batching plant and mix concrete on site, excavating by hand or machine and if by machine what kind of machine, etc.

**2.2.2.1.4** **Lack of accurate cost information**

 Productivity of labour force is estimated by applying labour constants. The accuracy of these constants is questionable unless the firm have their own system of feeding cost information back from site to the estimating office for incorporation into future rates. Even where cost information is available it might not be in the same format in which the cost is required or labour costs for different activities on site are so intertwined that guesswork is the only alternative e.g. distinguished between brickwork and plaster.

**2.2.2.1.5 Differences in sub-contractors’ and suppliers’ prices**

 One contractor may have received a lower price from a specialist subcontractor or supplier that wasn’t asked to price by the other contractor. The successful tenderer may subsequently obtain a cheaper price but this will not affect the billed rates.

**2.2.2.1.6 Mistakes**

 An outright calculation error could occur in the pricing stage or the description could have been misinterpreted or the estimator isn’t familiar with the product prescribed.

**2.2.2.1.7** **Deliberate distortion of prices**

 The estimator may have deliberately distorted the price. This is done for two reasons, firstly where variations are anticipated in which case items thought to be omitted are priced cheaply and pricing items that are likely to increase high. Secondly to obtain as much profit as soon as possible by pricing work to be executed early on higher e.g. pricing scaffolding in brickwork that is not likely to change. Earthworks could also be priced higher if profit is required even earlier in the project, but this is risky as foundation depths could change considerably and the quantities will subsequently be re-measured. This tactic is called front-loading.

**2.2.2.1.8 Different standards of workmanship**

 One sub-contractor might price for preparing and painting according to specification while another prices for slapping two quick coats of paint all over (2, 3, 4).

**2.2.2.1.9 Factoring in previous experience**

 The contractor may have had a bad experience with the particular design team in the sense of a difficult architect or an unreasonable quantity surveyor and factors it into the rates.

**2.2.2.2 Variation in billed rates for different jobs**

A number of additional factors come into play when one compares rates of two different projects with each other. These are:

**2.2.2.2.1 Difference in site conditions**

A building on a confined site with limited access will obviously be more expensive than a similar building on a spacious site with good access.

**2.2.2.2.2 Differences in conditions of carrying out work**

 Facade panels to a ten storey building would be costlier than the same panels to a single storey building. Other factors such as location and access will also influence the price.

**2.2.2.2.3 Difference in standards**

Buildings known for intricate detailing such as churches will be more costly than simple office blocks even though the description of the items in the bills of quantities might be the same.

**2.2.2.2.4 Architect**

The architect might be known to be difficult and unsympathetic towards the difficulties experienced by the contractor.

**2.2.2.2.5 Tendering conditions**

A popular contract open to public tender will be priced very keenly while a difficult contract that is restricted to a selected group of tenderers will tend to be highly priced.

**2.2.2.2.6 Contract conditions**

The more onerous the contract conditions the higher the tender will be due to the fact that the contractor has to higher risks in relation to for example the cost of additional working capital, the increased probability of the penalty being applied due to shortened construction periods, etc.

**2.2.2.2.7 Financial conditions**

The high rate of insolvency in the built environment is common knowledge. Contractors tend to try and uphold cash flow and try to obtain new work at any price for the sake of income instead of considering anticipated profit. Under-cutting each other’s prices are therefore common in difficult economic times.

**2.3 ACCESSING AND EVALUATING INFORMATION**

As discussed above, the main source of cost information remains the bill of quantities. It is actually more accurate to refer to price information than to refer to cost information because the information derived from a bill of quantities is based on the selling price (tender price) of the contractor and not on the actual cost of the resources to execute the construction activities. The actual cost information is not in the public domain but remains within the realm of the tendering party.

