

# **Building Economics and Cost Control**

**Worked solutions**

**A. Ashworth MSc ARICS**

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# Preface

Building economics and cost control has become a particularly important subject to study within the discipline of quantity surveying, and is also given some consideration by both designers and contractors. It seeks to ensure the efficient use of available resources in the construction industry.

There are already several excellent books which describe and detail the subjects of building economics, cost planning and cost control applicable to the construction industry. There is also further supporting information and literature that is available to both practitioners and students alike. There are, however, few textbooks dealing with worked solutions to practical examination problems, yet such books are of particular value and interest to students. Furthermore, questions taken from previous examinations of appropriate professional institutions are even more relevant. However, the contents of this book provide only for worked solutions to the problems posed. They are not intended to be the only solution available or a model answer, but are intended to cover the main points relevant to the discussion.

The idea for this book originated from a series of questions written by the author for 'QS Weekly', a news magazine for quantity surveyors. These articles received an enthusiastic response, both from the then editor Mr William Pike and also from many students who found the series useful, informative and helpful in their revision. Although some of the examples were previously printed in 'QS Weekly', many of the questions are entirely new. This book also includes many examples which, because of their length, are unsuitable for publication in a weekly periodical.

The book is of particular relevance to quantity surveyors, although students of other disciplines, e.g. building surveyors, who need to study this subject will also find it useful. It is, therefore, appropriate to students studying for the RICS (quantity surveying division), IQS, CSI and CIOB examinations.

Students reading for quantity surveying degrees or studying on diploma courses will find the book helpful in their learning process. It will also be a useful reference book to students of the other professions of architecture, building and civil engineering particularly where construction economics is part of their course.

I am grateful to the Institute of Quantity Surveyors, the Royal Institution of Chartered Surveyors and Preston Polytechnic for granting me permission to reproduce their examination questions. I would also like to express my thanks for being able to quote from the Building Cost Information Service.

Finally, I would like to thank Frances Dewar for her care in typing the manuscript.

**A. Ashworth,**  
Preston 1982

**Preface**

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# 1 Construction economics

**The construction industry is sometimes used by the government as an economic regulator.**

- (1) Discuss how government can implement such a policy.**
- (2) Discuss the effect it has on**
  - (a) the national economy.**
  - (b) the construction industry.**

**(1) The importance of the construction industry in the economy is due to three factors:**

- (a) Its size.** In the early 1970s the value of building in the United Kingdom amounted to 12 per cent of the gross domestic product. The labour force employed was in the region of 6 per cent. The number employed in the repair and maintenance section alone is greater than that in agriculture, coal mining, shipbuilding and many other large industries.
- (b) It provides predominantly investment goods.** Construction is an investment industry; its products are wanted not for their own sake but for the goods or services which they can help to create. This is particularly true for factory buildings, but it also applies to the majority of other building types.
- (c) Government is a large client.** In the early 1970s public building accounted for over 50 per cent of the construction industry's workload. Work undertaken for local authorities, central government and public corporations falling into this category.

**In managing the economy, the government has four main objectives:**

- (i) The ability to pay its way abroad by balancing the payments.**
- (ii) An acceptable level of employment of resources, particularly manpower.**
- (iii) An increase in the amount of goods and services produced and consumed, leading to a rise in the standard of living.**
- (iv) The control of inflation.**

In spite of the damage to efficiency of sudden stops and starts in its workload, because of its size and importance the construction industry is a tempting regulator of the economy. Economists, however, are in some disagreement about whether the industry is ever used as such.

Government measures to control the economy usually affect the industry either directly or indirectly: by the control of output by increasing or reducing public expenditure, or by a restriction on borrowing via high interest charges.

- (2)(a) The effects of changes in output, employment, incomes or demand in the construction industry are likely to have repercussions in other sectors of the economy. Thus a decline in construction activity will have an adverse effect on many other industries.
- (b) (i) Government has an important role because public authorities buy over half of its output.
- (ii) A steady rather than a wildly fluctuating workload is important if the industry is to plan and manage its resources properly.
- (iii) Government economic policy will either stimulate or depress the construction industry.
- (iv) The adverse effects of a depression on the construction industry are as follows:
- Unemployment of building operatives.
  - Smaller firms being forced out of business.
  - Large firms being reluctant to invest large sums of money in plant and equipment, or to experiment with new techniques.
  - Suppliers of materials and components being unlikely to extend their plants.
  - Recruitment of persons into the industry at all levels being made more difficult.
  - Lack of continuity of work equals increased costs and reduced efficiency.

