# *Modelling the construction projects using plans of work*

# Modelling the construction process using plans of work

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**Abstract**

An overview of organization in the construction industry is identified from plans of work published in the UK. This provides a basis for identifying the essential steps through which any construction project must pass. It is shown that all construction projects pass through a set of stages of work, consisting of Inception, Feasibility, Scheme design, Detail design, Contract formation, Construction and Commissioning. Although there may be changes to the sequence and importance of these stages, their identification helps in making judgments about organizational structure on construction projects.

**Résumé**

Au Royaume-Uni, une idée générale de l'organisation dans l'industrie du bâtiment est identifiée à partir des plans de travail. Ceux-ci établissent une base pour l'identification des étapes essentielles auxquelles chaque projet de construction doit être soumis.

On peut montrer que tous les projets de construction passent par une série d'étapes de travail qui consistent des suivantes: la conception, la faisabilite, le dessein du schema, le dessein du detail, la formation des Contracts, la construction et la commision. Bien que il se peutque il y âit des changements a l'ordre et l'importance de ces sujets, leur identification aide à faire des jugements sur la structure organisationelle sur les projets de construction.

## 1 The need for a comparison of organizational approaches

Many of the management structures used for construction projects are inappropriate. They have developed from outdated views of management (Neale, 1984) and the needs of professional institutions, rather than clients (Andrews, 1983). There is a clear need for a flexible, adaptable organizational structure

for building projects. The current economic, political and technological changes that are taking place create an unstable environment for the industry. Thus, as Biggs states, the organizational forms that are now required cannot be styled on status quo and tradition as they often have been in the past (Biggs, 1985). The RIBA Plan of Work is well known in the UK building industry, yet commentators readily acknowledge the limitations of plans of work. One of the main criticisms levelled at them is that they are inflexible and only suited to a limited range of jobs.

If systematic descriptions and quantitative comparisons are to be meaningful, they must be done from a common base. This requires common points of reference between different projects (Hughes, 1989). With a wide definition of project structure, it becomes unusual to find points of comparison between different projects. In order to be able to make comparisons, some order should be imposed. Cleland & King (1975) achieve this in their process of organizational analysis by identifying a "normative" model, against which their observations may be compared. A similar approach is needed for the analysis of construction project organization. This can be developed from the plans of work recognized by the industry.

Every project goes through similar steps in its evolution in terms of stages of work. The stages vary in their intensity or importance depending upon the project.

## 2 Analysis of plans of work

This analysis compares seven plans of work. They have been chosen to typify the variety of such plans of work, and the sample includes text books about construction project management. They are described below, and summarized in Table 1.

**Table I**: Summary of plans of work compared

| G. Peters | CAPRICODE | Austen & Neale | BPF | PSA | M.D. Finn | RIBA Plan of Work |
|---|---|---|---|---|---|---|
| IDEA | - | - | - | - | - | A Inception |
| IDENTIFICATION | APPRO IN PRINCIPLE | - | - | - | - | - |
| - | Inception | - | CONCEPT | PRE-DESIGN | - | - |
| - | Define objectives | - | - | - | - | - |
| - | - | - | Appt of Client's rep | - | - | - |
| - | Consider options | - | Devel of concept | - | - | - |
| Select prefd option | Select prefd option | - | Outline brief | - | Client's init brief | - |
| Examine need | - | - | - | Need definition | Nature of the devel | - |
| ID corporate plan | - | - | - | - | - | - |
| ID funding limits | - | - | Outline cost plan | - | - | - |
| - | Appro in principle | - | - | Need evaluation | - | - |
| FEASIBILITY | - | - | - | - | Feasibility study | B Feasibility |
| CONCEPTUAL ENG'G | BUDGET COST | - | - | - | - | - |
| Prelim process design | - | - | - | - | - | - |
| Preliminary layouts | - | - | - | - | - | - |
| Invsgt std designs | - | - | - | - | - | - |
| Design brief | Scheme brief | BRIEFING STAGE | PREPARATION OF BRIEF | - | Confirm instns | - |
| PROJECT STRATEGY | Proceed to design | Work plan | Appt of design leader | - | Appt project manager | - |
| Choose designers | - | Appoint designers | Appoint consultants | - | - | - |
| - | - | User requirements | The Brief | Site & brief | Site identification | C Outline proposals |
| - | Sketch design | (Sketch scheme) | - | - | - | D Scheme design |
| Resource examination | - | - | - | (Resource planning) | Financing | - |