**3. SETTING UP AND MAINTAINING A DATABASE**

**Learning outcomes**

*After studying this section, you should be able to:*

*set up and maintain databases by:*

* *selecting the database to satisfy the project cost information requirements.*
* *customising the database to satisfy the project cost information requirements, where relevant.*
* *formatting and entering information into the database.*
* *monitoring currency of data and overall information in the database.*
* *updating the content of the database as required.*
* *developing policy for maintenance and maintaining the database.*

**3.1 INTRODUCTION**

 In Professional Skills Module no. 3 you were introduced to alternative procurement strategies. In recent times the tendency has been to move away from the traditional procurement strategy. The most commonly used price determination method with the traditional procurement strategy is the bill of quantities. The discipline of cost planning has been derived from the traditional system and revolves around the basic skills of measurement and cost analysis (3). In order to maintain an accurate level of cost information for all projects executed under procurement strategies for which no formal bills of quantities are prepared, cost information needs to be generated to be compatible with information derived from bills of quantities.

**3.2 SELECTING THE DATABASE TO SATISFY PROJECT COST INFORMATION REQUIREMENTS**

The relationship between the design stage and the applicable cost information was introduced earlier on in this module and emphasis was placed on the fact that cost planning and control during the design development stage is of paramount importance as it has a determining influence on the manner in which the project is rolled out. Professional Skills Module no 2 introduced the project stages according to which built environment professionals plan and execute projects in South Africa. These stages with their associated cost information and design development stages are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Stage and Description** | **Design Development** | **Cost information** |  |
| Stage 1: Inception | Briefing stage | Single unit cost | Planning phase |
| Stage 2: Concept and Viability | Sketch plan stage | Elemental cost analysis/ Approximate or rough quantities |
| Stage 3: Design Development | Detailed design | Refine Elemental cost analysis |
| Stage 4: Documentation and Procurement | Working drawings | Bill of Quantities |
| Stage 5: Construction |  |  | Construction phase |
| Stage 6: Close-out |  |  |

 **Table 2: Design development and cost information according to stages**

**Source: Author**

The information contained in the databases is derived from either bills of quantities or from elemental analysis. The information retrieved from bills of quantities can be converted to a single unit rate such as a rate per unit (for example per bed, per seat, etc.) or expressed as a rate per area. This would then be suitable and applicable to very early stage estimating / budgeting.

Software packages such as WinQS have the capacity to produce cost analysis from bills of quantities through directly linking billed items to the appropriate unit of analysis required and to automatically generate rates for unit of analysis based on the billed rates. The cost can be generated according to elements, workgroups, activities, etc. or whichever sort keys the user defines.

**3.3 CUSTOMISING THE DATABASE TO SATISFY THE PROJECT COST INFORMATION REQUIREMENTS, WHERE RELEVANT**.

There are basically two kinds of building cost models namely (i) product-based cost models that model the finished product and (ii) process-based cost models that model the construction process. Generally, the process-based model is regarded as the most accurate, but to attempt to implement this model too early on in the design stages could be to the detriment of the design process. The most commonly known example of a product-based cost model is a bill of quantities and the most commonly known product-based cost model is the elemental estimate (2, 3). In South African the bill of quantities is commonly prepared according to the standardised measuring system published by the Association of South African Quantity Surveyors titled The Standard System of Measuring Building Work, 1999 (sixth edition revised) and the elemental estimates are prepared according to the Guide to Elemental Cost Estimating & Analysis for Building Works, 2013 also published by the Association of South African Quantity Surveyors.

 It is evident from the discussions above that the cost information needs to be arranged at different levels of complexity in the same order as what the design development takes place. The preferred format for customising the database is the Elemental Cost Estimate.

**3.4 FORMATTING AND ENTERING INFORMATION INTO THE DATABASE**

**3.4.1 Developing a database**

 Like any system containing a mammoth amount of information, the information needs to be coded and arranged in different levels so that it can be accessed with easy, understood clearly and be able to be fed into other databases to be further manipulation, etc.