### **What is meant by the term construction economics?**

Construction economics is a branch of general economics. It consists of the application of the techniques and expertise of economics to the particular area of the construction industry. Economics, in general, is about the choice of the way in which scarce resources are and ought to be allocated between all their possible uses. Construction economics is concerned with man's needs for shelter and the suitable and appropriate conditions in which to live. It seeks to ensure the efficient use of available resources to the industry, and to increase the rate of growth of construction work in the most efficient manner. It includes a study of the following:

- (1) A client's requirements. This involves a study of the client's wants and needs, and ensuring that the design of the project is kept within the available funds to be provided by the client. The client's requirements can be summarised as follows: satisfied that the building meets his needs, is available for occupation on the specified date for completion, the final account closely resembles the estimate and the construction project can be maintained at reasonable cost.
- (2) The possible effects on the surrounding areas if the development is carried out. This considers the wider aspects associated with planning and the general amenities affected by proposed new construction projects.

- (3) The relationship of space and shape. This evaluates the cost implications of the design variables, and considers those aspects of a particular design and their effects on cost. It does not seek to limit the architect's design skill or the aesthetic appearance of the project, but merely attempts to inform the architect and the client of the influence of their design on the overall cost.
- (4) The assessment of the initial cost. This is the establishment of an initial estimate that is sufficiently accurate for advice purposes and which can be used for comparison purposes throughout the building process.
- (5) The reasons for, and methods of, controlling costs. One of the client's main requirements for any construction project is the assessment of its expected cost. The methods used for controlling the costs will vary depending upon the type of project and the nature of the client. The methods adopted should be reasonably accurate, but flexible enough to suit the individual client's requirements.
- (6) Estimating the life of buildings and materials. The emphasis on the initial construction costs has moved to consider the overall costs in use. The spending of a little more initially can result in a considerable saving over the life of the building. However, estimation of building-material life, interest rates and the economic life of a project can be difficult to determine in practice.

In addition, the wider economic aspects are worthy of note. These are:

- (1) The role of the surveyors, engineers and builders employed in the industry.
- (2) The division of the industry between the design and construction process.
- (3) The size of the industry, its relationship to other industries and the national economy.
- (4) The types of development undertaken.
- (5) The types and sizes of construction firms, and the availability of specialist contractors.
- (6) The variations in building costs and factors that influence these variations, such as market conditions, regional location etc.

The construction industry has characteristics which distinguish it from other industries. These can be classified as follows:

- (1) The physical nature of the product.
- (2) The structure of the industry.
- (3) The organisation of the construction process.
- (4) The method of price determination.

The final product is often large and expensive, and is required over a wide geographical area. Buildings and other structures are for the most part specially made to the requirements of each individual customer, although there is the provision for some speculative work, particularly in housing. The nature of the product also means that each contract often represents a large proportion of the work of a single contractor in any year, causing substantial discontinuity to the production functions.



## **Discuss the economic outlook for the construction industry over the next five years.**

The answer to this question must largely be of a speculative nature, but nevertheless the following factors should be considered.

### **Government policy**

Because government is a large client of the construction industry, any change in its policy towards new buildings or engineering projects is likely to have a considerable influence on the economic position of the industry. A reduction in housing, educational buildings, hospitals and the road-building programme will have serious effects on both the professions and the constructors. The trend has been to spend more upon the rehabilitation and maintenance of works in preference to new projects, although the actual amounts invested have been inadequate. Government policies in respect of tax concessions, development grants and interest rates have all influenced the contraction of the industry.

### **Industrial activity**

Another major client of the construction industry is manufacturing industry. A reduced market both at home and overseas will only discourage industrialists from expansion into new or enlarged premises. The effect of a shrinking market has a knock-on effect on smaller manufacturers and other industries, with a consequent loss of possible new building schemes. This reduction in economic activity has a far-reaching effect, resulting in a lack of confidence generally on any possible future development.

### **World economic trends**

A world recession affects particularly a country's exporting capabilities. This results in a reduced home base, which may increase costs and therefore prices charged, because of reduced economics of scale, resulting in further recession. This can only result in a decline for construction orders in many areas and types of work.

