CONSTRUCTION PROJECT MANAGEMENT
- Martin Barnes

Martin Barnes has been a specialist in engineering and construction project management since 1968. His firm Martin Barnes Project Management, which is a member firm of Coopers & Lybrand (International), manages construction projects on a broad front for clients in the UK and assists with management on projects worldwide. He has advised on the management of megaprojects such as Eurotunnel, the Greater Cairo Wastewater Scheme for the Government of Egypt and the Eastern Scheldt Barrier for the Government of the Netherlands. He has been an adviser to the World Bank on dealing with inflation and multiple currencies on international projects and has been Chairman of the Association of Project Managers.

Martin Barnes assisted the Australian claims and disputes research project which resulted in the report entitled Strategies For The Reduction Of Claims And Disputes In The Constuction Industry. Mr Barnes has had a key involvement in the British Property Federation's BPF System and the ICE New Style Contract project and comments authoritatively in this article on project management.

An overview of the various factors involved in the management of a project is presented. Approaches to controlling performance cost, time and quality are examined: the importance of working to a programme and to a preconceived specification is stressed. An in-depth analysis of the management tasks at the design, construction and commissioning stages is given. Emphasis is placed on the precise roles of participants within a project, along with guidelines concerning the choice of management contract.

Keywords: **project management, performance cost, performance time, performance quality, specifications, roles, contract.**

Part 1: Controlling performance cost and time

Client's Objectives

The object of project management is to produce a completed project which complies with the client's objectives. Although this may seem a statement of the obvious, it is a starting point often forgotten as a project proceeds. Its importance is hard to over-emphasize. If the client's objectives have been clearly established, they should impact upon all the decisions made by other people involved in the project, from project managers through to designers making detail decisions and contractors confronting alternatives during construction and supply.

In simple terms, the client's objectives are always a combination of the objectives for performance of the completed scheme, for achieving this performance within a named cost or budgetary limit and for getting the project into use by a target date (see Figure 1). Knowing the relative importance of these three types of objective is essential for effective project management. Decisions taken for a project where minimum time is the overriding objective will be different in principle and in detail from those where achievement of a performance target is the overriding objective.

When projects are managed badly, the client's objectives are perceived differently by different people involved and they also change from time to time as the project proceeds. Good project management ensures that there is a widespread unity of view as to the client's objectives, and that this view is maintained throughout the phases of design, construction and commissioning of the new project.

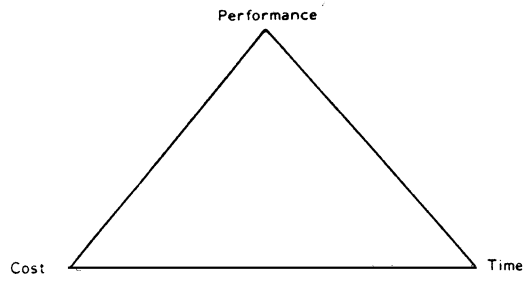

Figure 1. The client's objectives

Keeping within the Budget: Contingency Setting and Control

One of the ways in which the project manager exerts overall control of the project is by setting contingencies and controlling their release. Each specialist design group must work within the budgets set for them by the project manager, contingencies having been deducted. When each team sees the need to apply for release of a contingency, they should do so through the project manager. With all teams acting in this way, this enables the project manager to maintain overall control and ensures that he is brought into the decision each time an adjustment between the various sectors of the total budget is being proposed. Experience suggests that contingency allowances should be set very high indeed in the early stages of a project (see Figure 2). This is so that there is still some contingency left at the end of design and the beginning of construction stages and, more importantly, so that pressure to contain costs applies to design teams in the early stages. This is essential as it forces them to flush out cost problems when there is still some possibility for corrective action to be taken on the authority of the project manager.

The same considerations apply to setting contingencies and managing their release during the construction phase. For example, the contractor's project manager, in order to complete construction within the estimated budget, should adopt the same approach to setting and controlling release of contingencies to the managers in

charge of each section of the work.

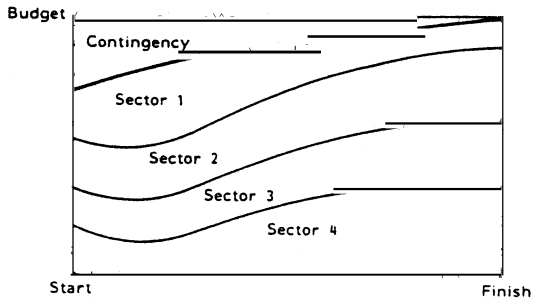

Figure 2. Contingency setting and control

Attitudes to Cost Control

There are many projects which have been completed within budget, although the paperwork and control systems were poor or even nonexistent. Equally, there have been many projects completed at considerable cost overrun although the cost control paperwork and systems were appropriate and handled efficiently. Of course, some of the former were projects where the budget was more than sufficient to do the work, a rare occurrence. Amongst the latter, there were many projects where the budget never was enough to do the work. However, experience shows that for the majority of people, completing the work within budget is attainable. It also shows that attitudes towards completing the work within the budget have more impact than the quality and efficiency of the paperwork and systems. The only projects which are certain not to exceed budget are those where the budget cannot be exceeded, where there is no way that extra money can be found. The next best way to run a project in order to achieve completion within the budget is to ensure that all those people making decisions affecting cost believe that the budget is an absolute top limit on expenditure. Experienced designers and construction managers will ensure that they keep enough money back to finish the job if they know that no more money can be found. They may still be taken by surprise by the totally unforeseeable cost consuming events, especially if they occur towards the end of the project. But, whether the budget is met or not is mainly a question of how pessimistic the individuals are and how strongly they are able to defend their wish to keep money back to cope with the unexpected.