 The development of a database should thus be designed in such a manner that the required information discussed above is generated. The development stages are:

* defining the objectives
* obtaining and collating the data
* analysing the data
* developing the model
* testing the model under trial conditions
* utilising the model

 The development stages are illustrated as follows:

Define objectives

Obtain and

collate data

Analyse data

Develop mode

(optional)

Test model under trial conditions

Utilise model

 **Figure 12: Development stages for a model**

 **Source: Building Economics (page 203)**

 The broad levels according to which the information should be arranged for each building that is being analysed is:

* the function of the building for example schools, office buildings, hotels, hospitals, etc.
* the type of analysis being undertaken for example a detailed elemental analysis
* the type of work for example is it a new building, an extension to an existing building or a refurbishment of an existing building
* the number of storeys one, two, etc.
* the construction area
* the location of the building for example in Gauteng, in the Western Cape, etc.
* the date – so that the information can be updated correctly

**3.4.2 Information to support the different models**

 In order to arrange our cost information sensibly so that the information is accessible; the position of its application is known; the meaning of the information is agreed and understood by all users and the information can be manipulated to suit specific situations the information needs to be classified or labelled. The data making up the database must therefore not just contain the cost of resources to create the construction projects, but also describe the project in terms of its function. The difficult part of classifying information is to decide what should be kept together and what should be given separately.

**3.4.2.1 Product-based Cost analysis**

 The process (statistical techniques) according to which the cost data is arrived at with a product-based cost analysis is often referred to as a “black box” method because it is not possible to see what is happening within the model and there is no specific explanation or justification of the results. Earlier on in the module the factors that influence a rate per m2 were discussed in detail. When there is fluctuation in a rate per m2, it is impossible to determine what factor actually caused the fluctuation, whether is was cause by one factor only or by a combination of factors.

**3.4.2.2 Process-based Cost analysis**

 The format for an element within the elemental estimate is as per the extract from the guide illustrated below. From this format can be seen that the elemental rate is R193.61/m2. This rate is obtained by dividing the cost of the element with the construction area e.g. R 3 645 125 / 18 827 = R R193.61/m2. This rate can be used as a benchmark for comparison. Also the percentage of 3.53% that represents this specific element’s contribution towards the entire estimate can be used as a benchmark for comparison purposes The component cost is obtained by dividing the elemental area into the costs of the elements e.g. R 3 645 125/ 5 860 = R 622.03/m2.



 **Figure 13: Elemental cost**

 **Source: Guide to Elemental Cost Estimating & Analysis for Building Work, 2013 (page 104)**

 The database would consist for the analysis of many projects and would be grouped into different types of buildings

 Each element is carried forward to an elemental summary, but still reflects the component cost, element cost and the contribution of the element to the entire estimate. Once again this information would also be created for various projects and will be grouped into different types of buildings for future use.

 

 **Figure 14: Elemental summary**

 **Source: Guide to Elemental Cost Estimating & Analysis for Building Work, 2013 (page 107)**

Similarly, an executive summary is created for the overall project that reflects the rate / m2 for the project



 **Figure 15: Summary of Construction Cost**

 **Source: Guide to Elemental Cost Estimating & Analysis for Building Work, 2013 (page 105)**

 This information is ready to be used for early stage estimating and budgeting.

**3.5 MONITORING CURRENCY OF DATA AND OVERALL INFORMATION IN THE DATABASE**

3.5.1 Introduction

 Construction cost indices are used to adjust costs of items or groups of items from various points of time (tender dates) to current time. It is not possible to obtain a large amount of cost data that relates to the same point in time due to the long duration of building projects.

**3.5.2 Building cost index (Contract price index)**

 Due to continuous inflationary escalation in the cost of labour, materials and other resource inputs, a contract price index is vital for updating past records for estimating purposes.

 At present there are two bodies that provide the South African built environment with contract price indices together with other relevant statistics on a continuous basis, namely:

 ***Bureau for Economic Research (BER) ‑ University of Stellenbosch***

This BER publishes two quarterly publications namely "Building and Construction" and "Trends in Building Costs". The first of these is distributed to firms who pay a certain annual subscription fee whilst the second publication is distributed free of charge to all participating quantity surveying firms. By "participating" it is meant that bills of quantities are analysed and the information thus obtained is filled in on a standard form provided by the Bureau. Apart from using this index to update information it is also used to calculate pre-tender escalation in estimates.

***Central Statistical Service: Contract price index for buildings***

A monthly index that is distributed to all quantity surveying firms and all firms are compelled to provide information to the Department on its prescribed standard forms on a continuous basis.