### **Political trends**

The political influence of a government can have immense effects upon the economic outlook of the construction industry, and must never be underestimated. For example, a government committed to increased public expenditure in capital projects is likely to provide a considerable proportion of work for the industry. However, such a government may be more inclined to develop a public-building corporation or expand the direct labour organisations, which may thus provide mixed fortunes for the building industry. In the long term this may not directly benefit the private contractor. Because a large proportion of expertise lies in the private sector,

this may mean the switching of allegiance of many of the industry's employees. An alternative political viewpoint may favour encouraging the private sector to expand at the expense of the public sector.

### **Energy sources**

A large investment has been made in recent years in both the gas and oil industries. Nuclear energy has also been expanded. Research is currently being undertaken to find alternatives to rapidly diminishing fossil fuels and to nuclear power (which is fraught with political argument). Whatever energy sources are used, all involve the construction industry for capital projects.

### **Conservation**

There has in recent years been an unprecedented attempt to conserve, repair or modernise premises. This has been particularly true in housing, where the emphasis has shifted away from new construction and towards the rehabilitation of existing properties. Considerable expertise has grown up around this work, and this sector of the construction industry is still increasing.

### **Changes in technology**

The construction industry is today still very much a labour-intensive industry. Automation resulting in reduced labour forces in manufacturing industry has not been matched in the construction industry. System building, with components manufactured under factory conditions, has moved only a little way in this direction. Apart from speed of erection, this type of building has disadvantages in cost, function, appearance, life and recurring costs. Some changes in methods and materials used for construction are expected during the next decade. Mechanisation of the building site has made some inroads, but in future this may make an even greater impact.

### **Silicon chip**

The chip has begun to affect the way we run our lives. This could have many diverse effects upon the construction industry, e.g. greater environmental control of buildings, further automation in materials manufacture and an influence in the way buildings are designed. The chip will also have far-reaching effects on the building professions, as we move towards an 'electronic office'.

**Projects tend to be completed more quickly in the USA than in the United Kingdom. Suggest some of the underlying reasons for the poor performance of completion times in the UK.**

There have been a number of comparisons between the US and UK construction industries over the past decade. Dramatic comparisons between the time taken to build Sears Tower in Chicago and the National Westminster Bank Tower in London, and the more serious studies by Slough Estates Ltd., are two examples. All the work arrives at the same conclusion: that the US construction industry produces buildings more quickly than the UK. The results of the earlier studies have caused many aspects of the UK approach to construction to be questioned. Often it has been assumed that there must be a single simple cause for the inferior UK performance.

There is, however, no general agreement on which factors are important and which are not. There is no established theoretical framework to guide the study, and the current level of understanding is not highly developed.

Some of the factors that might be considered when comparing building performance in these two countries are listed below. They are suggested in the report 'UK and US construction industries: a comparison of design and contract procedures' published by the RICS. They are not ranked in any order of importance.

It has been suggested by others that the real difference between the two countries is the absence of the quantity surveyor in the US, and his important role in the UK. Whilst this fact cannot be denied, someone in the US must, however, undertake 'quantity surveying' work. From these reports it is evident that the quantity surveyor is not one of the reasons for our poor performance. Indeed the report suggests that the US should consider employing quantity surveyors for the good of their construction industry.

A lengthy design process, the necessity for variations, higher standards of quality control, the delayed involvement of the contractor, restrictive labour practices, less mechanisation and a less predictable workload are probably some of the main reasons. These are now examined in greater detail.

(1) UK clients expect to be able to change their brief both during the design stage and whilst the construction work is being carried out on site. The US clients know that changes to the building during the construction phase are very expensive and offer poor value for money, and are generally discouraged. Changes to the contractor's work programme can be a major factor causing delay.

(2) UK orthodox procedures are largely determined by public sector insistence on control and accountability. The US procedures have to respond to private sector demands for speed, and a clear allocation of responsibilities and risks.

(3) Large technically advanced or risky projects are approached differently. The US clients are much more prepared to adopt unorthodox procedures.

(4) Any comparison of time and cost must also take into account the quality of the finished projects. In this respect, it can be argued that US buildings are inferior. For example, inaccuracies and tolerances in concrete work are much greater than in the UK.