If follows that, where completion within budget is the main objective of the project, establishing and sustaining the right attitude to control is all important.

Cost recording

The traditional approach to cost control taken from the manufacturing and service industries is to record costs accurately and compare them with the budget. Variances are calculated by subtraction for each component of a carefully broken down budget. Conventionally, very complex and carefully worked out arrangements for breaking down the budget are worked out, usually associated with a cost code. Conventionally, the more detail in which the costs are recorded the more detailed variances can be calculated and, in theory, the largest number and most effective prompts to corrective action are generated by the cost control system.

Although this type of system works reasonably well in manufacturing and service industries, it is very seldom of any use in construction project work. There are many reasons for this, the most important being:

- In construction, the rate of change of what is being done within an activity and from one activity to another is sufficiently fast in relation to the period in which cost data can be recorded, digested and distributed that the records are often irrelevant to control before they can be studied.
- The accuracy with which budgets can be set in the uncertain circumstances of construction makes a detailed breakdown of the budget too inaccurate as a basis for comparison. It produces too many wrong messages.

Cost forecasting

The style of cost control which is altogether more effective for project management activity concentrates on cost forecasting rather than cost recording.

If the work in a project is to be completed within budget, the effect of all decisions affecting cost must be forecast before the decision is made. Cost records, either from this project or from others, should be used to help make accurate forecasts, but they have no other influence upon budgetary control for the current project. They are, of course, useful for reconciliation with accounts and for providing feedback for estimating and decision making on other projects.

Each decision affecting the cost of the project has three stages. The options open have to be set out, a forecast made of the cost of each option and, having made the choice, the total cost forecast has to be modified according to the forecast cost of the option chosen. Obviously, if completion within budget is a fundamental objective, no option will be selected in any decision which has a forecast cost which will push the total forecast cost above the budget. The forecast cost is assessed in conjunction with the amount of the unexpired contingency.

Forecasting and Control

We can now examine the key areas of technique for keeping within the budget.

- Managers and the systems which they use must give good prompts for when a decision extending or improving the plan for the remaining work is necessary.
- Wide-ranging consideration should be given to possible actions.
- Good cost forecasts must be made of all the possible actions listed. A good forecast is one which is as accurate as it can be in the circumstances. No forecast is ever precisely accurate.
- The option chosen must be the one which fits best into the forecast cost for the total project.

Normally, if minimum cost is sought, this will be the lower cost solution. It will not always be the lowest cost solution because time and performance factors are usually of some relevance. At this stage, the use of the unexpired contingency allowance has to be considered. Having made the decision, the forecast cost of the chosen option is included in the total cost forecast for the total remaining work. This up-to-date total cost forecast should still be within the budget and remains available ready for use in making the next decision which is prompted.

This analysis of the process of cost control demonstrates that completing within the budget depends upon a combination of three principal factors which are:

- a well developed ability to prompt control decisions.
- an ability to make good cost forecasts.
- an effective policy for setting and controlling contingencies.

Early Warning and Early Decisions

Some useful points of technique arise out of this simple model of the budgetary control process. For example, all three of the main factors contributing to good control are made easier to put into effect if decisions are made early.

One of the most helpful things we do as project managers is to stimulate early decision making. Too often, those at the point of making design and construction decisions, due to normal pressure of work, concentrate of the immediate problems rather than the important problems. Simply requiring people to spend time looking further ahead and attempting to foresee problems which have not yet become urgent, will stimulate early consideration of decisions, better decisions and a greater likelihood of completing within the budget.

Information for Control

The same control model provides useful pointers to selection of the most appropriate information collecting systems for achieving good budgetary control. Essentially, these are systems which enable the overall cost model to be kept up to date easily and provide means of forecasting the effect of options upon cost. A modern computer-based cost-modelling systems fits this requirement very well, and produces conventional cost records for accounting and feedback purposes as by-products.

Other benefits are that the delegation of management decisions is encouraged and that measures to improve the accuracy of forecasts are properly considered and adopted. Appropriate and comprehensive site investigation is a good example of activity designed to make the selection of options realistic and the forecasting of cost more accurate. It has a very beneficial effect upon control and upon increasing the likelihood of completing within the budget.

Control of Time and Quality

Control of time and quality may be thought to be matters which effective project management has under good control. In many important respects, however, they are the neglected factors in project management. The nature of the neglect is similar in both sectors. The science of drawing up a programme of work and the science of drawing up a specification for the work to be done are both well developed. But the sciences of working to a programme and of working to a specification are not well developed. Far more programmes are prepared than are worked to and far more specification clauses are written or reproduced than are implemented without difficulty.

There is an implication that control of timing of work is synonymous with planning, as if all that was needed to control timing was to have a programme. This proposition is as untrue as the proposition that cost control is achieved simply by preparing a budget or estimate. Equally, control of quality is not achieved simply by writing a specification.