3.5.3 Estimating pre-tender escalation on built environment projects

 The starting point for all construction cost estimates is the day on which the estimate is done. In other words, the rates used are those applying on that day as if the project could be completed on the same day, usually called the “Estimated ***Current*** Construction Cost”.

 This is of course not possible. Feasibility studies (of which the estimate of construction cost is an important part) first have to be carried out, tender documentation must be prepared, tenders called and adjudicated, plans submitted for scrutiny and permission to start building by the local authority, etc. This can take from 4-12 months or even longer on large and complex projects.

During this time construction costs will fluctuate in response to both macro-economic and local construction market factors. In the recent past these fluctuations have almost always been upwards as a result of continued inflation, and it is expected to remain that way for the foreseeable future.

The anticipated future tender price for the work will invariably be higher than the estimated current construction cost, which amount must therefore, be escalated in full for the estimated total planning period at a projected rate based on construction market trends.

 Example: estimating pre-tender escalation (or escalation during planning period):

 **Basic information:**

 - Estimatedcurrent building cost: R10 000 000

 - Estimated planning period: 6 months

 - Anticipated rate of escalation in

 construction market prices for next 6 months: 1.25%/month (or % expressed through the application of the BER indices)

 **Estimated escalation during planning period:**

 Using the formula for compound interest *Sn = K(1 + i) n ,* and the following values for the symbols:

 *- K* or initial capital or present value = R10 000 000

 - ior escalation (interest) rate = 1.25%

 - *n* or number of periods = 6

 The accumulation factor can either be obtained from tables such as can be found at <http://myhandbook.info/table_amount_compound.html> or calculated with financial calculators

The interest or accumulation factor for the above data is 1.07738 (read from the tables), and the future value or estimated tender sum is thus 1.07738 x R10 000 000 = R10 773 800. The pre-tender escalation is therefore, the difference of R773 800.

3.5.4 Estimating post-tender escalation on built environment projects

 ***Escalation during tender adjudication period:***

Once tenders have closed, the base-date or starting index for construction contract escalation is fixed (usually month before closing of tenders if tenders closed before the 15th, and the month in which tenders closed if after that). This means that while tenders are being adjudicated escalation on the tender sum is running.

 Let us assume in the example above, that the estimate was exactly right, and that the lowest viable tender came in at R10 773 800 (highly unlikely of course), and that tender adjudication will take one month. The entire 85% of the tender sum that is subject to escalation will escalate for a month before construction even starts. If the projected contract escalation rate is 0.5% per month, the escalation during tender adjudication will be:

 *K (or PV) = R10 773 800 x 0.85 = R9 157 730*

 *n = 1*

 *I = 0.5%*

 The compounded future value as calculated or read from the tables is then

 1.005 x R9 157 730 = R9 203 519. In other words, while the tender was being adjudicated the building cost escalated by R45 789 (R9 203 519 – R9 157 730)! The building cost has therefore, gone up in this time by R45 789, from R10 773 800 to R10 819 589

 ***Escalation during construction:***

 Expenditure curves on construction contracts usually show that more money is spent during the second half of the contract period (slow starts, site establishment, high volume/low value work in the early stages, etc. The effect of this is that more than 50% of the contract value is subject to escalation for longer than the average period that each payment would have been subject to escalation if expenditure was spread evenly across the contract period. This is sometimes referred to as the “cash-flow factor”, or the “S-curve factor”, which can be anything between 0.4 and 0.65.

 Assuming a factor for our example of 0.6, estimated escalation during construction for our example above, would be as follows:

 **Basic information:**

 i = 0.5%

 n = 4

 K (“Vtotal” x 0.85 x 0.6) = R10 819 589 x 0.85 x 0.6 = R5 517 990

 **Estimating the escalation:**

 R5 517 990 x 0.02015 = R111 187

 ***Estimated final escalated building cost:***

 1. Estimated current building cost R10 000 000

 2. Estimated pre-tender escalation R 773 800

 3. Estimated tender sum R10 773 800

 4. Estimated post-tender escalation:

 4.1 During tender adjudication: R 45 789

 4.2 During construction: R111 187 R 156 976

 **Estimated final escalated building cost R10 930 776**

 The factor of 0.85 is derived from the Haylett formula used for calculation escalation over the construction period. Candidates are referred to Professional Skills Module no. 6 for a detail discussion on the working of the Haylett formula.