(5) The UK construction industry is very much geared to refurbishment, which provides an attitude of 'make do and mend'. In the US, buildings decay and are then demolished. This latter approach of providing new buildings leads to both fast and cheap building performance.

(6) Although US buildings are constructed more quickly than UK ones, there is no significant difference between the total construction costs of office buildings in these two countries.

(7) The time taken for both the design and construction work is longer in the UK than in the US. A longer design period is often required in the UK in order to comply with the planning regulations.

(8) Office buildings in the UK provide more recreational and social amenities and therefore less actual office space than similar buildings in the US. The latter are also more intensively occupied than in the UK, so that the cost to the users is therefore less.

(9) Detailed design decisions have a very high impact on costs and time. The separation of design from construction always involves major time and cost penalties. The US system involves the contractor's influence at the design stage, when account can be taken of construction methods. The traditional UK system prevents this involvement.

(10) The incentives offered by the finance and tax structures in the US encourage the faster completion of buildings. The dominant philosophy in the industry is 'time is money'.

(11) Speed of construction in the US is achieved by different work practices from those in the UK. Many of these result from the willingness of US engineers and architects to accept alternative designs from the contractors and subcontractors, aimed at simplifying the building construction.

(12) There is a recognition in the US that wet trades in the building process will slow down progress. They are thus kept to an absolute minimum, and emphasis is placed upon simple methods of construction.

(13) The US construction worker does not physically work any harder or longer than the UK counterpart. The higher productivity is achieved partly through less complicated construction details and the use of more mechanical aids.

(14) Construction plant used in the US is generally larger than that in the UK, where greater emphasis is placed on selecting the smallest plant which is capable of doing the work. The tendency is partly due to the fact that transportation in the US is easier because of their much wider carriageways.

(15) Better welfare facilities are provided by UK contractors, and their safety record is much better than that of the US construction industry. Overtime in the US is unusual and incentive payments in the form of bonuses are not paid, owing to the higher hourly rates received by operatives. There is an ease of 'hire and fire' in the US construction industry, which alleviates the problems of the US contractor regarding resource levelling. US unions generally are contacted regarding the selection of appropriate labour. The unions' attitude is generally that if their construction industry is healthy, then their members will be employed, and they are prepared to adopt a flexible attitude to ensure that this is so.

(16) There is a more stable and predictable demand for construction in the US, and this provides for greater efficiency throughout the whole process of designing and work on site.

## 2 Cost control

**'Cost control of a construction project is primarily the responsibility of the quantity surveyor'. Discuss.**

The quantity surveying profession has gradually evolved over the past 100 years, although in more recent years there has been a rapid expansion of its services into new areas of work. 200 years ago architects were responsible not only for the design but also for the construction of the works in a more direct manner, and also for 'cost control'. In addition they often played an important role with engineering-type projects. Their overall importance, therefore, in the construction industry has diminished somewhat. Civil engineers used to accept (and regrettably some still do) that quantity surveyors were unnecessary. This stems largely from a misunderstanding of the work of the quantity surveyor and the work that he performs. Quantity surveyors, themselves, have often shown too much preoccupation with building projects at the expense of other types of work in the construction industry, and so have until recent years left cost control to ill-equipped architects, engineers and builders. Although these other members of the construction profession should be aware of the effect of their actions on construction costs, cost control should primarily be the province of the quantity surveyor.

The cost control of a construction project, or indeed any type of project, should start at the inception stage and not finish until the project is handed over to the client. Even then the final cost is still likely to be agreed, and there is scope for cost control of the recurring costs in use throughout the life of the building.

The following factors support the viewpoint that this area of responsibility is naturally that of the quantity surveyor.

- (1) Architects and engineers tend to prefer design, investigation and construction. They are not generally interested in measurement, valuation and cost control.
- (2) Engineers and architects are ill-equipped to deal with the complexities of cost control. Their training and education for this work is negligible and inadequate.
- (3) Quantity surveyors are, by contrast, specially trained to ensure that clients obtain value for money, and that payments due are the correct amounts.

The efficient system of cost control in the building industry is due largely to the efforts of the quantity surveyor. The days of the addendum bill have largely disappeared, and where a project is adequately designed and documented, the problems of claims, accepted in certain quarters of the construction industry, should not occur. Even amidst mounting pressure and cynicism, the quantity surveyor has been one of the few professionals in the construction industry to show signs of continuing development.

