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TASKS AND PROCESSES OF THE CONCEPTUAL PHASE FOR CONSTRUCTION PROJECTS

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ABSTRACT

The genesis of understanding the productivity behaviour of the construction process is underpinned by analysis and synthesis of tasks and processes within each of the main construction phases: conceptual; detailed engineering; and construction. Analysing and synthesizing tasks in any process is an accepted notion since the days of the Greeks, and the Romans. It is also a common feature of many modern productivity studies, Total Quality Management, and Benchmarking.

It is generally accepted throughout the construction industry that the conceptual phase has the greatest influence on most construction projects, and yet time spent during this period arriving at the correct decisions incur the least expense. Though the potential is great in terms of productivity improvements, the conceptual phase for construction projects has to date been somewhat overlooked.

This paper presents a pilot study aimed at analysing the tasks and processes associated with the conceptual phase of construction projects. The projects included civil engineering, building construction, process engineering and power supply. Each of the analysed projects has a minimum value of £50 million. Exposition of the results and analyses are also given. The implications of the conceptual phase tasks are deliberated upon, in terms of productivity of site resources, time, plant, finance, and labour.

INTRODUCTION

Japan emerged in the fifties as an economic superpower and joined the exclusive G7 club from the ashes of World War II. This phenomenal growth within a single generation has been widely attributed to the effective management of quality and productivity through the Japanese concept of Total Quality Control (TQC) (Burati et al., 1991). At the heart of TQC is the concept of continuous improvement which is destined for excellence in quality and productivity. TQC is a philosophy and hence, negates many boundaries: manufacturing; services; or, construction. TQC is an acceptable operational philosophy adopted by most industries in Japan.

The on-slaught directed towards the American market share by Japanese products was responded with equal vigour. Among the popular literature reporting the battle were "The American Samurai" by Jacobson and Hillkirk (1986); and "In search of excellence" by Peters and Waterman (1985). A few American companies emulated the TQC philosophy and fought back to regain their market share. Rank Xerox, being one of them, used the same TQC philosophy as its main Japanese competitor. In the American culture, TQC became known as TQM - Total Quality Management. TQM gained considerable ground in the manufacturing industry amid initial scepticism. The construction industry also showed the same reluctance, but reports by Burati et al. (1991) indicated a marked improvement.
An important agenda addressed in TQM is the assessment of a company’s or project’s status quo in relation to competitors or market leaders. This can be achieved through the practice of benchmarking. The need for benchmarking is so crucial that it became one of an awarding criteria for the prestigious American Malcolm Baldrige National Quality Award and the Swedish National Quality Award (Karof and Ostblom, 1993).

An understanding of processes and related tasks is an essential theme to benchmarking. Process and task analysis is also a common thread in the findings of Deeming, Drucker, Mayo and other management experts (Jacobson and Hillkirk, 1986; and Drucker, 1991). To extent the TQM philosophy into the construction industry, there is the necessity to map tasks and related processes of project life cycle.

THE CONCEPTUAL PHASE OF CONSTRUCTION PROJECTS

All construction projects comprises several phases, of these the conceptual phase has received little attention in relation to its degree of influence on project costs. Yet, the conceptual phase has the greatest impact on project life-cycle (Construction Industry Institute, 1990). To further reinforced this notion, Williams (1991) stated that:

"In the construction industry a systematic analysis must include both the on-site work and the off-site activities of design, planning, procurement, and delivery, when many condition for high productivity on the project are decided."

The conceptual phase is the main determinant of success for the forthcoming phases namely: detailed engineering; construction; and handover. The failure of many clients to adequately address the conceptual phase has been reported by the Banwell Report (1964), Building Economics Development Committee (1973), McKenzie (1979), and McDermott (1986). It is, therefore, imperative to map out the process and related tasks of the conceptual phase, if we are to achieve greater productivity and improved quality on future projects.

RESEARCH INTO CONCEPTUAL PHASE OF CONSTRUCTION PROJECTS

This research initially concentrated on projects costing more than £50 million including engineering construction, civil engineering, and building construction throughout Europe. To attain the main aim of the research of mapping the conceptual phase tasks and process, the following sub-objectives were established:

- determine the main tasks with its related issues of the conceptual phase;
- determine tasks definition;
- determine the tasks sequence as performed in the conceptual phase;
- determine the ranking of relative importance of tasks in terms of influence on site productivity;
- determine the influence of tasks on site resources productivity; and
- determine tasks relationship and process.