The two sets of indices discussed above pertain to the adjustment for time only. It would also be necessary to consider whether an adjustment for location should be considered. Unfortunately, the indices produced in South Africa do not make provision for different regions

**3.6 UPDATING THE CONTENT OF THE DATABASE AS REQUIRED**

Updating the database on a regular basis is of paramount importance to ensure that the information for estimating and determining budgets for new projects is readily available. One must be cautious not to escalate the information in the database too far forward as the indices would compensate for cost fluctuation, but would not allow for changed economic climate, updated technology and the use of modern materials.

 It is advisable that projects older than two years be priced at current market related rates to create an up-to-date data base.

**3.7 DEVELOPING POLICY FOR MAINTENANCE AND MAINTAINING THE DATABASE**

 The maintenance of the databases should not be undertaken on an ad-hoc basis, but rather according to a well-developed maintenance plan. The first step would be to ensure that a comprehensive back-up is made of the current database to ensure all cost data is secure. Thereafter all users should be informed that the database is being updated before the actual updating of the statistics / data commences. When the update is complete is needs to be verified.

 The regularity with which updates is done is important. Decisions need to be taken on whether projects older that a certain age should be updated or rather removed from the database. Decisions on what is to be updated at which stage should also be considered for example the repricing of all projects that are say older than two years are all to be updated during the same cycle and the latest project should all be added to the database in the same cycle.

**4. APPLYING PROJECT COST INFORMATION DATABASES TO THE FINANCIAL MANAGEMENT OF BUILT ENVIRONMENT PROJECTS**

**Learning outcomes**

*After studying this section, you should be able to:*

*apply project cost information databases to the financial management of built environment projects by:*

* *selecting the appropriate data from cost information databases.*
* *demonstrating the application of relevant data.*

**4.1 INTRODUCTION**

 In order to be able to select the appropriate data from the cost information database one must understand what methodologies are applied

**4.2 SELECTING THE APPROPRIATE DATA FROM COST INFORMATION DATABASE**

 The information required to set up an early stage budget, is:

* a suitable cost analysis of a building similar to the building being designed. The closer the similarity the more accurate the budget would be and the more successful to design cost management process would be. The similarity is sought in the type or function of the building for example a school or office building
* where a similar type of building is found, further similarity is sought in the size and general arrangement of the building, the number of storeys, the complexity of the plan and the nature of the ground (topography and geology)
* selecting an analysis of a building that has been completed as recently as possible. Although indices are applied to compensate for the time value of money, chances are that the adjusted rates will not reflect changes in market conditions, client requirements, technical solutions, etc.
* selecting an analysis of a building that is in close proximity to where the building under review is being developed for example it might be more expensive to build in remote locations as opposed to in city centres

 The technique is therefore to choose and analyse buildings according to similarities in terms of quantity, quality, time and location.

**4.3 DEMONSTRATING THE APPLICATION OF RELEVANT DATA**

 In section 1.4 above the application of the cost models in relation to the corresponding design development stages was discussed in detail. The importance of delivering more and more reliable cost information quicker cannot be overemphasised. Yet there is no sense in applying a complex costing model at the earliest stage of development before detailed design information is available.



**SELF-ASSESSMENT QUESTIONS**

1. Ferry and Brandon (1999: 117) state “If we were to look at the work being undertaken in a typical quantity surveying office we would find cost information being used for four main purposes:
* The control and monitoring of a contract, for which the contractor has already been selected, through interim and final account procedures.
* The estimation of the future cost of a project and the control of design to ensure that this figure is close to the tender figure.
* The ‘balancing’ of costs in a cost plan to ensure that money has been spent in accordance with the client’s priorities.
* The negotiation of rates with a contractor for the purposes of letting a contract quickly.”