| G. Peters | CAPRICODE | Austen & Neale | BPF | PSA | M.D. Finn | RIBA Plan of Work |
|---|---|---|---|---|---|---|
| Plan phasing | Devel control plan | (Planning) | - | - | - | - |
| - | - | - | - | - | Acquire interests | - |
| Project programme | - | Programme the work | Master programme | - | - | - |
| Scope of project | - | - | - | - | - | - |
| ESTIMATE | - | - | - | - | - | - |
| Decide accuracy | - | - | - | - | - | - |
| ID work packages | - | - | - | - | - | - |
| Establish data base | - | - | - | - | - | - |
| Cost packages | - | - | - | - | - | - |
| APPROVAL | - | - | - | - | - | - |
| Financial evaluation | Budget cost | Cost estimates | Master cost plan | - | - | - |
| Details of funding | Procurement method | - | - | - | - | - |
| Evaluate options | Scheme validation | - | - | - | - | - |
| Select prefd option | Budget cost approval | - | - | - | - | - |
| EXECUTION | - | - | - | - | - | - |
| DETAIL ENG'G DESIGN | DESIGN | DESIGNING STAGE | DESIGN DEVELOPMENT | DESIGN | - | - |
| Detail design spec | Design brief | Finalise brief | - | Outline design | - | - |
| - | Proceed to design | - | Appoint consultants | - | Appt design team | - |
| - | - | Tech investigations | - | - | Statutory consents | - |
| - | Design development | Scheme design | Priced programme | Final sketch design | Design phase | - |
| Perform design | Detail design | Detail design | Devel of scheme desn | Detail design | - | E Detail design |
| - | - | - | TENDERING & DOCN | Contract preparation | - | - |
| - | - | - | Tender documents | - | - | F Production Info |
| Prepare tender drwgs | Production info | Wkg dwgs specs & BQs | Prep of drawings | - | - | G Bills of Quantity |
| Record changes | - | - | - | - | - | - |
| Design review mtgs | Pre-tender checks | - | - | - | - | - |
| (contd.) | | | | | | |
| TENDER PREP & EVAL | Proceed to tender | - | - | - | - | - |
| Contracts Spec | - | - | - | - | - | - |
| Bills of Quants | - | - | - | - | - | - |
| Contract estimate | - | Final cost estimate | - | - | - | - |
| - | - | Production programme | - | - | - | - |
| - | TENDER & CONTRACT | TENDERING STAGE | - | - | Tendering/Cont negn | H Tender action |
| - | Select tenderers | Pre-selection | - | - | Tender package | - |
| Issue tenders | Invite tenders | Invitation | Tender invitations | - | - | - |
| - | Receive tenders | - | - | - | Tender results | - |
| EXPENDITURE APPROVAL | - | - | - | - | - | - |
| Recommend contractor | - | Selection | Select contractor | - | - | - |
| Eval contract price | - | - | - | - | - | - |
| Appro expenditure | Contract programme | - | - | - | - | - |
| Issue drwgs contract | Award contract | Contr documentation | - | - | - | - |
| - | CONSTRUCTION | CONSTRUCTION STAGE | CONSTRUCTION | CONSTRUCTION | Construction phase | - |
| ADMINISTRATION | Constsn preparations | Production planning | - | Constn planning | - | J Project planning |
| Mon'r cost time & qly | Exec & control wks | Site operations | All construction | - | - | - |
| Record variations | - | - | - | - | - | - |
| Regular valuations | - | - | - | - | - | - |
| Cont progress mtgs | - | - | - | Constn control | - | - |
| COMPLETION | Completion of works | - | - | Constn completion | - | K Completion |
| Commission | - | COMMISSIONING STAGE | Takeover com & maint | - | - | - |
| - | - | Record drawings | - | - | - | - |
| Approval of work | - | Inspection of bldg | - | - | - | - |
| Completion cert'cate | Final account | - | - | Contract completion | Final account | - |
| - | COMMISSIONING | - | - | - | - | - |
| - | Commissioning brief | - | - | - | - | - |
| - | Commissioning preps | Op instns & maint man | - | - | - | - |
| - | Building handover | - | - | - | - | - |
| - | Building opening | - | - | - | - | - |
| - | - | - | - | POST-CONSTRUCTION | - | - |
| - | EVALUATION | - | - | - | - | M Evaluation |
| - | Eval scheme devel | - | - | Building operation | - | - |
| - | - | - | - | Maintenance | - | - |
| Monitor performance | Eval scheme operation | - | - | Performance appraisal | - | - |
| - | - | Train staff | - | - | Appt letting agents | - |
| - | - | - | - | - | Managing the devel | - |
| - | - | - | - | Improve/dispose | Disposal | - |

## 2.1 "Project management & construction control"

Peters (1981) explains in detail the procedures that should be adopted when managing a project. He embraces the idea of the project being a "dynamic and ever-changing system". The Project Manager's role is emphasized. His stages of work are summarized in column 1 of Table 1. Overall, this is the widest range of tasks of all of the plans of work.