Propositions for conceptual phase tasks and tasks definition, task relationships and tasks Process.

Prior to implementation of research through survey and case studies, propositions were developed (Abdul-Kadir and Price, 1993). The propositions, which revolved around the research objectives, were a culmination of extensive literature review and in-depth interviews with a client and three contractors organisations. Questionnaires and case studies were then developed based on the propositions and objectives.
CONCEPTUAL PHASE TASKS

It was established in the early stages of this research that the conceptual phase comprised the following ten tasks: consents and permits; project definition; financial strategy; project planning; contract strategy; project management organisation; construction philosophy; procurement strategy; design of temporary works; and, design of permanent structures.

DEFINITIONS AND RELATED ISSUES

The following definitions were developed in conjunction with members of the Productivity Task Force of the European Construction Institute.

. CONSENTS AND PERMITS

DEFINITION: The embodiment of a society's constitution, laws, statutes, regulations, norms and culture, which ensures rights and protections of itself in relation to the proposed project.

The key issues addressed during the consent and permit task are: the generation of information and data relating to the facility to be constructed; and, an estimation of cost and time associated with obtaining future consents and permits. The social, economic and political issues must also be addressed, and the correct environment for successful project must be established.

. PROJECT DEFINITION

DEFINITION: Resolution of options during the conceptual phase which culminates in statement of client's requirements.

Project definition addresses key issues such as project feasibility and definition of project needs at a very early stage. Project definition must be effectively communicated to all relevant parties as early as possible.

. FINANCIAL STRATEGY

DEFINITION: The principal means and methods by which the financial requirements of total project delivery are satisfied.

The key issues considered during the development of a financial strategy are conceptual estimating, including source and cost of finance. Ensuring the right choice of currency, the appropriate political climate, a stable economic system, and security of funding sources during the whole project life-cycle are among the issues which should be addressed as part of the financial strategy. Compatibility with other tasks must also be achieved.

. PROJECT PLANNING

DEFINITION: Global planning of the whole project including the establishment of and commitment to defined schedules and milestones.

The main issues to be considered during project planning are the deadlines for finalising all other tasks in the conceptual phase, and the other phases of detailed engineering, procurement, construction and start-up of a construction project. Other issues such as identification of
resources, objective setting, and establishing communication and information system are also to be addressed. The main outcome of project planning should be a defined schedule with easily identifiable milestones.

* CONTRACT STRATEGY

**DEFINITION:** A strategy that defines relationships, duties, obligations and policies which are directed/engineered towards the desired successful total project delivery in accordance with project planning, financial strategy, project definition, and consents and permits.

The main issues considered as part of the contract strategy are the type of contract, the method of assessing tenders, and the selection criteria. Amongst other issues to be considered are appropriate pricing policy, establishing the appropriate contract document and project control, setting quality standards, and finalising work package organisation.

* PROJECT MANAGEMENT ORGANISATION

**DEFINITION:** *The formulation and configuration of the client’s management team in accordance with the contract strategy.*

Project management organisation involves the formation and configuration of the client's management team. It must establish the extent of power and responsibility, whilst facilitating a team building process. Establishing a mechanism for dispute resolution, team decision making process, and communication networks are important issues to be considered in this task. Ensuring the right motivating work environment must also taken into consideration.

* CONSTRUCTION PHILOSOPHY

**DEFINITION:** *The conceptual approach and method of construction that dictates the design of permanent and temporary structure.*

Construction philosophy involves the evaluation of alternatives and characterises the degree of standardisation, modularization, and prefabrication. It also represents policy towards neighbouring operations, and structures. Construction philosophy is heavily influence by weather, resources availability, safety and quality requirements.

* PROCUREMENT STRATEGY

**DEFINITION:** *Strategy for proactive project hardware purchasing required to achieve complete project delivery in accordance with project schedule.*

Procurement strategy establishes the policy on the whole procurement task ensuring availability and timely supply of resources such as material, plant and equipments and power. Achieving the required standards and specifications is also of concern.

* DESIGN OF TEMPORARY WORKS

**DEFINITION:** *The principles of construction practices to realise the permanent structures of the project which may or may not be part of the permanent structure.*

The design of temporary works very often reflects the construction philosophy taking account of site layout, site facilities, efficiency and safety.
DESIGN OF PERMANENT STRUCTURES

DEFINITION: The conceptual design, preliminary layout and sketches outlining the permanent structures so as to fulfil project definition.

The design of permanent structures must take account of construction philosophy, and realise simplification and standardisation of design which will promote efficiency and conformity to the required schedule and standards.

TASK RELATIONSHIPS AND TASKS PROCESS

The conceptual phase tasks are highly interrelated. All exist as a dynamic and organic entity which sums up to emerge as conceptual phase of construction project. Figure 1, the conceptual phase tasks relationship models, depicts such complex relationships. Whilst Figure 1 depicts tasks relationship, Figure 2 portrays the process that is involved in a conceptual phase of construction projects. Essentially, the conceptual phase is perceived to go through two stages. The first stage reflects corporate policy on a projects which may results in possible options. These options then go through the second stage in an iterating process as shown in Figure 2.

PILOT QUESTIONNAIRE

The respondents for the pilot study were from both client and contractor companies. The number of years of experience each respondent had varied between 13 - 38 years. Several different types of construction activity are represented: civil engineering; building construction; process engineering; and power supply. The pilot survey is, therefore, a good reflection of the industry in terms of experience and duration in the industry, and varieties of construction project. Respondent characteristics are illustrated in Figure 3.

The design of the questionnaire is structured so as to achieve the sub-objectives of the research: determination of tasks definition; determination of tasks sequence as performed in the conceptual phase; and, determination of influence of tasks on site resources productivity.

RESULTS AND ANALYSES

Tasks definition

Definitions of the ten tasks and related issues developed in the propositional stage were tested through ten questions. A scale of 1 to 5 ranging from strongly agree to strongly disagree, respectively, were put alongside each question. Figure 4 (Task / Respondent degree of agreement), illustrates the responses: it gave an indication of reasonable agreement. The results are skewed towards strongly agree and agree. Hence, within the limit of the pilot survey, the proposition that the conceptual phase comprises of ten tasks and respective definition, i.e. consents and permits, project definition, financial strategy, project planning, contract strategy, project management organisation, construction philosophy, procurement strategy, design of temporary works, and design of permanent structures, appears acceptable.
Ranking of conceptual phase tasks sequence as performed in the conceptual phase

Respondents were also requested to rank the sequence in which the tasks were performed in the conceptual phase. The results are presented in Figure 5. Consents and permits assumed the highest position and design of permanent structures as the lowest in the ranking. The rankings obtained in the pilot survey are promising in relation to the proposition. Except for consents and permits holding the sixth position, all the rest are in an ascending trend. This gives some indication of the efficacy of the proposed conceptual phase tasks relationships in Figure 1 and the conceptual phase tasks process in Figure 2.

The ranking for consents and permits ranges from 1 to 10 amongst the eight respondents. This variability reflects the perception and experience of respondents who comes from two backgrounds: client and contractor. Experience wise, the client is more involved in consents and permits. However, a larger sample is required to see if the difference is significant statistically.

The other possible explanation for the wide variability of responses may stamped out from different project type experience. The clients in the pilot survey are involve in both civil and building works, while the contractors covered a wider range of projects. It should be noted that the role of consents and permits becomes more important in projects involving power supply and processing plants (O’Riordan, Kemp and Purdue, 1988).

Conceptual phase tasks influences on productivity of site resources of time, capital, plant, labour and material

Finally, fifty questions were tested to indicate the influence of the ten conceptual tasks on site resources. These resources are time, capital, plant, labour and material. The questions were whether each of the ten tasks has significant influence on site resources, the results are illustrated in Figure 6. Generally, the ranking in terms of influence of productivity is the reverse of ranking for that of sequence of tasks (Figure 5), i.e. a descending order. Project planning and construction philosophy indicated a significant impact on site resources productivity. It could also be observed that the conceptual phase tasks have a significant influence on time and capital.

CONCLUSIONS

Identifying the tasks and processes of the conceptual phase and obtaining a consensus on the associated definitions is an important step towards understanding site productivity and quality. This pilot survey has helped confirm the validity of the propositions used as the basis of the research into the tasks and process, and its influence on site resources productivity.

The tasks definition are agreeable; the proposition for the sequence tasks is acceptable; time and capital are the two major resources which are significantly affected by conceptual phase tasks; and, project definition and construction philosophy are the two conceptual phase tasks that has significant influence on site resources of time, capital, plant, labour and material.

The full survey should realise the potential differences brought about by different project types and organisations, and must ensure a statistically viable number of clients, contractors and consultant with multitudes of project types.
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**Figure 5: Ranking of conceptual phase task sequence**

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**Figure 6: Conceptual phase tasks/site resources diagram**

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