For each of these activities, identify and discuss the specific forms of cost data and their applications within the South African construction sector, describing *inter alia* the problems in retrieving and storing the information to be used. Specifically address the pertinent issues, and do not present detailed examples of how to do estimates – describe the philosophies underpinning the successful compilation of the various documents that are used in the activities described above.

1. The data used by quantity surveyors for cost estimating and contract administration purposes are artificial constructs. In essence, the base data is distorted or transformed to such a degree that they no longer represent the cost of production on site. Explain why this is so, identify potential resultant problems, and what could be done to improve the situation. You are required to clearly describe the ways in which data transformation occurs for a range of different types of data commonly used by QS’s, and for each one, to propose ways of resolving resultant problems.
2. In the United Kingdom, a form of construction information classification has been developed entitled Uniclass. Describe the structure and format of the system and explain ways in which this system could enhance the data management process applied by quantity surveyors in practice. In addition to describing the format / content of the classification system, you are expected to develop this information in a way that could potentially improve typical quantity surveying practices which utilise data.
3. The following are all common terms used in relation to cost databases. Explain what they are, illustrating your answer with examples where applicable:
4. Cost indices
5. Price indices
6. Work groups
7. Quantity surveyors tend to rely almost exclusively on cost data contained within Bills of Quantities for the inputs to their estimating methods. However, these data have serious shortcomings. Discuss the quality of the data used by quantity surveyors for estimating purposes, and comment on the steps that quantity surveyors could take to minimise the negative effects of these distortions.
8. Research by Pearl (1994) indicated that a major factor contributing to the poor pre-tender estimating performance being achieved by SA quantity surveyors at that time was the dearth of suitable cost / price data available to the many small consulting firms. Has the situation changed significantly since then? Compare current data availability with that described in the study, and provide practical suggestions on how to ensure continued improvement in this field. (Source: Pearl, R.G. (1994) Hazards of estimating without price data, in Association of Cost Engineers (UK) 13th International Cost Engineering Congress *'Cost Management for the 21st Century'*, London, October, pp. CE13.1 - CE13.13).
9. In the construction industry, cost / price estimation of all types is usually based on past experience projected forward. 'Past experience' is recorded in the various forms of cost data available. Historical data are used as a basis for estimating future costs. Clearly, the more detailed and accurate the data, the higher the probability of achieving a good estimate, all other things being equal. Critically discuss the uses, reliability, structuring and sources of cost data used by quantity surveyors in South Africa.
10. Recent research conducted in the UK indicates that quantity surveyors strongly support the continued use of elemental estimates as a price modelling technique. It is not known if a similar situation currently applies in South Africa. If you were contemplating the adoption of this technique within your own firm, what would be the primary issues impacting upon your decision? In considering this possibility, you should describe both the strengths and weaknesses of the system as it is commonly used in SA, as well as comparing it with other estimating systems typically utilised within local firms.
11. The results of an empirical study of quantity surveyors’ forecasting accuracy confirms that price forecasts being provided do not meet the expectations of South African clients and architects, or even of the quantity surveyors themselves. Discuss this statement with particular emphasis on: the importance of accurate price forecasts; forecasting accuracy achievable in theory; quantity surveyors’ perceptions of achievable accuracy; architects’ and clients’ expectations of accuracy; the actual performance of quantity surveyors in pre-tender price forecasting; and observations made of mentor organisation activities.
12. Resource-based cost models are claimed to address the problems associated with traditional cost models. Discuss the weaknesses of traditional cost models and comment on the extent to which resource-based cost models overcome these weaknesses.
13. You have prepared a detailed estimate and cost plan for a proposed 20-storey office block in Central Durban. The client is, however, considering varying his original requirements and as a result you will shortly be asked to estimate the financial effect of these modifications.

Describe the factors you would consider when making an estimate for the following proposed design variations:

* addition of a further five storeys;
* addition of air conditioning;
* omission of a basement car park;
* substitution of ordinary glazing by solar reflective glazing in the curtain walling
* upgrading the office block from a speculative building intended for sale to an owner-occupied prestige building.