The cost control of major building projects has long since been the territory of the quantity surveyor, and he has an even more important role to play in the administration and cost control of minor or small works projects. However, the quantity surveyor does not necessarily use the same techniques for different types of project, but adapts his methods and processes for the type and size of project under examination. In the area of package-deal projects (which are assumed to be increasing in number), a wise client is always likely to retain the services of the independent quantity surveyor, not only for cost advice but also cost control throughout the duration of the contract.

The quantity surveyor is also the more suitable person for the cost control of engineering projects, such as civil engineering, process plant engineering and mechanical services within buildings. The argument that is often used for retaining outdated and inefficient methods where they still occur, is that the majority of other countries appear to 'get by' without the quantity surveyor. In recent years, quantity surveying and cost control methods have been used more widely (where they were absent before) in countries like the USA and in Europe. They have for many years been employed in countries that are members of the British Commonwealth.

The argument that the quantity surveyor is really a cost advisor and does not in practice control costs is merely a play on words. Quantity surveying is seen as the profession that undertakes the function of cost control within the building industry. It could be argued that since the designer is responsible for issuing and approving variations, he dictates the amount of extra works, and looks to the quantity surveyor for cost advice and for cost records. On the other hand, there is the point that since the quantity surveyor prepares the valuations for interim payments, he controls the cash flow between client and contractor. It can also be reasonably argued that during the design process without the cost 'control' from the quantity surveyor the project could get financially out of hand, as often occurred before quantity surveyors developed cost planning. The same argument would be used in support of post-contract quantity surveying services.

**'The cost control of engineering services in buildings is different from the approach applied to the other building elements'. Discuss this statement and comment upon the comparative cost efficiency of the services and building elements.**

Engineering services in today's modern buildings often account for over 30 per cent of the initial project costs. The percentage is often considerably higher than this, as environmental control inside the building becomes an ever-increasing requirement in the design. As a direct consequence of this approach, the costs to the owner after completion of the construction contract will represent a substantial annual charge for running, repairs and replacement charges. These sums will represent a large proportion of the costs in use for the project.

Traditionally, engineering services are undertaken by specialist contractors, and are therefore often incorporated within bills of quantities as prime cost sums. The budgets required for the cost plans are provided by the engineering services consultant. The design and specification (performance specifications are sometimes used) would also be prepared by this consultant. Bills of quantities were, and still are, somewhat unusual. The preparation of any other contract documents, inviting quotations, assessing and selecting tenders would also be undertaken by the engineer. The quantity surveyor's traditional role was therefore to accept lump sums for inclusion in the bills, allow for interim payments and adjust the Prime Cost Sum in the final account by means of an invoice.

The quantity surveyor is therefore able to control costs effectively for only about 70 per cent of the project. It has been correctly suggested that because this work is sub-contracted, so too is the function of cost control. There has, needless to say, been some rivalry between the quantity surveyor and the services consultant as to who should undertake the cost control of engineering services.

The ability to control costs can be described as cost efficiency. The whole process of cost planning developed by the quantity surveying profession seeks to achieve this objective and its efficiency can be measured by the end product. A sum is allocated as a target for an element, and as the design develops the quantity surveyor can realistically cost this design and compare it with the element target cost. In this way the effects on the costs of alternative design solutions can be made. Alterations can, therefore, be made to the design before the building work is started, in order to avoid abortive designs and to restrict overspending.

Adopting the traditional system for engineering services, the engineer will predict sums for the various engineering services based upon previous projects and expected future needs. The work will not be properly or adequately cost-analysed, and therefore no appropriate cost control can be undertaken until the design is completed. This may mean that if the final design is too expensive, some redesign will be necessary, resulting in a less than satisfactory project. Without some detailed form of cost analysis, design within a cost target will be difficult to achieve. Cost control throughout the contract period is both minimal and unsatisfactory. Either the contractor is assumed to have included all that was required, extra work is paid for on the basis of some vague change in the specification, or alterations are made to the price of the work on an ad-hoc basis.

Because the engineering services represent such a large proportion of the whole contract, if the cost control of this section is inefficient, then the entire cost control function for the whole project becomes questionable. There is little real merit in properly controlling only 70 per cent of the contract value, if the remaining part is not also subject to stringent requirements and accountability.