## 2.2 "Capricode"

The second plan of work examined is "Capricode" (DHSS, 1986). It is a mandatory framework for managing capital building schemes in the health service. The framework is independent of monitoring and control systems, which are expected to vary according to circumstance. It is expected that professionals' contributions will vary, and that the management pattern will change from one stage to another. Capricode is summarized in column 2 of Table 1.

## 2.3 "Managing construction projects"

Austen & Neale (1984) emphasize the essential nature of good project management and the need for careful planning in the early stages. They recognize that there are general principles and internationally accepted practice with regard to project management. Thus they describe basic guidelines which may be construed as a plan of work. Column 3 of Table 1 shows their perception of the development process.

## 2.4 The british property federation

The "Manual of the BPF System" (British Property Federation, 1983) splits the process into five major stages (see column 4 of Table 1). Flexibility is intended, so the system does not try to prescribe the exact organizational structure. Each stage is definitely punctuated by a client decision about whether or not to proceed with the project.

## 2.5 Property services agency project management guide

The PSA Plan of Work (Property Services Agency, 1984) is intended to be the framework for all project management structures in the UK government building programme. Its purpose is to outline the management procedures only, and not the technical steps that have to be undertaken. The majority of the guide is intended to be applicable to all types of project. Stages and sub-stages are punctuated by decision points. See column 5 of Table 1.

### 2.6 "Project management in development"

Finn (1984) has summarized his experiences of managing property development projects in the form of a checklist. This is a project management guide. His list draws together 237 separate activities which have to be done for the successful management of the project. Priorities and dependencies are not considered as the whole is only intended as a checklist. It is summarized in Table 1, column 6.

### 2.7 RIBA plan of work

The RIBA Plan of Work is the best known and most comprehensive set of documentation (RIBA, 1980). It is not intended to be specific to any one kind of project, neither is it intended to be immutable. It is the intention that by following the plan of work, "an architect may concentrate on architecture, rather than on management". There is much detail allocating responsibilities to particular consultants at every stage. The stages are shown in Table 1, column 7.

## 3 Comparison of plans of work

The seven plans of work summarized in Table 1 clearly have much in common. The horizontal lines highlight their commonality. These lines approximate to major decision points, loosely fitting all of the plans of work. It is the variation between projects that is the cause of confusion and poor definition of management structures. These are exactly the problems which the plans of work seek, and fail, to overcome.

Many of the plans of work have little in common with a "systems" view of management, offering little more than a check list. The key features which seem to be underplayed are control, and boundaries. Control is in most cases interwoven with the activities to such an extent that it is hard to distinguish it. The boundaries to systems and sub-systems are not explicitly defined, as such: But Capricode, PSA and RIBA plans of work take decision points as being the boundaries to sub-systems. These decision points serve to punctuate stages of work. The extent of commonality amongst the plans of work is clear when these major decision points are examined. Plans of work with no overt identification of such decision points still exhibit patterns which are common to all projects. Accordingly, the lines drawn across the columns of Table 1 show the occurrence of these decisions punctuating the lists of tasks. These lines lead to the identification of eight major decision points which will be common to all construction projects, and these have been extracted on to Table 2.

**Table II**: Decisions and stages of work

| |
|---|
| **Inception:** Define need & determine financial implications and sources. |
| **Feasibility:** Preliminary designs, costings & investigation of alternatives. |
| **Scheme Design:** Programming, budgeting, briefing, outline design etc. |
| **Detail Design:** Development of all sub-systems within the design, detailed cost control, technical details etc. |
| **Contract:** Contract specification, pricing mechanism, sufficient documentation for selection of contractor etc. |
| **Construction:** Execution and control of all site work & associated activities, further contract documentation. |
| **Commissioning:** Snagging, operating instructions, maintenance manuals, opening ceremonies, occupation, evaluation, managing the facility, staff training etc. |

The stages in Table 2 may take place in a variety of sequences; indeed, some stages may overlap. However, although the sequence may vary, the stages of work remain sequential. Examples of two common procurement methods are given in Figure 1. This shows stages of work in relation to decisions which punctuate them.

The top example, the traditional method of procurement, shows a typical pattern. The first of these decisions is the decision to adapt to external influences, which acts as the trigger to the process of building procurement. It is during this stage that the need for the project is identified, in terms of corporate planning and funding limits.

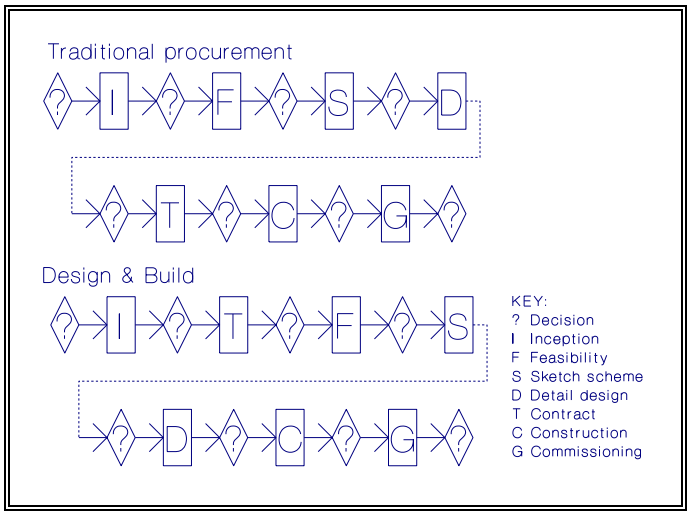


**Figure 1**: Examples of procurement processes

The second decision triggers the Feasibility stage of work, i.e. preliminary designs, investigations of alternatives and costings of the possible solutions. The result of this stage enables the client to take the third decision; that the preferred solution, is feasible and the project can go ahead.

The third stage is Scheme Design. The client will be interacting with the designers, briefing and identifying user needs, and approving sketch designs. The designers will be interpreting in detail the client's requirements. At the end of this stage, it is usual for the design team to wish to freeze the brief, and the client should be prepared to do this as far as possible. (However, at the same time the project team must be willing to acknowledge that as the project progresses the circumstance of the client will be subject to environmental influence, and thus the client's requirements will be subject to unavoidable

change.) The decision at this point is that the design is acceptable, within cost limits and is an adequate interpretation of the client's requirements.

The fourth decision point triggers the Detail Design stage. This is where the consultants develop the design and achieve integration of all of the various sub-systems of the building (structural, services, circulation etc.). The technical problems of design have all to be worked out and statutory consents checked.

The fifth decision point is that the contractor can be selected. The design is sufficiently advanced for the specifications, bills of quantities and tender drawings to be issued, and for the tendering process to commence. It is this stage which is subject to the most variation between procurement methods. For example, if buildability is a key requirement, then the contractor may well have been selected at a much earlier point in the process. The lower example in Figure 1 shows how the stages of work might be arranged for a Design & Build procurement pattern. In this case, the documentation used for selecting the contractor is very different.

The sixth decision point is that the project is ready for commencement on site. This stage simply contains all site-related activities, including further documentation and design work brought about as a result of the emergence of further information.

The seventh decision point is that the building is ready for commissioning. The identification of this particular decision point removes the problem of identifying the completion date, with the associated problems of final account which can drag on for years. The involvement of construction professionals in the commissioning stage will vary greatly between projects, but ought to be clear from the outset. The final decision point, that the project is complete and all contractual obligations discharged is occasionally difficult to pin down to an exact point. This is because there are often several different contracts which have to be discharged. Usually contractual completion may be taken as the finish point to the building project. In the cases where it may take several years to fully discharge a contract (in terms of liabilities and remedies) this decision point is defined as the decision by the client that the project is concluded. Thus it is dependent on the particular client and the particular project.

# 4 Conclusion

This brief analysis shows that the tendency in the construction industry has been to prescribe activities on construction projects to too great a level of detail. If progress is to made in analysing project management structures, the description of the activities taking place needs to be more systematic, and done in such a way that different consttruction projects can be related to each other. It is more useful to concentrate on

the genuinely common aspects between projects, than to begin analyses by describing the unique features of a project. The uniqueness is at a greater level of detail than the commonality, and therefore it should be modelled as such.

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