Working to a Programme

Improved attitudes to time control can be achieved by training, but is also assisted by adopting a series of relatively minor but collectively important techniques. A simple point which has a noticeable effect is to refer to the task of achieving key dates and completion dates as 'time control', not as 'planning'. The ramifications of this are that time-control engineers get out of the office and involve themselves with current activity rather than making detached and sometimes unrealistic plans. They are also accountable if target dates are not met. A time controller has to make sure that programmes are prepared, that they are realistic and that people are working to them. A planning engineer has only to prepare programmes; if they are not met it is somebody else's fault.

The technique for making cost-control work (described in Part 2) applies equally to making time-control work. Its principle is that decisions about the remaining work on the project should be taken with the advantage of using a forecast of the time effect of the option on which a choice is to be made. The choice should be of the options whose time effect fits into the overall time plan for the work. It is apparent that this statement of principle is precisely the same as that derived for cost control, except that the word 'time' has been substituted for 'cost'.

Time and cost are interchangeable in project management to a very large degree. Decisions made by project managers have cost and time implications and both should be considered in equal terms when decisions have to be made.

A simple device which is a good example of this improved attitude to time and control is in the conduct of site or project progress meetings. It is one of the simplest facts of project management that only what remains to be done can be controlled or managed. What has already happened is incapable of being influenced. Any time spent in management meetings in discussing what has already happened is likely to be a waste of management effort unless it is undertaken because of its relevance to a deci-

sion to be taken about the remaining work. Progress meetings should be conducted entirely on the basis of reviewing plans for the remaining work, discussing foreseen problems and their possible solutions and clarifying future information flows.

A point of technique which we try to use which stimulates this type of discussion and decision making is to confine progress reports to statements about what remains to be done. What has been done since the last meeting should not be discussed. To determine exactly what remains to be done is exactly the same process of measurement as to determine exactly what has been done. The difference is that reporting what remains to be done stimulates consideration of what remains to be done. Reporting what has been done stimulates either complacency or, quite frequently, disruptive discussions of who is to blame for things that have gone wrong.

Float Control

Setting float in a programme and controlling its distribution is exactly the same management function in the context of time control as setting contingencies and controlling their distribution in cost control. The approaches and methods to setting and distributing contingencies described in Part 2 are exactly applicable to setting and controlling the distribution of float in achieving time control. This means that the project manager must be the person who establishes float and that he should be generous in carving float out of the total time available in the early stages of the work under his control. This sets tight time targets for section managers, forces their problems into the open for discussion and solution, and has the other beneficial effects described in the context of cost control.

Similarly, distribution of the float as the work proceeds should be in the hands of the project manager. It should be released gradually according to a pre-decided pattern in the same way as described for the contingency allowance.

This is not often done. A lot of confused thinking takes place as regards policy for using float in programmes. Recognition that it is directly comparable with contingencies in cost control makes setting a policy very much easier, more realistic and more helpful in achieving time targets.

Quality Control and Specifying

This paper began with a reminder that project management is concerned equally with control of performance, cost and time. To conclude this part of the paper, we consider the proposition that control of the performance of the installation, building or engineering structure should be managed in the same way as the management of time and cost.

Techniques of quality management and quality assurance are fashionable words and are of growing importance in management generally. They are not as totally new as their advocates might imply. However, the traditional way of managing quality and performance of the completed installation in construction and engineering was deficient, and a new approach to it can produce marked improvement.

For example, specifications were traditionally written as an exercise in the pursuit of detail and the description of perfection. The result was that, in many sectors of engineering and construction, specifications were repeated unthinkingly from one project to another because it was just too much work to write one specifically for the next project. The actual standards of quality demanded of construction were less than the perfection stated in the specification and, not being written down, were a matter of uncertainty for the contractor and client. See Figure 3.

Modern methods of managing quality are very similar to those of controlling cost and time. It is entirely appropriate that these three factors are given appropriate weight in all management decisions. The fact that the three can be considered similarly is also revealing as an indication that, if the same principles of control can be applied to three apparently different factors, those principles are probably right.

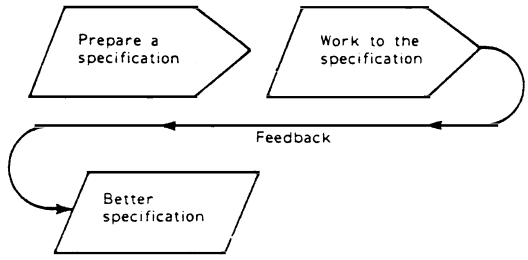

Figure 3. Quality control and specifying

Working to a specification

Working to a specification is as important to quality control as working to a programme is important to time control. It has just the same characteristics.

If the control is deficient, delays result and the lost time can be made up, usually at a considerable cost. If lapses in quality control occur, defective work can be removed and replaced, usually at a considerable cost. In both sectors, it is much better to have a good plan and fewer lapses than a poor plan and many lapses. A good plan in the quality control context is a good specification, and arrangements for working to it carefully made. It is now recognized that for the client's inspectors to work with the contractor to establish good quality control procedures before the work is done, is much more effective than walking around the site or the factory inspecting work already carried out and rejecting that which fails to meet the quality standards.

Quality management

The key words in control of cost and time are equally applicable to control and management of quality. Being taken by surprise is a symptom of poor management. Having to adjust targets downwards towards the end of a project is a symptom of bad management. This applies equally whether the target being missed is an overrun cost,

and overrun completion date or completed work not meeting quality and performance standards. They are all equally symptoms of poor management and management decision making with the same deficiencies.

Turning this around, it is perfectly valid to say that the project manager displaying foresight and practicality in setting targets for cost, time and quality, who makes decisions armed with forecasts of the effect on cost, time and quality and who controls the setting of float, contingency and space and their distribution around section managers, is in control.

This introduces the concept of space in quality control to be equivalent to float in time control and contingency in cost control. It means setting performance/quality targets at the beginning which can be relaxed if unforeseen circumstances make it necessary. This is an unusual concept in project management but the development of the analogy between quality, cost and time control presents it inevitably. It is not recommended that such space should always be made available but it is a matter of fact that construction projects are the victims of uncertainty and that decisions necessitated by the occurrence of the unexpected always have cost, time and quality consequences. if there is no space in the performance target, then float in time and contingency in cost are bound to be used up in dealing with the problem. If there is space in the performance requirement, it is likely that a solution will be found which does not require the absorption of more cost or time. it follows that, on a cost dominated project, it is essential to have performance/quality space, otherwise an absolute cost limit is unlikely to be achieved. Similarly, on a performance dominated project, the performance target is unlikely to be achieved unless there is significant spare time or money.

This analysis brings us back to the triangle of client objectives in Figure 1, which was our starting point in the consideration of project management.

Part 2: The management task at briefing, design, construction and commissioning stages

Design Stage Management

In too many courses and textbooks about construction and project management, concentration is put almost entirely upon the construction stage. In fact, many of the seeds of success and failure are sown during the design stage, and effective management of the design process is of major importance. This has two principal components:

- decisions taken during the design stage must all be directed towards achieving the client's performance, cost and time objectives.
- the design process itself must be well managed so that it is completed on time and within budget, and with all necessary decisions having been properly taken and fully and clearly expressed in specifications, drawings, etc.

It is the project manager's responsibility to make sure that design decision making is properly managed, although not to take design decisions himself. Similarly, it is his responsibility to make sure that the design process is properly controlled, but not to do the detailed management of the design process himself. In the experience of Martin Barnes Project Management, it is in these two areas that the project manager has his greatest influence over the whole project. In particular, imposition of the discipline that all significant design decisions are taken in the context of performance, cost and time forecasts made for each alternative being considered has proved to be important and effective. In the other sector of design management, ensuring that the design process itself is managed as regards time and performance is important. The cost of the design process itself is seldom one with which the project manager has to concern himself. This is because the costs incurred by a particular design consultant are in his own risk area. However, experience shows that, if the performance and timing of the design process are well controlled, the cost is usually controlled as a by-product.

Information For Design Control

Design management is a big subject, but there are small points of technique about 'information for control' and 'control of information' which are seldom discussed and which are worthy of being passed on.

For example, there are always several design agencies involved in a major project. In dividing the total design effort into packages for each agency, it is most important to identify the boundaries clearly and comprehensively. The design process has been unnecessarily slow on many projects because the exchange of information between designers has been ineffective the first time round. This can be avoided by, for example, when the design programme is set up, describing the information to be exchanged at various stages in detail rather than by name or by drawing titles.

The experience of Martin Barnes Project Management is that the frequent circulation of a rapidly revised action list amongst the members of the design team is not only a helpful source of information, but a powerful stimulus towards making rapid progress.

In the same vein, experience has shown that the design programme is more likely to be worked to if discussion and decisions at progress meetings are confined to refining plans for future action, excluding discussion of the past. Making plans for keeping to the programme or recovering lost time is altogether more fruitful than discussing the reasons why targets set previously have been missed.

In all the exchanges of information during the design stage, continuous reference should be made to the performance objectives set for the project and the quality standards of the components which these imply. This does not always mean pursuit of high quality; it means pursuit of appropriate quality. If every design decision is associated with a quality or performance statement, this important aspect of management of the project has a chance of being given proper emphasis and forethought.

Cost Control During the Design Stage

It is now reasonably well understood that most of the decisions affecting the cost of a project are taken during the design stage. It is therefore the stage at which establishment of effective cost control is most important. Design decisions have to be made with foreknowledge of their likely effect upon the cost of construction. This foreknowledge is never accurate, but no excuses for not making the forecast on the basis of inaccuracy should be accepted.

It is only by keeping the total cost plan for the work up to date by including all new forecasts made as each new decision is made, that a continuous total forecast to be compared with the budget can be made. Only in this way can appropriate pressure on design decisions resulting from overall budgetary control be established.

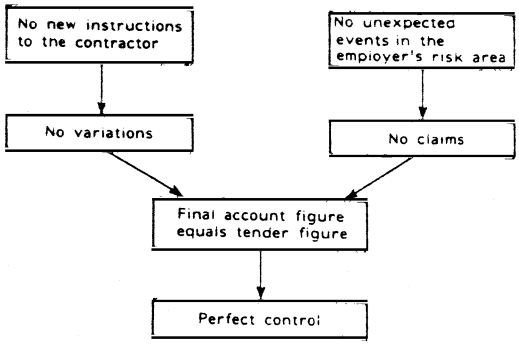

Figure 4. Control of variations and claims

Financial Control During Construction: Control of Variations and Claims

For discussion of these two important factors in financial control during the construction stage, it is helpful to consider how they originate.

To idealize the situation, if there were no new instructions to the contractor after the contract was awarded, there would be no variations. If there were no unexpected events which the contract placed in the employer's risk area, there would be no claims. If there were no variations or claims, the final account figure would be the same as the tender figure and all the employer's predictions of the cost of construction made once the contract had been awarded would be precisely accurate. This is one definition of perfect financial control (see Figure 4). There are other considerations such as cash flow and the contractor's internal financial control.

Perfection in financial control cannot be achieved. It is sometimes forgotten that perfection will be approached if

- the number and significance of new instructions to the contractor are kept to the absolute minimum.
- the likelihood of unexpected events is also minimized.

Minimizing new instructions

New instructions to the contractor can be minimized by taking practical steps before award of contract. Exhortation to the client not to change his mind or to the designers to complete the design are seldom effective.

Some practical measures to consider are the following:

Clear and robust brief for design.

Many unnecessary variations arise because the project team has allowed the client to leave briefing decisions untaken or unclear. A systematic interrogation of the client during briefing helps significantly in this area.

Minimal gaps in design.

The fewer gaps there are in the design at tender stage, the fewer variations are likely to be required subsequently. As exhortation is ineffective in this area, practical measures should be taken to ensure that the time spent during design is properly balanced. This means, for example, setting out a programme for design which leaves sufficient time for completing details, for obtaining information from potential suppliers and for coordinating mechanical and electrical installations. Arrangements must be made which ensure that the programme will be worked to.

Appropriate design.

Appropriate design means making design decisions to reduce the likelihood of new instructions to the contractor being necessary. Two recent examples are provided by building projects in the UK. In the case of a major property development, particular efforts were made to ensure that the building contained the absolute minimum of components, which might be inappropriate for the requirements of building tenants as yet unknown. Details of the design of the services were generalized in order to make the likelihood of changes when tenants were selected also minimal. In the other case of a complex of new high technology laboratories, the design of the laboratories was kept as flexible as possible so that development in technology would not necessitate changes during construction.

Minimizing unexpected events

Almost all the standard conditions of contract which are used in construction contain a list of events which, if they occur, entitle the contractor to additional payment and sometimes to additional time. Few standard conditions are laid out sufficiently logically that this list appears in one place. Usually, the items on the list are distributed around various clauses and obscured by the use of slightly or even considerably different wording in each place where an item on the list is concealed. It is usually possible for practical management purposes to extract the list. In the ICE Standard Conditions of Contract Edition 5, for example, there are 17 such statements.

In order to minimize claims, the list should be kept vividly in mind in the period before inviting tenders, and practical steps taken to minimize the risk of the events on

the list occurring.

For example, thorough site investigation reduces the risk of claims due to unforeseen ground conditions. Although this is a statement of the obvious, it is also obvious from experience that the extent and accuracy of site investigations carried out is often insufficient to effectively shrink the risk of unforeseen ground conditions being encountered. Other examples of tactical policies to shrink risks are minimizing the use of nominated subcontractors, ensuring that specified materials and suppliers will actually be able to make the contribution which is defined for them and checking all design details to ensure that construction interfaces are simplified.

This last factor includes analysing carefully the coordination of different building components, using a small number of construction trades wherever possible, designing so that the sequence of work eliminates repeat visits by trades and avoiding shared responsibility for achieving performance or quality targets.

Policy for Dealing with New Instructions and Unexpected Events

However energetic is the pursuit of the policies outlined in the preceding paragraphs, of necessity new instructions will arise and unexpected events will occur. When this happens, a policy for dealing with them is required. It should include the following features:

Ensure that matters are dealt with as soon as possible.

This may also seem like a statement of the obvious, but it is not always heeded. Too often, a new instruction is necessary because a shortcoming in the issued design information is revealed. Dealing with it is delayed because there is an element of admission of a shortcoming if it is confronted immediately. Dealing with the unexpected, for example, in ground conditions, is often not purposeful because the client's representatives believe that the contractor should have foreseen what has now been found and the contractor believes that he could not have foreseen it. Neither makes a proposal for dealing with what has been found in case it is seen as an admission of responsibility. Boldness is required; these attitudes must be cut away if new effective plans dealing with the situation are to be drawn up and implemented rapidly.

When paying for new instructions and unexpected events, ensure that good value for money is obtained.

The employer is entitled to get good value for money for extra payments to the contractor as he is for the payment which was envisaged at the tender stage. Equally, he is not entitled to underpay the contractor for additional activity carried out efficiently and in good faith. Use of bills of quantities and the rates which they contain to value variations and to compensate the contractor for unexpected events is often unhelpful in this context and can work against effective implementation of this policy. The probability of work varied at short notice or of dealing with an unexpected event having costs which are related in any way to the prices entered for work described in the tender documents is small. It is much more realistic, much more conducive to good relationships, and therefore to better management of the project, to assume that variations and unexpected events earn payment for actual costs efficiently incurred. This may seem like heresy to the traditional quantity surveying approach, but it is entirely in line with modern project management practice directed, as it is, to achieving the objectives of the client as the main goal for all activity on the project. It is based on a simple truth which surprisingly has taken so long to expose; that the project is most likely to be finished on time and within budget if the contractor is motivated to help achieve this. If he is alienated by the actions of people whom he believes to be adhering to the procedures of a contract which is unhelpful, the likelihood of achieving the client's objectives recedes and may even vanish.

Involve the client.

A third factor in establishing effective policy for dealing with new instructions and unexpected events is to involve the client in the process as effectively as possible. He should be kept informed when unexpected problems occur and the options for dealing with them which are being considered should be discussed with him. This ensures that his preference for choosing a 'low cost' or a 'quick completion' response to the problem is taken into account. It has other side effects which are beneficial to the management of the whole process. In particular, decisions affecting new instructions to the contractor often imply a change of brief from the client.

Part 3: Organization to achieve control; the role of the contract

Roles Contributing to the Project

Historically, the client has only a minimal role in the project. The work from decision to proceed until handover of a completed project was divided between a professional consultant (the engineer, the architect) and a contractor. Now and in the future, no such simple arrangement satisfies the pressures put upon the managers of the projects.

There must be a project manager, whether he is employed by the client or is a specialist consultant. There will be several designers and there are likely to be several contractors, or at least one main contractor and several subcontractors. The client himself has a more active role which he must fill effectively if the project is to be successful.

Few major projects are now successfully completed using the former arrangement. For each project, it is now advisable that the precise extent of the roles of the participants should be defined at an early stage (see Figure 5).

The tendency is towards an increasing role for the client, a more substantial and more rapidly increasing role for the project manager and an increasing role for the subcontractors and suppliers. The role of designer/manager, typified by the traditional role of the engineer and the architect is shrinking. This is not only because the management responsibilities they formerly took are being taken by the project manager but because more of the design work itself is being carried out by the contractor or his subcontractors and suppliers.

Management Strategy

The client for a project makes major early decisions about the contents of the project and the objectives which it is to satisfy. These decisions are essentially those taken during the feasibility study stage. His chances of achieving these objectives are heavily influenced by major decisions taken in parallel affecting the strategy for managing the project which is chosen. The choice of management strategy is as important a decision as the choice of technical solution which identifies the physical contents of the project. In the past, few options existed for management strategy; there was only the normal way of organizing design and construction. Now the options are many. A choice between them must be made which will give the highest probability of achieving the client's objectives in terms of performance of the completed project, its cost and how long it takes to bring into use.

Depending upon the particular combination of the client's objectives in terms of performance, cost and time, different roles will be established for the project managers, the designers, the contractors and the subcontractors and suppliers. The roles must be established in terms of their nature and extent and the boundaries between the responsibilities of the various contributors to the total scheme.

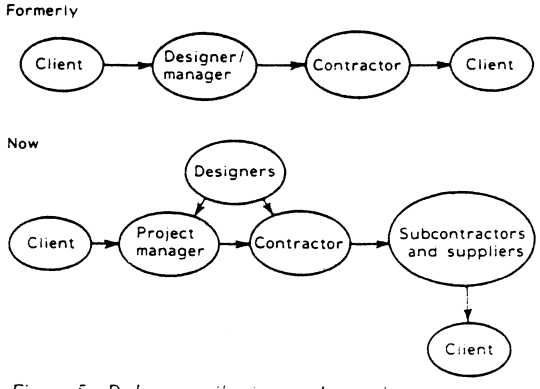

Figure 5. Roles contributing to the project

The Project Manager

The role of the project manager varies from project to project. For the role to be performed comprehensively and effectively, the project manager should be identified and brought into action right at the beginning of the project, and should remain in control until the completed installation is operating satisfactorily.

The duties which sensibly make up his role are as follows:

- definition and achievement of the client's objectives,
- selecting and implementing management strategy,
- appointing and instructing other members of the team,
- overall control of performance, cost and time,
- setting up and maintaining interparty information flows and planning.

However, it is not uncommon for some of them to be undertaken by the client himself and for them to be linked with those of the designer when the circumstances are favourable to this approach.

However the project management role is defined, a review of the list of duties which make it up shows that it is no longer possible to expect a project to be managed satisfactorily without the role being performed. The age of amateurism in project management is passed. All project management is an important contribution requiring professional people to carry it out. They need to have specialized training and/or expertise and to be able to apply modern techniques in their field effectively, just like any other professional person.

Management Factors Influenced by the Contract

The choice of the right type of contract both for the project as a whole but also for the various design contributions, subcontractors and suppliers is an important area for project management decisions.

The factors over which it has a dominant effect include the following:

- the opportunity which the client has, through his project manager for control,
- the strength of the contractor's motive to achieve the client's cost, time and performance objectives,
- the allocation of risk in total and in particular between the client and the contractor.

There are other subsidiary factors, each of considerable importance. These include cash-flow implications, responsibility for design and construction defects, method of dealing with variations and responsibility for providing information to the client, etc.

These considerations should not be seen as a matter of setting up contracts to minimize a client's exposure to risk. A more objective approach to deciding on the contract arrangements leads to proper motivation of contractors and proper scope for management of the project on behalf of the client. Without these two things, a complex, fast-paced construction project to be designed and built in a climate of uncertainty is most unlikely to be managed effectively in the interests of either the client or of the contractor.

The Principal Choices

The principal types of contract available are

- lump sum
- measure and value
- target cost

- cost reimbursable
- management
- design and build
- BPF/new style

The first two, lump sum and measure and value account for by far the majority of construction contracts. The next four are used less frequently but are highly specific to projects having particular problems and characteristics. The last option on the list, the BPF/new style contract, is perhaps the most recent development and is only yet in use on a handful of medium-sized building projects in the UK.

As the characteristics of the lump sum and measure and value contracts are well known, it is perhaps most helpful to make some comments on the target cost, cost reimbursable, management and design and build alternatives.

Target cost

This type of contract is most often used on projects in developing countries and in other situations where a high total risk must be allocated between the client and the contractor. The basic arrangement is that the contractor is paid his actual cost but that his payment is adjusted according to whether the actual cost exceeds or is less than a target set at the beginning. If the share of the difference between the actual cost and target is 50% to the client and 50% to the contractor as far as cost is concerned, the client and contractor have precisely equal incentive to save money and in cooperating to choose solutions to the problems which emerge. That is the theory, but in practice it is not easy to achieve such a clarity of shared incentive.

It is normal to have a procedure for adjusting the target in the same sort of circumstances that contract prices are adjusted in conventional contracts. This can result in the contractor putting just as much energy as usual into trying to ease up the target and rather less energy than might be hoped into easing down the actual costs. There are also some quite complex administrative matters which have to be dealt with carefully in target cost contracts and which can become quite costly to operate.

Cost reimbursable

Traditionally, this type of contract was regarded as one which led to wasteful expenditure on behalf of the client. This view is not now so widely held. This is because the cost-reimbursable contract provides the client, through his project manager, with the greater scope for controlling construction activity. Where the uncertainties of the nature and extent of the work to be done are considerable, such as in emergency work, highly innovative work and work whose nature can only be determined as it proceeds, this type of control may not only be necessary but highly beneficial to the client.

Management contract

The basic characteristic of a management contract is that the main contractor is paid the actual cost of the work carried out by subcontractors and that all work is carried out by subcontractors. The main contractor is paid a fee.

This method of contracting has taken hold very rapidly in the building industry in most developed countries. It is known as construction management in the USA.

It has the principal advantage of giving the contractor a strong incentive to act always in the client's interests. It therefore makes it easier for the contractor to have a helpful influence on the design and ensures that he is motivated to foresee and minimize the effect of problems rather than to 'let them happen' and generate extra costs and claims. The method can produce problems in relation to time overruns and latent defects. The system will usually save time overall because it permits design and construction to be overlapped.

Design and build

For no single clear reason, the proportion of major and minor construction projects in which design and construction is placed in the hands of one entity is increasing. This can be seen in ordinary building projects and also in certain heavy civil-engineering projects, such as roadworks and public health projects.

An obvious advantage of this arrangement is that the contractor's knowledge of construction methods can be brought fully to bear on the design decisions with resulting economies of cost and time. Similarly, problems of responsibility for defects are clarified as responsibility for design is not separated from responsibility for construction.

In the building sector, it used to be thought that contractors could only design relatively simple buildings such as warehouses and factories. Now, more complex buildings and those where a significant architectural input is required are also being carried out by design and build.

The actual conditions of contract for design and build have still not entirely settled down. Issues of responsibility for design at the boundary of the client's requirements and the interpretation of these by the design and build contractor are still under consideration. In principle, there is no reason why there should be more difficulties at the client/design and build contractor interface than there have always been at the client/designer interface.

Specific Risk Allocation

Having chosen the form of contract to use, further smaller decisions can be made affecting the allocation of specific risks between the contractor and client. Traditionally, this was carried out by using special conditions of contract appended to the various standard forms of general conditions of contract. This had dangers of conflicting and imprecise drafting but was often necessary to tune the conditions of contract to the particular circumstances. It is still necessary and modern conditions of contract will allow this to be done in a less dangerous way.

The principle to be followed in deciding upon specific risk allocation should be that if any particular risk is unusually severe in a particular contract and is outside the control of the contractor, it is best that it should be carried by the client. This is because the client will then carry the

cost of whatever element of the risk eventuates, not the cost which the contractor thought fit to allow in his tender to cover the risk. It also frees the contractor to manage those things which he can control, which is in the interests of the client in the long run.

The disadvantage of taking specific risks off the contractor is that the motive for the contractor to minimize the cost of dealing with the risk is also removed. The most important consideration is that if the total risk carried by the contractor is too great, the tendering process is likely to yield as the lowest contractor, the one who has most massively under-estimated the risks. He is also likely to be one of the contractors who has least confidence in the technology required. The almost inevitable consequence of this is that the contractor get into difficulties, both technically and financially. When this happens, the outcome for the client is almost always unsatisfactory. Consequently, it is vitally important to ensure that the total risk carried by the contractor is not excessive. This can be done either by using one of the forms of contract which apportions risk in total in a particular way or by eliminating particular heavy risks on the contractor using a conventional form.

Sometimes the opposite effect is required. On a recent major marine project, for example, cost and time overruns of horrific proportions were being forecast by the client when a cost-reimbursable form of contract was being used. This left the contractor with no risk but also with very little incentive to keep costs down and to work to target dates. The corrective measure taken by the client was to negotiate a change of contract conditions halfway through onto a target cost arrangement. This necessarily involved a substantial single additional payment to the contractor to compensate him for carrying risks which he had not formerly carried. However, the effect on cost and time of the contractor's new incentive was considerably greater than the single initial cost and the outcome of the project on completion was no worse in cost and time terms than had been forecast at the time the shift of contracting arrangements was made.

The BPF System and the New Style Contract

These new developments are as yet confined to the UK. Both were developed by Martin Barnes Project Management.

The BPF system was designed for the British Property Federation. Its objective was to produce a management system and conditions of contract which were based upon good modern project management principles and techniques. It was hoped that their use would produce completed buildings of better quality in a shorter time and at lower cost than the somewhat cumbersome conventional system. At the same time, the system was to be designed so that well managed and technically competent contractors could be more confident of making profits from their work. These may seem like idealistic and somewhat conflicting objectives. However, early use of the system is showing that it does produce the advantages sought despite initial opposition from the professional and trade bodies which was voiced loudly when the system was first published. It is too early to say what its advantages and disadvantages are in practice, but the early indications are very promising.

The new style contract is a similar development being undertaken for the Institution of Civil Engineers in the UK. It will also embody up-to-date management principles, but has the additional objective of being applicable to a wide range of engineering projects, not just civil engineering, and of embodying the target cost, cost reimbursable, design and build and management contract options. The opportunity is also being taken of drafting conditions of contract which are altogether more brief and clear in their wording. The object of this is not only to make administration and management of contract easier (and easier to learn) but also to shrink the incidence of disputes and claims which as come to characterize the traditional methods.

Clarity and Simplicity

Whatever arrangements are made for contact responsibilities on projects, it is fundamental that the resulting documents should be as clear and brief as possible. The heavy incidence of disputes both at project level and in arbitration and litigations which is now experience is in part due to increasing commercial pressures on contractors and clients, but it is also heavily related to the lack of clarity and simplicity of the contract documents that are used. This not only applies to the conditions of contract themselves but also to specifications.

The majority of disputes arise from one of two causes. Either someone involved in the project is taken by surprise by an event and resists paying the consequences, or the contract documents leave scope for two interpretations of what was intended. Often, of course, a dispute has both these elements. Better site investigation, more thorough detailing of design and more careful checking of the availability of specified materials and components can dramatically reduce the incidence of surprises. More careful drafting and checking of specifications and special conditions of contract has a big impact upon the second group of disputes.

It is not necessary for conditions of contract or any other documents to be worded in complex legal phraseology and jargon. Modern contracts can be written in a simple style which, amongst other benefits, makes the likelihood of disputes arising on international contracts very much less.

In setting up contracts, it is not uncommon for people knowingly to sow the seeds of dispute. For example, statements made in letters accompanying tenders are often worded in the hope that the client will not believe that they are qualifications to the offer, but in the hope that, if it becomes necessary, they can be regarded as qualifications.

Adding extra clauses to contracts and specifications in order to plug the loopholes from the last contract often opens up more holes than it plugs. Contradictory or confusing provisions are fertile ground for disputes.

If disputes do arise, they are always best settled as

quickly as possible, whilst they are still small. This almost always involves a loss of face by one side or the other, or both. This must be accepted and accommodated, as the alternative is a steady and rapid deterioration of relationships on the project with cooperation discarded. Nothing is more certain to result in an unsatisfactory project for the client and the contractor.

- **First published in the International Journal of Project Management.**

NEW QUALITY ASSURANCE STANDARD FOR THE BUILDING AND CONSTRUCTION INDUSTRY

One of the more tangible and immediate benefits arising out of the Joint Working Party on Claims and Disputes established by the National Public Works Conference and the National Building And Construction Council last year has been the NPWC/NBCC initiative in conjunction with Standards Australia to develop a new Quality Assurance Standard for the building and construction industry. There is an ambitious programme for this project. It is intended by the QA committee members that a public review draft of this new Standard should be available about August 1990 and that the Standard should be published late in 1990 or early in 1991.

Since 1987, AS2990 - Quality Systems for Engineering Construction Projects (which is based on the Canadian Standard CZ2990) has been used on an increasing basis within the building and construction industry.

However, there have been many complaints about the applicability of AS2990 for the industry, particularly due to the terminology and format of the Standard, the consequent comprehension difficulties many have experienced and the difficulties many have experienced in implementation. This is in part due to the fact that the original Canadian Standard was developed for the power generation industry for power station construction projects and not specifically for the building and construction industry.

Since AS2990 came into use, Standards Australia has also published a new series of Quality Systems Standards known as AS3900-4, which are identical to the International Standards ISO 9000-4 series. However, this new AS3900 series is also considered to be not entirely suitable for application in the building and construction industry.

Consequently, the NPWC/NBCC Joint Working Party into Claims and Disputes has requested Standards Australia to establish a committee to write a new document specific to the Australian building and construction industry in "user friendly" terms.

Standards Australia has agreed in principle to this concept. Therefore, it is likely that the new document will:

- be designed for use in the building and construction industry and accurately reflect the industry's requirements;
- be a definitive stand alone document consistent with the AS3900 series so as to comply with the current government policy to use existing International Standards where they are available;
- contain any additions to the provisions of the AS 3900 series considered necessary to satisfy the requirements of the building and construction industry;
- use clear logical language and easily understood terms which are appropriate for and familiar to the building and construction industry;