A more modern approach is to employ the quantity surveyor to undertake full cost control functions for this work using his already proven system. This has already been the method adopted on some complex engineering services projects, where the quantity surveyor has either been employed in his own practice or in the office of an engineering consultant.

## **Discuss the importance of cost research to the profession of quantity surveying.**

Cost research involves the examination of construction costs from any aspect either through the client's viewpoint or on the basis of the costs of a contractor's organisation. It also includes their effects on the economy and a development of the efficient use of resources. The purpose of such research is to develop a basic understanding that enables the planning, monitoring and controlling of all costs to be undertaken more effectively and with greater certainty.

Many quantity surveyors do not see research as a means of development either individually or for the profession in general. They are not alone in this opinion; it is shared by other professions within the construction and other industries. It stems from the fact that some research is done simply for its own sake, without any suggestion of useful practical application. But in even the best research projects, a large amount of research and investigation is needed to secure only a little progress. It is, however, generally accepted that research should be more carefully planned and monitored, and this would then secure greater advantages to the profession.

Cost research is carried out by many different sectors of the profession. A large proportion of research work has been undertaken by the universities and polytechnics, and the considerable increase in quantity surveying research is largely attributable to their staff. In addition, the professional institutions have adopted their own research programmes, often of direct application to the profession. However, the profession has not always been helpful in suggesting suitable topics for research, and there has always been resistance to change. Some professional practices have made significant contributions towards quantity surveying development, and several of the processes we now use are as a direct result of their ideas. Several government departments have also formulated their own research programmes to examine building cost aspects applicable to their own projects but often incorporating much wider applications. For example, within the Property Services Agency (PSA), a group named the Department of Quantity Surveying Services (DQSS) has, as part of its function, the investigation of the cost aspects of construction. There is also the valuable work of the Building Research Establishment (BRE), or the various trade associations who sometimes undertake cost studies as an aid to commercial expertise.

Accepting that research will be carried out, albeit by a minority of quantity surveyors, what advantages can the profession hope to achieve?

### **Science of quantity surveying**

The majority of the other professions have been in existence much longer than that of quantity surveying. They have therefore been able to establish for themselves an academic basis of understanding of their subject knowledge. Some quantity surveying procedures have been accepted without the basic formulation of the principles involved. This is not meant as a direct criticism of the profession or to invalidate the procedures used, but the present position must be to substantiate the theories and accepted practices of the quantity surveyor's work.



## **Understanding**

Understanding the economics of construction has been a new study, developing only during the past thirty years. The understanding of how costs are incurred is fundamental to a proper and efficient system of control. The research of the processes used can help us to complete our knowledge. This can then become the foundation of our accepted and future practices using sound knowledge as a basis rather than a series of rather general assumptions.

## **Techniques**

If one examines the processes used by quantity surveyors 100 years ago and compares these with the methods in existence today we can see a dramatic change. Many of these changes are in the form of the techniques used, and would not have been developed but for the pioneer work of a few surveyors who were dissatisfied with old-fashioned procedures. The profession can never stand still, and increased knowledge can help us to develop new techniques for the future.

## **Cost advice**

One of the quantity surveyor's roles in connection with any construction project is the provision of cost advice to clients and contractors. A proper understanding of the cost implications of construction will enable the quality of this cost advice to be improved. This is likely to place the quantity surveyor in greater demand, enhance his position and equip him for further roles in the future of the construction industry.

## **Results**

Cost research in recent years has necessarily become more mathematical, often requiring the knowledge of algebraic and statistical methods and the possible applications of operational research. Using these methods has meant an understanding based upon empirical tests rather than a simple rule-of-thumb approach. This has allowed the natural use and development of the computer to be harnessed in the cost planning and cost control function. Research has also helped us to foresee the wider use of bills of quantities, simplified methods of calculating cost fluctuations, the way other countries assess building costs, how to reduce claims and the accuracy and reliability of building prices.

## **Describe the quantity surveyor's process of cost control in connection with a construction project.**

Cost control embraces all methods of controlling the cost of construction projects within the limits of a determined sum, from inception of the scheme, throughout the design until final completion of the contract. The cost control of any construction project can be described under the following headings: